Mobile Apps for the Management of Diabetes

Diabetes Care 2017;40:e145–e146 | https://doi.org/10.2337/dc17-0853

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...
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.

| 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 |

Author Contributions. D.F. and F.M. designed the study. S.C., M.S., and J.W. collected the data. D.F., Y.G., and F.M. designed the data analysis. S.C. and Y.G. ran the analysis. S.C. and F.M. wrote the manuscript. D.F., A.B., and F.M. reviewed and edited the manuscript. F.M. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

References
1. Pew Research Center. Mobile fact sheet [Internet], 2017. Available from http://www.pewinternet.org/fact-sheet/mobile/. Accessed 11 April 2017
2. Diaz JA, Griffith RA, Ng JJ, Reinert SE, Friedmann PD, Moulton AW. Patients' use of the Internet for medical information. J Gen Intern Med 2002;17:180–185
3. Hogan NM, Kerin MJ. Smart phone apps: smart patients, steer clear. Patient Educ Couns 2012;89:360–361
4. Stoyanov SR, Hides L, Kavanagh DJ, Zelenko O, Tjondronegoro D, Mani M. Mobile app rating scale: a new tool for assessing the quality of health mobile apps. JMIR Mhealth Uhealth 2015;3:e27
5. AADE. AADEd Self-Care Behaviors. Diabetes Educ 2008;34:445–449