Mobile-Based Applications and Functionalities for Self-Management of People Living with HIV

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Abstract. Background: Due to the chronicity of HIV/AIDS and the increased number of people living with HIV (PLWH), these people need the innovative and practical approaches to take advantage of high-quality healthcare services. The objectives of this scoping review were to identify the mobile-based applications and functionalities for self-management of people living with HIV. Methods: We conducted a comprehensive search of PubMed, Scopus, Science direct, Web of Science and Embase databases for literature published from 2010 to 2017. Screening, data abstraction, and methodological quality assessment were done in duplicate. Results: Our search identified 10 common mobile-based applications and 8 functionalities of these applications for self-management of people living with HIV. According to the findings, "text-messaging" and "reminder" applications were more addressed in reviewed articles. Moreover, the results indicated that "medication adherence" was the common functionality of mobile-based applications for PLWH. Conclusion: Inclusive evidence supports the use of text messaging as a mobile-based functionality to improve medication adherence and motivational messaging. Future mobile-based applications in the healthcare industry should address additional practices such as online chatting, social conversations, physical activity intervention, and supply chain management.

Keywords. Mobile, Application, Self-management, HIV/AIDS

1. Introduction

HIV (Human Immune-deficiency Virus) is now largely considered as a chronic condition that its control is overtaking of human evolution in the healthcare industry [1]. This chronic condition is the most important reason for morbidity and mortality all over the world [2]. More than 30 million people live with HIV infection and 10 million are at Acquired Immunodeficiency Syndrome (AIDS) phase who must receive the lifesaving antiretroviral therapy (ART) [3]. Consequently, there are more people living with HIV (PLWH) (over 30 million) many of whom are qualified for ART. Nevertheless, treatment coverage is insufficient, and among the PLWH receiving antiretroviral therapy, adherence to medication is low [4]. The main issue for PLWH is providing self-

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management interventions in an active manner during their routine practices and between social and clinical visits [5,6].

In recent decades, the virtual integration of mobile technologies into routine practices has been generating many new opportunities to improve engagement in self-management interventions [7]. Self-management by mobile technologies offers new opportunities to PLWH through common functions such as appointment and medication reminders [8,9] and educational and motivational messaging [10]. The potential of mobile-based applications to provide healthcare services [11] and enhance the self-management interventions have been well documented over the recent years [12-15]. These documents cite the new mobile-based applications in the field of healthcare and management of chronic conditions [16-21]. Ramanathan et al., showed that mobile-based applications that provide telecommunication and self-management services of PLWH with a care/consultation center will provide social and psychological support for these persons and improve the quality of healthcare for them [22]. In 2016 a similar study by Garofalo et al., stated that the use of mobile applications for self-management of PLWH can ensure treatment tracking including prevention/interventions programs, medication, and clinical checkups [23].

Because of the importance of using mobile-based self-management for HIV care, more studies have been done on applications, functionalities, and challenges of this area [24-26]. With the development of this innovation, large numbers of mobile applications with a wide range of health applications have entered the healthcare market. However, use of these applications for HIV/AIDS self-management was not well-documented [27-29]. In this study, we undertook a scoping review of exploring the use of mobile-based applications and functionalities to support self-management of PLWH.

2. Methods

This study was a scoping review to identifying the mobile-based applications and functionalities for self-management of people living with HIV. We aimed to a detailed identification of different mobile-based applications and functionalities that help PLWH to manage their chronic condition. Research questions were included: 1. What are the mobile-based applications for self-management of PLWH? 2. What are the functionalities of mobile-based applications for self-management of PLWH?

2.1. Research strategy

Due to the appearance and increase of mobile-based applications to manage chronic conditions in last decade, we searched relevant databases for literature that published in 2010 to 2017. The searches were conducted in the databases PubMed, Scopus, Science direct, Web of Science and Embase. To identify published, original research and reviews that reported the mobile based applications and functionalities for self-management of HIV care, an organized search was conducted with the following search keywords in combination: Self-management, Self-care, Self-monitoring, Application, Functionality, Mobile health, m-Health, Mobile phone, Cell phone, Smartphone, and HIV/AIDS.

2.2. Inclusion & Exclusion Criteria

Our inclusion criteria were: Full-text papers with the keywords in the title or abstracts, studies that published in 2010 to November 29, 2017, and studies published in English. We excluded resources such as reports, editorial letters, newspapers, and abstracts. We also excluded studies that addressed the broader field of mobile applications, which is not applicable to the field of HIV/AIDS condition management.

3. Results

Using the applied strategies, 192 references were retrieved (for research question one 110, and research question two 82) and 29 papers were thoroughly surveyed. Table 1 shows the final analyzed articles and the studies that were found but did not meet inclusion criteria and were excluded from this paper.

Table 1. Search result from different databases

Research Question	Total Reference Retrieved	Total Duplicate References	Total Excluded References	Final Analyzed Articles
RQ1	110	32	68	10
RQ2	82	21	42	19
Total	192	53	110	29

3.1. Information extraction

In this study, to answer the research questions, reviewed articles were classified into two categories, articles that had referred to the mobile-based applications for self-management of PLWH and papers that had surveyed the functionalities of these applications. Review of first category of articles showed that there are 10 mobile-based applications for HIV self-management. Table 2 shows these applications and their functionalities with final surveyed articles. Based on the findings of this study, "Text-messaging" had the highest frequencies (6). Moreover, we obtained a set of functionalities of the mobile-based applications for self-management of PLWH. Results of this section showed that, "Medication adherence" among other functionalities, had the highest frequencies.

