The determinants of home healthcare robots adoption: An empirical investigation

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Ahmad Alaiad [*,1], Lina Zhou

Department of Information Systems, University of Maryland Baltimore County, Baltimore, MD 21250, United States

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ABSTRACT

Background: Home healthcare robots promise to make clinical information available at the right place and time, thereby reducing error and increasing safety and quality. However, it has been frequently reported that more than 40% of previous information technology (IT) developments have failed or been abandoned due to the lack of understanding of the sociotechnical aspects of IT.

Objective: Previous home healthcare robots research has focused on technology development and clinical applications. There has been little discussion of associated social, technical and managerial issues that are arguably of equal importance for robot success. To fill this knowledge gap, this research aims to understand the determinants of home healthcare robots adoption from these aspects by applying technology acceptance theories.

Methods: We employed both qualitative and quantitative methods. The participants were recruited from home healthcare agencies located in the U.S. ($n = 108$), which included both patients and healthcare professionals. We collected data via a survey study to test a research model.

Results: The usage intention of home healthcare robots is a function of social influence, performance expectancy, trust, privacy concerns, ethical concerns and facilitating conditions. Among them, social influence is the strongest predictor. Monitoring vital signs and facilitating communication with family and medication reminders are the most preferable tasks and applications for robots.

Conclusion: Sociotechnical factors play a powerful role in explaining the adoption intention for home healthcare robots. The findings provide insights on how home healthcare service providers and robot designers may improve the success of robot technologies.

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1. Introduction

Healthcare is one of the largest growing burdens on a nation's economy [1]. Health expenditures in the U.S. neared $2.6 trillion in 2010 [2]. Health spending accounted for 17.9% of the nation's GDP in total [3], and is expected to increase faster than national income over the next ten years. Therefore, controlling the rising healthcare cost continues to be a major policy priority. Among the existing proposals for reducing the long-term cost include patient-centered medical delivery systems, funding for comparative effectiveness research, and wider use

of health IT in the delivery system [4]. One of the most effective initiatives being implemented today is home healthcare [5].

In recent years, healthcare has been transferred from hospitals and nursing facilities to the patient home [4,5]. This home healthcare initiative has been undertaken broadly by healthcare industries in the U.S. to reduce readmission and transportation costs; improve pos-hospitalization healthcare quality; and increase patient independency [5]. Furthermore, the rapid increase of the older adult population (expected to reach 21 percent in the U.S. by 2030), and the growing population of people with disabilities will create the need for more nursing and home-care services [6].

Home healthcare robots (HHRs) are one of the emerging technologies that promise to make clinical information available at the right place and time, thereby reducing human-error and increasing safety and quality. In the last few years, HHRs have started helping professionals, including nurses, doctors, therapists and physicians, provide home health cares and services to their patients in a variety of forms such as monitoring personal health and safety, providing medication management and scheduling, detecting people lying on the floor, assisting in physical, cognitive and occupational therapy and nursing tasks (e.g., monitoring the blood pressure and bed bath).

Despite the promise of HHRs to reduce healthcare cost, research has repetitively shown that more than 40% of previous IT developments in various sectors including the health sector have failed or been abandoned [7–10]. One of the major factors leading to the failure is an inadequate understanding of the sociotechnical aspects of IT, particularly how people and organizations adopt IT [11,12]. Accordingly, the ultimate success of HHRs hinges on whether we can address their associated technological, social, and managerial challenges. The current research aims to understand the adoption of HHRs from these above aspects.

There has been a stream of technology acceptance research in the information systems field [13–16]. Since HHRs are at an early stage of diffusion, it is critical that we understand these sociotechnical factors that influence their adoption. However, HHRs have not been studied from the technology acceptance perspective to date. Previous robotics research has focused on technical implementation as well as technology development and clinical application [17–20], but there has been limited discussion of social and managerial issues that might be equally important for robot success. To fill the knowledge gap, this research integrates technology acceptance research and HHR research to provide insights into home healthcare adoption.

This research makes several contributions to the literature. First, it enriches the technology adoption literature by extending existing theories to the domain of HHRs; second, it enhances the theoretical foundation of home healthcare research by applying technology acceptance models to explain robot adoption; third, it extends the technology acceptance models by introducing several new constructs such as trust, privacy, ethical and legal concerns; fourth, it enables robot designers and service providers to improve their products or services by suggesting a list of preferable tasks and services.

2.   Literature review

2.1.   Home healthcare initiative

In the first decade of the 21st century, great attention was devoted to the U.S. society's need for access to health care and health care delivery. To date, there has been an increasing focus on the transition of care into the home. Health care is increasingly occurring in residential settings rather than in professional medical settings [21]. The Centers for Medicare and Medicaid Services (CMS) estimates that 8090 home health care agencies in the United States provide care for more than 2.4 million elderly and disabled people annually [22]. By 2020, 70 million elderly people will increasingly need to stay at home rather than in nursing home [23].

Home health care is a system of care provided by skilled practitioners to patients in their homes under the direction of a physician. Home health care services include nursing care; physical, occupational, and speech-language therapy; and medical social services [22]. The main goal of home health care services is to optimize an individual's well-being and independence to avoid hospitalization or admission to long-term care institutions [22]. Common diagnoses among home health care patients include circulatory disease (31 percent), heart disease (16 percent), injury and poisoning (15.9 percent), musculoskeletal and connective tissue disease (14.1 percent), and respiratory disease (11.6 percent) [23]. In the U.S., several home healthcare projects have demonstrated success. For instance, The Urban Medical Housecall program in Boston, MA – currently treating nearly 600 Medicare high cost beneficiaries with multiple chronic diseases yet has reduced hospital admissions for these patients by 29% and hospital days by 34%. The Home Physicians program in Chicago, IL – currently treating 7000 high cost Medicare beneficiaries with multiple chronic illnesses. This program has shown a reduction in ER visits and hospitalizations to 35% from as high as 60% over the years.

2.2.   Home healthcare robots (HHRs)

After decades of research, robots have aided the manufacturing, military, agricultural industries and have recently entered the medical field. Healthcare robots can be broadly classified into three main categories depending on target users [23]: doctor healthcare robots, nurse healthcare robots, and home healthcare robots. The last category is the focus of the current study. According to NASA, robots can be defined as machines that can be used to do jobs. Some robots can do work by themselves, while others must always have a person telling them what to do. When these jobs are related to home healthcare, the robots are called home healthcare robots (HHRs).

In recent years, HHRs have started helping the different professionals to provide home health care services to their patients in a variety of tasks [24–29]. For instance, remote presence robots RP [24] provide professionals (e.g. physicians) at one location direct access to remote patients at different locations (e.g. home) in emergency cases, especially in rural areas, by providing diagnostic capabilities through the use of camera, remote control, speaker, light, ultra sound and EMR access. For