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Evaluating the Quality of a Clinical Mobile App for Physicians' CT Scan Ordering Using the MARS Rating Scale

Zahra MEIDANI[a],Aydin OMIDVAR[b], Fatemeh ASGHARI[a], Hossein AKBARI[c], Reza KHAJOUEI[d], Ehsan NABOVATI[a1], Sahar ZARE[a], and Felix HOLL[e,f]
[a] *Health Information Management Research Center, Kashan University of Medical Sciences (KAUMS), Kashan, Iran*
[b] *Department of Neurosurgery, Kashan University of Medical Sciences, Kashan, Iran*
[C] *Department of Epidemiology & Biostatistics, Kashan University of Medical Sciences, Kashan, Iran*
[d] *Department of Health Information Sciences, Faculty of Management and Medical Information Sciences, Kerman University of Medical Sciences, Kerman, Iran*
[e] *DigiHealth Institute, Neu-Ulm University of Applied Sciences, Neu-Ulm, Germany*
[f] *IBE, Ludwig Maximilian University of Munich, Munich, Germany*

Abstract. Given the lack of literature on the contributing factors to adopt mobile applications (apps) among physicians and the crucial role of the quality of the apps in their widespread use, the aim of this study is using the Mobile App Rating Scale (MARS) to evaluate the quality of the head CT scan appropriateness criteria app(HAC app). It was developed to assist medical interns and residents in ordering head CT scans. MARS is internationally recognized as an app rating tool and consists of four objective and subjective quality subscales quality subscale. Although the overall quality score of the HAC app was favorable (82 out of 100), it had low quality scores in the "information" (73.37 out of 100) and the "engagement" (73.48 out of 100) subscales. The HAC app appears to be functional to the physicians; however, it needs to improve its quality in terms of interactivity and effectiveness.

Keywords. mobile application, computed tomography, x-ray, physicians

1. Introduction

It has been reported that more than 40% of physicians are using mobile devices and applications (MD&Apps) for clinical practices globally [1]. Evidence introduced a significant impact of MD&Apps on clinical practices among physicians [2]. Regardless of the positive attitude, the development and utilization of MD&Apps for physicians are still not widespread [3], and it lags far behind the multitude of usage among patients. For instance, more than 1000 apps were available for diabetes by 2015 [4]. Consequently, the usability and quality of MD&Apps were comprehensively evaluated in previous

[1] Corresponding Author, Ehsan Nabovati. Health Information Management Research Center, Kashan University of Medical Sciences, Kashan, Iran. Email: Nabovati@kaums.ac.ir

studies, and various behavioral change techniques were designed to promote apps among patients [5].

In contrast, the understanding of motivations and interests and the contributing factors in adopting or not adopting MD&Apps among healthcare providers (HCP) suffer from insufficient evidence. Previously reported results indicated that MD&Apps studies among medical students and HCP are narrowly focused on users' self-reported outcomes and evaluation of attitude and perception [6]. Hence, successful adoption factors of MD&Apps among physicians in terms of technical and social factors, physicians' characteristics, usability, and quality of MD&Apps should be fully explored before their widespread use [7]. Given the highlighted role of evaluating the quality of the app in its utilization among HCP and the lack of comprehensive evaluation of the clinicians' centered apps (C-apps), this study aims to evaluate the quality of head CT scan appropriateness criteria app (HAC app) using the Mobile App Rating Scale (MARS).