4. Discussion

In recent years, application of HIV/AIDS mobile-based programs in healthcare organizations and clinics has been extensively considered [30]. There is well-documented evidence of potential efficacy of mobile-based applications for addressing common challenges for people living with HIV to support communication with health care providers, increasing the ability to access services, management of mental health, reduction of substance use, a decrease in sexual risk behaviors, and enhanced medication adherence [23,24,31-33]. This scoping review aimed to detail identification of mobile-based applications and functionalities for self-management of PLWH.

Table 2. Summary of final studied articles and overview of identified apps and Functionalities

	Mobile-Based Self-Management Applications										
ID	**First Author (Reference/Year)**	Health system Focused applications	AIDSinfo HIV/AIDS	Reminder applications	Hiv & Aids Guide	Facing AIDS	Patient-care focused applications	Safe sex Guide	Text-messaging	TxText tool	Aidsmap news
1	Garofalo R (23/2016)			√					√		
2	Henry BL (28/2016)			√					√		
3	Schnall R (16/2015)		√			√					
4	Forrest JI (36/2015)	√					√				
5	Ingersoll K (37/2014)									√	
6	Smillie K (31/2014)								√		
7	Odeny TA (29/2014)			√					√		
8	Muessig KE (27/2013)				√			√			√
9	da Costa TM (38/2012)			√					√		
10	Cornelius JB (34/2011)								√		
Frequency		1	1	4	1	1	1	1	6	1	1

	Functionalities of Mobile-Based Self-Management Apps								
ID	**First Author (Reference/Year)**	Antiretroviral Therapy	Medication adherence	Educational messaging	attendance at appointments	Safe-sex negotiation	Facilitate communication	Reminders	Motivational messaging
11	Sharpe JD (44/2017)			√				√	
12	Cooper V (54/2017)		√		√				
13	Swendeman D (24/2016)								√
14	Nhavoto JA (19/2015)			√					√
15	Thomas B (42/2015)					√			
16	Montoya JL (48/2015)		√						√
17	Mbuagbaw L (4/2015)		√		√				
18	Tufts KA (18/2015)	√	√					√	
19	L'Engle KL (46/2015)		√					√	√
20	Shet A (45/2014)		√				√		
21	Montoya JA (50/2014)		√					√	
22	Ramanathan N (22/2013)							√	√
23	Catalani C (39/2013)			√			√	√	
24	Miller CW (49/2013)		√				√		√
25	Muessig KE (27/2013)					√	√		
26	Kalichman SC (47/2011)		√						
27	Chang LW (41/2011)				√		√		
28	Shet A (43/2010)							√	
29	Lester RT (40/2010)	√							
Frequency		2	9	4	2	2	5	7	6

We identified 10 mobile-based applications for self-management of PLWH. The use of mobile-based applications for self-management of PLWH in similar articles is well

documented [34-36]. According to the findings of this paper, "text-messaging" and "reminder" applications were more addressed in reviewed articles. Mobile-based applications can send messages daily, receive responses, and make out them to deliver personalized asserting or medication reminders [37]. Short message sending (SMS) is the primary mode of delivering an m-health application. For example, SMS could exploit on women's motivation to attend the clinic for postnatal HIV care and infant testing [23,28,29]. Use of text messaging for daily routine activities reminding represents cost-effective approach adaptations to PLWH [16,27]. According to the feedback of related studies, patients who received SMS for less than 4 months, the SMS messages aided them in treatment adherence, and they would like to continue receiving SMS messages for self-management objectives in treatment process [31,38].

With regards to the second question of this research, we obtained 8 common functionalities of the mobile-based applications for self-management of PLWH. In recent years, use of the mobile-based applications as a platform for delivering disease intervention programs and health promotion is being increased [39-41]. Integration of mobile-based applications into HIV self-management holds potential, mainly in resource-limited healthcare organizations [19,24]. Mobile-based functionalities facilitate mechanisms such as clinical and medication alerts, data collection, safe-sex negotiation, direct communication with healthcare providers (HCPs), receiving motivational [4] and educational messages, and delivery of necessary information on demand about chronic condition [22,27]. However, potential functionalities of mobile-based applications from the perspective of HCPs included: 1) enhancing patient engagement, motivation, adherence, and self-management; and 2) improving provider-patient relationships and HCP care coordination [42-44].

The result of this study indicates that "medication adherence" was the common functionality of mobile-based applications for self-management of PLWH. People living with HIV should adhere to the medication regimens because the non-adherence causes more resistance to HIV and consequently, the drugs should be prescribed in advanced doses, which leads to substantial worsening of disease, death, and increased health care costs [45-47]. Technical functionalities of mobile-based applications can be very supportive by offering reminders [8,48] and engaging patient in interventions to improve adherence in routine clinical practice [18,49]. Similar studies showed that, use of mobile technology functions such as providing a timely reminder to improve medication adherence and Engaging PLWH in their treatment may be an initial step toward enhancing healthcare services of PLWH [50-54].

5. Conclusion

In this article, we determined 10 common mobile-based applications and 8 functionalities for self-management of people living with HIV. It can be concluded that among the identified applications, "Text-messaging" with medication adherence and reminding functionalities can really support PLWH in coping with their illness. It is suggested that, more relevant studies be carried out to identify future mobile-based applications for PLWH that should address additional functionalities such as online chatting, social conversations, and physical activity intervention.

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