Healthcare Applications for Smartphones

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INTRODUCTION

Smartphones

Smartphones refer to the handheld-sized mobile devices that have both advanced mobile communication and computation technologies. Smartphones combine the functionality of pagers, cell phones and Personal Digital Assistants (PDAs). The common features and functionalities of smartphones include phone services (e.g. voice calling, text and multimedia messaging, etc.), advanced input capabilities (e.g. touch screen and/or QWERTY keypad), a larger screen size than traditional handsets, robust operating systems that provide platforms for third-party applications, e-mails, calendars, contact lists, task lists, internet access, HTML browsers, camera and video capabilities, etc. Smartphones are generally equipped with Bluetooth, WiFi, Near Field Communication (NFC), and USB connectivity.

Healthcare

Healthcare refers to the process of care of physical and mental health of human beings through medical services. The medical services include diagnosis, treatment, and prevention of physical or mental impairments, including diseases, illness, injury, etc.

OVERVIEW

The healthcare system is highly mobile in nature, involving multiple clinical locations such as clinics, inpatient wards, outpatient services, emergency departments, operating theaters, intensive care units (ICUs), laboratories, etc. (Ammenwerth, Buchauer, Bludau, & Haux, 2000; Banitsas, Georgiadis, Tachakra, & Cavouras, 2004; Bardram & Bossen, 2005; Bardram, 2005). As such, working in the healthcare system requires extensive mobility of healthcare professionals as well as communication and collaboration among different individuals, including their colleagues and patients. Healthcare professionals mainly used pagers for mobile communication until the wide availability of cell phones in the 1990s (Burdette, Herchline, & Oehler, 2008). The advent of mobile Personal Digital Assistants (PDAs) during the 1990s enabled healthcare professionals to organize their contacts and calendars electronically, requiring another device in their pockets. The combined functionality of a pager, a cell phone and a PDA is now replaced by a single device called a "smartphone," which is becoming very popular among healthcare professionals as well as the general public (Wu et al., 2010).

Recent years have seen an increased adoption of smartphones by healthcare professionals. A systematic review summarizing 23 surveys on

PDA usage by healthcare professionals demonstrated that overall adoption rate varied between 45% and 85% in 2004–2005 (Garritty & El Emam, 2006). These surveys were conducted in the U.S. (16 surveys), Canada (4 surveys), Australia (1 survey), both the U.S. and Puerto Rico (1 survey), and both the U.S. and Canada (1 survey). Manhattan Research also reported a noticeable increase (from 30% in 2001 to 64% in 2009) on the professional use of smartphones by physicians (manhattanResearch, 2009). The increased adoption of smartphones by healthcare professionals demonstrates the opportunity for improved clinical communication, and access to information systems and clinical tools at the point of care, or from anywhere at any time. In addition, smartphones are also playing a very important role in the self-management and remote monitoring of patients with chronic conditions.

Dr. Haux (Ammenwerth et al., 2000) at University of Heidelberg, Dr. Ackerman (León, Fontelo, Green, Ackerman, & Liu, 2007) at National Library of Medicine, and Dr. Thoma (Demner-Fushman et al., 2006; Hauser et al., 2007; Hauser, Demner-Fushman, Ford, & Thoma, 2004) at Lister Hill National Center for Biomedical Communications are among the earliest examining this topic. Dr. Burdette (Burdette et al., 2008; Burdette, Herchline, & Richardson, 2004; Richardson & Burdette, 2003) at Wright State University, Dr. Wu (Wu et al., 2010) at University of Toronto, and Dr. Demner-Fushman (Demner-Fushman et al., 2006; Hauser et al., 2007, 2004) at Lister Hill National Center for Biomedical Communications are among the leading experts in the area.

CURRENT SCIENTIFIC KNOWLEDGE IN HEALTHCARE APPLICATIONS FOR SMARTPHONES

In this section, we present the healthcare applications for smartphones. The applications are grouped by the targeted user of the applications, as divided into three groups: (1) healthcare professionals, (2) medical or nursing students, and (3) patients.

Application for Healthcare Professionals

There are many smartphone-based applications for healthcare professionals. We've categorized these applications into 7 groups based on functional similarity: disease diagnosis, drug reference, medical calculators, literature search, clinical communication, HIS clients, and medical training.

1. Disease Diagnosis Applications

Disease diagnosis applications are designed to access diagnosis and treatment information in a few taps on a smartphone. Handheld versions of printed medical references for disease diagnosis are available on smartphones, providing information on infectious diseases, pathogens, diagnosis, treatment, medications, differential diagnosis, etc. There are eight medical reference applications: Johns Hopkins Antibiotic Guide (JHABx), 5-Minute Clinical Consult (5MCC), 5-Minute Infectious Diseases Consult (5MIDC), Sanford Guide to Antimicrobial Therapy (SG), ePocrates ID, Infectious Disease Notes (ID Notes), Pocket Medicine Infectious Diseases (PMID), and IDdx. These applications also provide internal links for easy navigation and searching.

A 2004 study evaluated SG, JHABx, 5MIDC, 5MCC, PMID, and ePocrates ID for treatment recommendations on 202 cases and reported that five of the applications provided treatment recommendations in more than 95% cases. Specifically, SG and ePocrates ID provided treatment recommendations in every case, JHABx in 99% of cases, 5MCC in 97%, 5MID in 95%, and PMID in 52% (Burdette et al., 2004). The treatment recommendations of four applications, ePocrates ID, JHABx, 2002 SG, and ID Notes, were compared with current practice guidelines by Miller

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