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Evaluation of the Usability of a Mobile Application on Neglected Skin Diseases in Côte d'Ivoire: A Pilot Study

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Abstract

This study investigated the usability of a mobile phone-based system, "eSkinHealth", for healthcare providers in Côte d'Ivoire. The eSkinHealth can be used both online and offline to address the poor Internet connectivity of these rural settings. Data recorded in the mobile application were synchronized with an online database, and specialists in Abidjan, Côte d'Ivoire and in Japan advised local healthcare providers on difficult cases. In this pilot study, 21 healthcare providers used the eSkinHealth and completed questionnaires assessing the usability. The average score of a system usability scale for eSkinHealth was 84.2 (SD 11.7), which can be interpreted as excellent. The average registration for patient information (e.g., name, sex, age, area of residence) was 8.6 (SD 15.5). Further studies with more targeted areas and participants are needed to evaluate the usability of eSkinHealth in rural Côte d'Ivoire.

Keywords:

Mobile Applications, Africa, Neglected Tropical Diseases, Skin Diseases, Skin NTDs

Introduction

Early diagnosis and treatment are critical for patients with skin neglected tropical diseases (skin NTDs), which include Buruli ulcer, cutaneous leishmaniasis, leprosy, mycetoma, yaws, onchocerciasis, lymphatic filariasis, and scabies. Skin NTDs may lead to long-term disability, stigmatization, and mental health problems [1-5]. Côte d'Ivoire is heavily burdened by ten endemic NTDs. In the communities where they occur, they are a major concern for the populations [6]. As a result, people with skin NTDs often end up impoverished, in a cycle of poverty and disease [7].

Early diagnosis and treatment of skin NTDs that require the expertise and extensive experience of medical professionals are challenges in a resource-limited setting. However, mobile phones with applications may be useful tools, which enable medical professionals to assist remotely. According to the World Health Organization (WHO), mHealth is defined as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices" [8]. mHealth has been proven to be a promising tool for improving the diagnosis and treatment of several skin diseases [9, 10]. Given the high number of mobile phones users in low- and middle-income countries (LMICs), mobile applications provide an opportunity to overcome traditional barriers to the epidemiological surveillance and clinical management of skin NTDs in LMICs [9, 11-13].

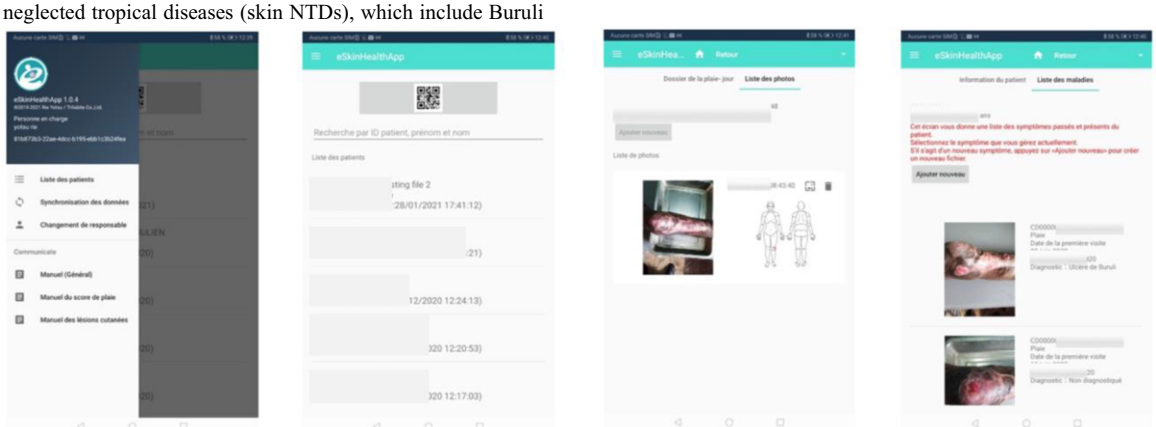

Figure 1– Sample view of the eSkinHealth for survey screen

However, there is still a dearth of evidence about the impact of mobile health interventions on early diagnosis and treatment of skin NTDs in LMICs [9]. Therefore, we developed a mobile phone-based system, eSkinHealth, to conduct a pilot study. In this study, we investigated the feasibility and usability of the eSkinHealth for healthcare providers in Côte d'Ivoire. Figure 1 presents screen samples from the eSkinHealth application. This system can be used both online and offline, addressing the poor Internet connectivity of the rural settings of LMICs.

Methods

Designing and developing the eSkinHealth

The mobile application was designed as a tool to survey and manage the skin NTDs in LMICs. We developed the mobile application using a user-centered design (UCD) where users are embedded in a rapid and iterative process that adaptively fits software to users [14-17]. UCD is a process framework that renders a system usable and understandable by accounting for end users' needs, wants, and constraints throughout the complete product cycle [16]. From these perspectives, UCD begins by understanding and specifying the context and requirement analysis and then designing and testing solutions iteratively [16]. In this study, value proposition canvases were also created to ensure that the mobile application was positioned around the values and needs of healthcare providers, patients, and the government. Figure 2 displays the study's value proposition canvases.