2. Methods

The study was conducted in a general teaching hospital affiliated with Kashan University of Medical Sciences (KAUMS) in Iran. Sixteen medical interns evaluated the quality of the HAC app using the MARS tool from March to June 2021. HAC app was developed during the former study with the collaboration of experts at KAUMS to assist medical interns and residents in head CT scan ordering [8]. It enables end-users to seek appropriate CT scans based on diseases, signs & symptoms, and modalities, e.g., CT, CTA, and MRI (Figure 1). Hence, the C-apps developed for HCP are meager; we did not manage to find free apps with the same functionality as the HAC app in Google Play, APP store, etc., to compare the HAC app with. The MARS is designed primarily for use by researchers and professionals, and the User Version of MARS (uMARS) is more suitable for evaluating apps by end-users. However, in the current study, we recruited medical interns to evaluate the quality of the HAC app given to these concerns: 1) medical interns were not naïve MD&Apps users and applied popular apps like Medscape and UpToDate in daily clinical practice; 2) the uMARS share the same foundation of MARS with minor changes; 3) MARS is the only reliable and validated tool in Persian to rate the quality of apps in Iran [9]. MARS consists of total 23 items of four objective quality subscales (engagement, functionality, aesthetics, and information); and one subjective quality subscale. Each subscale item is rated a five-point score from 1 (inadequate) to 5 (excellent). Usually, the mean score and standard deviation (SD) were used to rate the quality of apps. Since the number of items in each subscale was different, we also used this formula [(mean of subscale/ number of items in subscale) * (100)] to compute the score out of 100 and compare the subscales. To calculate the total HAC app score, the [(total mean of HAC app/ total MARS items * (100)]. The current study was approved by the Ethics Review Board [Code# IR.KAUMS.MEDNT.REC.1399.075] at the KAUMS. It was supported financially by Deputy of Research and Technology of KAUMS [Grant No. 99190] and the National Agency for Strategic Research in Medical Education (NASR): [Grant No. 970478).

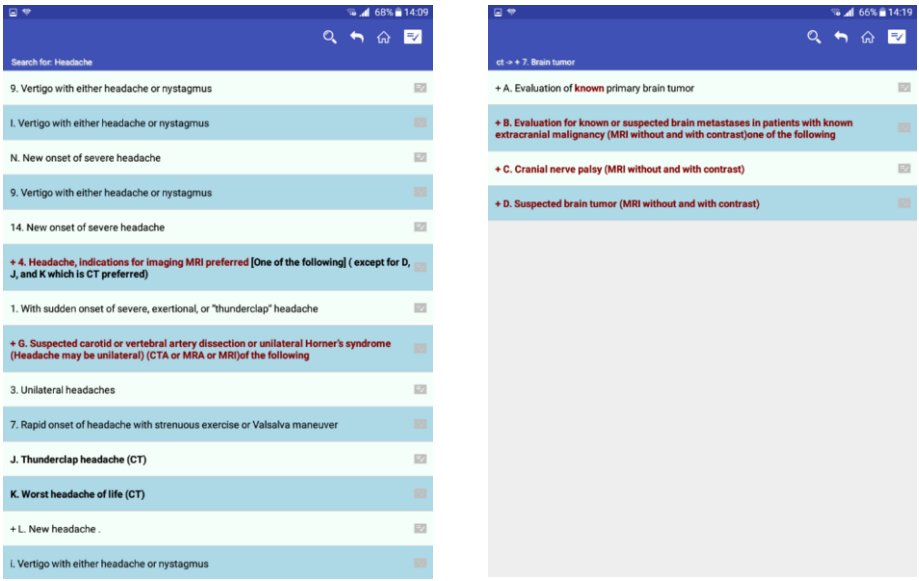

Figure 1: Screens of the HAC app

3. Results

Table 1 indicates that the overall quality score of the HAC app was favorable (82 out of 100). The four MARS subscales assessed for the HAC app present "information" (73.37 out of 100) and "engagement" (73.48 out of 100) had the lowest score; aesthetics had the highest score (87.86 out of 100) (Table 1).

Table 1. Overall quality scores of the HAC app

MARS subscales	Introduction of subscales	Mean ± SD	Total score out of 100
Engagement	Five items: interactivity, e.g., sends alerts, feedback, reminders), entertainment, fun, target group, customizability	18.37±1.40	73.48
Functionality	Four items: app functioning, easy to learn, navigation)	15.75±1.57	78.75
Aesthetics	Three items: graphic design and overall visual appeal)	13.18±1.32	87.86
Information	Seven items: high-quality information, e.g., text, feedback, measures, references), credibility, evidence base, evidence base, the accuracy of the app, etc.	25.68±3.3	73.37
Subjective	Overall perception and scoring of the app	14.93±2.61	74.56
Total		**18.86±2.40**	**82**

4. Discussion

HAC app quality suffers from "engagement" and "information," which focuses primarily on the effectiveness of apps in terms of interactivity, customizability, sending feedback, alerts, and reminders. Although we did not find evidence for assessing C-apps using

