Mobile Apps for the Management of Diabetes

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Approximately 29 million Americans are diagnosed with diabetes. The increased prevalence of type 2 diabetes (T2D) and required intensity of disease management programs are straining health systems, especially in primary care where physicians often lack adequate time with patients. Mobile technologies (e.g., smartphones, wearable devices) provide highly scalable new approaches to T2D management. Approximately 77% of American adults have access to a smartphone regardless of socioeconomic status or ethnicity (1), and more than 50% of smartphone owners use their mobile devices to obtain health information (2). However, mobile health (mHealth) applications (apps) have been found to lack evidence-based support when functionalities and information provided in apps are compared with clinical guidelines for specific disease management (3). The objective of this study was to assess whether popular apps for diabetes management were of sufficient quality to complement clinical care. We used the Mobile App Rating Scale (MARS) (4), a reliable and validated scoring instrument of mHealth app quality, to assess the quality of the most popular free apps for T2D management. We also measured the number of diabetes-specific management tasks each app met, since MARS is not T2D specific.

In June 2016, we selected the top 30 apps in iTunes and Google Play for each of the search terms "diabetes" and "diabetes management." Our selection criteria were as follows: *1*) free; *2*) designed for patient; *3*) not requiring subscription; *4*) in English. Our initial search yielded a total of 120 apps. Before download, we eliminated duplicate apps (n = 11), apps in Spanish (n = 3), prank apps (n = 2), and a pet diabetes app (n = 1). The remaining 103 apps were evaluated using MARS. An additional 14 apps not meeting our selection criteria were subsequently eliminated (eight apps requiring subscription, four non-English apps, two apps for health care providers). A total of 89 apps met selection criteria and were included in analyses.

MARS includes four sections (engagement, functionality, aesthetics, information), a total quality score (weighted average of the four sections), and an app subjective score that is not considered in the total quality score. All scores have a maximal possible value of 5. We added another metric scoring the number of diabetes management tasks (5) (physical activity, nutrition, blood glucose testing, medication or insulin dosage, health feedback, and education) incorporated in each app, with a maximal possible value of 6.

Apps were divided across three reviewers. Descriptive statistics were reported as mean ± SD. Interrater reliability of the MARS sections was calculated using the intraclass correlation coefficient (ICC). The MARS ratings for the 89 apps included in this study are outlined in Table 1.

Interrater reliability for 10 apps scored by all three reviewers was excellent for functionality (ICC = 0.95, 95% CI 0.91–0.97) and aesthetics (0.88, 0.78–0.94) and moderate for engagement (0.77, 0.61–0.88) and information subscales (0.51, 0.18–0.74). The selected apps were rated as having relatively high functionality (mean = 3.79), aesthetics (3.43), and engagement (3.15) scores, but suboptimal information (2.23), total quality (2.99), and subjective (2.59) scores. Although a majority of apps were of high quality with respect to a single task, only 4 out of 89 apps integrated all six diabetes management tasks, and less than half integrated at least four tasks.

We looked at the highest scoring apps, with respect to all four MARS sections, app subjective score, and diabetes management tasks score, for a total possible score of 31. The top scoring app (Tactio Health: My Connected Health Logbook) scored 28.61 points and integrated all six diabetes management tasks. The second app (ACCU-CHEK 360° Diabetes Mgmt*)* scored 25.94. Both were in the top percentile for all subscales.

Our study presents some limitations. We only looked at free apps and it is possible that paying apps score well with respect to MARS. Moreover, the scores the apps received do not necessarily reflect

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Table 1—App quality score, subjective score, and diabetes management tasks (n = 89 apps)

Sections	Items	Item names	Mean	SD	Quality
Engagement	5	Entertainment; Interest; Customization; Interactivity; Target group	3.15	0.78	Acceptable-Good
Functionality	4	Performance; Ease of use; Navigation; Gestural design	3.79	0.68	Acceptable-Good
Aesthetics	3	Layout; Graphics; Visual appeal	3.43	0.76	Acceptable-Good
Information	7	Accuracy of app; Goals; Quality of information; Quantity of information; Visual information; Credibility; Evidence base	2.23	0.85	Poor-Acceptable
App quality score	19	All items in above sections	2.99	0.64	Poor-Acceptable
App subjective score	4	Recommendations; Usage; Pay; Rating	2.59	0.90	Poor-Acceptable
Diabetes management tasks	6	Physical activity; Nutrition; Blood glucose testing; Medication or insulin dosage; Health feedback; Education	2.81	1.68	2–3 tasks

their impact in terms of behavior change and health outcomes. However, this study suggests that additional work is needed to assess the clinical significance of apps for diabetes self-management, and that app developers should work closely with health care providers and patients when building such mHealth tools.

Duality of Interest. No potential conflicts of interest relevant to this article were reported.

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