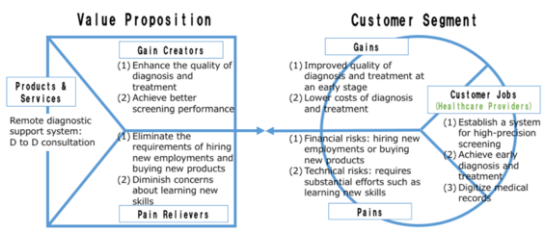

Figure 2– Value proposition canvases (healthcare provider version)

The mobile application currently has four functions: (1) records patient information, including QR codes; (2) catalogs symptoms, with pull-down options; (3) records photos of the affected area; and (4) allows for consultation with a dermatologist in Japan and in Côte d'Ivoire.

In this pilot study, mobile devices, on which the eSkinHealth application was installed, and wi-fi routers were provided to healthcare providers. They were trained in its usage during a one-day training session held by the study team. The participants pilot-tested the system in their practice. They first scanned the QR code to create a new patient file and obtained and entered patient information (e.g., name, sex, age, area of residence). They entered the following items using either options from a pull-down list or free description: affected area, test results, diagnosis name, and treatment method. The required information items were based on survey items from our previous surveys [2]. In addition, photographs of the affected area were recorded to create a progress record. For follow-up visits, the participants had an option to copy and paste the information from prior visit for time-saving.

Synchronization of data to a server and storage/updating of data was done when Internet access was available. This allowed dermatologists and NTDs experts in Côte d'Ivoire and Japan to provide advice on the diagnosis and treatment of skin NTDs if local healthcare providers encountered diagnostic and therapeutic difficulties. Figure 4 shows the mobile application in use.

Participants' use of the system was output in a comma-separated values (CSV) file so that the frequency with which local healthcare providers input data could also be monitored.

Figure 3– Use of eSkinHealth application in a primary health clinic setting of rural Côte d'Ivoire

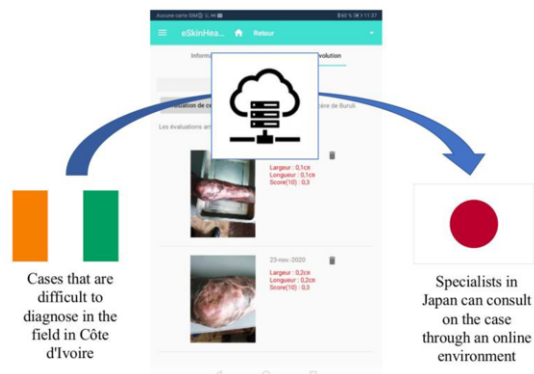

Figure 4– Remote consultation with dermatologists

Evaluation of the usability of eSkinHealth

In consultation with the district office, the target area was determined based on the number of patients with skin NTDs in the past and geographical conditions such as access. We selected target primary health centers in some health districts, Côte d'Ivoire.

The healthcare providers were recruited based on the following criteria: (1) 18 years or older; (2) agreed to use the mobile application (*i.e.*, eSkinHealth); (3) able to read and speak fluent French; (4) willing to participate the pilot study; and (5) able to consent for oneself. Ineligible healthcare providers was defined as those who had a difficulty in operating mobile devices.

Outcome and measurements

The primary outcome measurement was an average score of a system usability scale (SUS). The SUS utilized was created by John Brooke in 1986 [18]. Bangor, Kortum, and Miller found that the SUS was highly reliable (alpha = .91) and useful over a wide range of interface types [19, 20]. The SUS consisted of 10 statements with responses in the form of a five-point Likert scale (e.g., 1: strongly disagree, 5: strongly agree). Based on research by Bangor et al., a SUS score above 68 would be considered above average [20, 21]. According to Bangor et al., a mean SUS score of 68–80.3 can be interpreted as good, and

System Usability Scale	Mean (SD)
1. I think that I would like to use this system frequently.	4.76 (0.54)
2. I found the system unnecessarily complex.	1.29 (0.64)
3. I thought the system was easy to use.	4.38 (0.80)
4. I think that I would need the support of a technical person to be able to use this system.	2.14 (1.42)
5. I found the various functions in this system were well integrated.	4.38 (0.80)
6. I thought there was too much inconsistency in this system.	1.38 (0.86)
7. I would imagine that most people would learn to use this system very quickly.	4.48 (0.68)
8. I found the system very cumbersome to use.	1.62 (1.16)
9. I felt very confident using the system.	4.38 (0.92)
10. I needed to learn a lot of things before I could get going with this system.	2.29 (1.35)

*Calculating SUS score: X = Sum of the points for all odd-numbered questions – 5, Y = 25 – Sum of the points for all even-numbered questions, SUS score = (X+Y)×2.5

Table 2–Results with system usability scores (n = 21)

80.3 or higher can be interpreted as excellent [18, 20]. We used the French-language version of SUS.