MARS due to the scarcity of literature and C-apps, our findings support studies using MARS for a quality rating of patient-centered apps [10-11]. Qualitative research also suggested that HCP appear to be keen on apps that support clinical practices, including "suggestive diagnosis and treatment", and "guides and supports in diagnosis and treatment"[12]. Using other information technology (IT) toolkits also revealed that the IT tool would be effective among HCP if it would support interactivity, answer physicians' questions, send feedback, and provide decision reasoning [13]. Although the HAC app appears to be functional to the physicians in its current format, there is a need to improve its quality in interactivity, effectiveness, customizability, and usefulness. The MARS scale would facilitate the detection of quality drawbacks for C-apps. However, further research is required to understand C-apps' quality preferences among HCP, and the current study would provide a fruitful stream of research for C- apps.

References

[1] Teferi GH, Tilahun BC, Guadie HA, Amare AT. Smartphone Medical App Use and Associated Factors Among Physicians at Referral Hospitals in Amhara Region, North Ethiopia, in 2019: Cross-sectional Study. JMIR Mhealth Uhealth. 2021 Mar 26;9(3)

[2] Dupaix J, Chen JJ, Chun MB, Belcher GF, Cheng Y, Atkinson R. The Effect of Mobile Tablet Computer (iPad) Implementation on Graduate Medical Education at a Multi-specialty Residency Institution. Hawaii J Med Public Health. 2016 Jul;75(7):190-5.

[3] Chase TJG, Julius A, Chandan JS, Powell E, Hall CS, Phillips BL, Burnett R, Gill D, Fernando B. Mobile learning in medicine: an evaluation of attitudes and behaviors of medical students. BMC Med Educ. 2018 Jun 27;18(1):152.

[4] Vitger T, Hempler NF. Mobile applications for management of type 2 diabetes. Ugeskr Laeger. 2016;178.

[5] Anna E. Roberts, Tracey A. Davenport, Toby Wong, Hyei-Won Moon, Ian B. Hickie, Haley M. LaMonica, Evaluating the quality and safety of health-related apps and e-tools: Adapting the Mobile App Rating Scale and developing a quality assurance protocol, Internet Interv. 2021 (24):100379

[6] Hsiao JL, Chen RF. Understanding Determinants of Health Care Professionals' Perspectives on Mobile Health Continuance and Performance. JMIR Med Inform. 2019 Mar 18;7(1):e12350.

[7] Azizi SM, Khatony A. Investigating factors affecting on medical sciences students' intention to adopt mobile learning. BMC Med Educ. 2019 Oct 21;19(1):381.

[8] Meidani Z, Atoof F, Mobarak Z, Nabovati E, Daneshvar Kakhki R, Kouchaki E, Fakharian E, Nickfarjam AM, Holl F. Development of clinical-guideline-based mobile application and its effect on head CT scan utilization in neurology and neurosurgery departments. BMC Med Inform Decis Mak. 2022 Apr 20;22(1):106.

[9] Raeesi A, Khajouei R, Ahmadian L. Evaluation of HIV/AIDS-related mobile health applications content using an evidence-based content rating tool. BMC Med Inform Decis Mak. 2021 24;21(1):135.

[10] Martín-Martín & etal. Evaluation of Android and Apple Store Depression Applications Based on Mobile Application Rating Scale. Int J Environ Res Public Health. 2021 Nov 27;18(23):12505.

[11] Sharif MO, Alkadhimi A. Patient focused oral hygiene apps: an assessment of quality (using MARS) and knowledge content. Br Dent J. 2019 Sep;227(5):383-386.

[12] Pokhrel P, Karmacharya R, Taylor Salisbury T, Carswell K, Kohrt BA, Jordans MJD, Lempp H, Thornicroft G, Luitel NP. Perception of healthcare workers on mobile app-based clinical guideline for the detection and treatment of mental health problems in primary care: a qualitative study in Nepal. BMC Med Inform Decis Mak. 2021 Jan 19;21(1):21.

[13] Goergen SK, Fong C, Dalziel K, Fennessy G. Can an evidence-based guideline reduce unnecessary imaging of road trauma patients with cervical spine injury in the emergency department? Australas Radiol. 2006 Dec; 50(6):563-9.