Ethical considerations

This study was approved by the Life Sciences and Health of Côte d'Ivoire (Abidjan, Côte d'Ivoire; N/Réf:078-19/MSHP/CNESVS-kp) and the Ethics Committee of the National Center for Global Health and Medicine (Tokyo, Japan; 1665).

Results

A total of 21 healthcare providers participated in the study; their sociodemographic characteristics are shown in Table 1. They worked in the villages of Oumé and Zouan-Hounien health districts. The mean age was 40.1 (SD 6.4) years, with an average working period of 130.9 (SD 105.4) months.

Table 1– Characteristics of Study Participants

	n (%)
Age*, y	40.1 (6.4)
18 – 35 years	6 (28.6)
36 – older	14 (66.7)
Sex	
Female	1 (4.8)
Male	20 (95.2)
Educational background	
High school and below	2 (9.5)
University	9 (42.9)
Graduate school	7 (33.3)
Occupation	
Doctor	4 (19.0)
Nurse	11 (52.4)
Other (e.g., Assistant Nurse)	6 (28.6)
Working periods*, m	130.9 (105.4)

*Mean (SD)
Not all categories sum to total for the technology category because of missing values.

Feasibility and perceived usability

All of the 21 participants were able to complete the pilot study using the eSkinHealth without any major problems, except for the Internet connection problem. Poor internet connection in some villages not only slowed down the synchronization of the data, but also led to users' dissatisfaction with the eSkinHealth.

The average registration for patient information (e.g., name, sex, age, area of residence) and required fields (e.g., affected area, test results, diagnosis name, treatment method, and test results) was 8.6 (SD 15.5). Buruli ulcer, scabies, and leprosy were diagnosed with the eSkinHealth.

SUS score results are displayed in Table 2. The average score eSkinHealth SUS was 84.2 (SD 11.7). Each of the 21 participants felt that they would like to use this system frequently.

Discussion

We developed a mobile application, eSkinHealth, using UCD and investigated the feasibility and usability of the eSkinHealth for healthcare providers in Côte d'Ivoire. In the pilot study, the average registration for patient information was 8.6 (SD 15.5) and participants completed the registration without any major problems, proving that eSkinHealth is a feasible tool. The average SUS score was 84.2 (SD 11.7), which can be interpreted as excellent [18, 20]. The usability survey demonstrated that participants wanted to use the system frequently and that most of the participants thought the system was easy to use. These results suggest that eSkinHealth may be a useful tool for case management of skin NTDs in Côte d'Ivoire.

However, the problem of poor Internet connection occurred in the villages. For data synchronization, slow internet speed in the villages was one of the factors that reduced usability of eSkinHealth. As a previous study in Bangladesh, one of barriers to an effective implementation of digital health was slow internet connection [22]. As for the telerehabilitation in the Philippines, they also concluded the most common challenges were slow internet speed [23]. Therefore, further studies are needed to reduce the amount of data transmission and build an environment with good Internet accessibility in rural Côte d'Ivoire.

Furthermore, it is necessary to consider an interface that can be operated more easily. User interface is one of the main factors related to the usability [24, 25]. In this study, some participants thought they needed the technical support to be able to use the eSkinHealth and there was still room for improvement. Therefore, future tasks include developing more user-friendly interfaces that can be widely used by local healthcare providers with lower information- and communication-technology literacy. Moreover, further qualitative research is needed to assess the burden of changing workflows on healthcare providers, which will provide us better understanding to evaluate the usability of eSkinHealth.

This study has several limitations. First, the favorable results of the usability survey might be biased because participants tended to be highly educated, suggesting that participants had

better technology literacy. Further studies are needed to expand the target participants to include those who do not have a higher education level. Second, the number of participants were limited in this preliminary study. In this study, we conducted the pilot study in a total of seven villages of Oumé and Zouan-Hounien health districts. More targeted areas and participants are needed in further studies. At last, investigation of feasibility and usability over the long term is also necessary, as it has been reported that the longer the study period, the greater the decline in completion rates [26]. However, to the best of our knowledge, this is the first study to evaluate the usability of a mobile application on neglected skin diseases in Côte d'Ivoire. Given that eSkinHealth may be a useful tool for case management of skin NTDs in Côte d'Ivoire, medical institutions and governments could consider using this tool for the management of skin NTDs.

Conclusions

We investigated the feasibility and usability of the eSkinHealth for healthcare providers in Côte d'Ivoire. The average SUS score was 84.2 (SD 11.7), suggesting that eSkinHealth might be a useful tool for case management of skin NTDs in Côte d'Ivoire. Future study of increased number of participants and longer-term system use are needed to further evaluate the usability of eSkinHealth for case management of skin NTDs.

Acknowledgements

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