Original research

Developing and pre-testing a digital decision-tree smartphone application for smoking prevention and cessation among HIV care providers

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Abstract

Objectives: The diagnosis and continuous care of chronic conditions such as HIV infection present potential teachable moments for delivering smoking prevention and cessation interventions for patients. We designed and pre-tested a prototype of a smartphone application(app), Decision-T, specifically designed to assist healthcare providers when providing personalized smoking prevention and cessation services to their patients.

Methods: We developed the Decision-T app based on transtheoretical algorithm for smoking prevention and cessation following the 5-A's model. We employed a mixed-methods approach among 18 HIV-care providers recruited from Houston Metropolitan Area for pre-testing the app. Each provider participated in three mock sessions, and the average time spent at each session was measured. We measured accuracy by comparing the smoking prevention and cessation treatment offered by the HIV-care provider using the app to that chosen by the tobacco specialist who designed the case. The system usability scale (SUS) was used to assess usability quantitatively, while individual interview transcripts were analyzed to determine usability qualitatively. STATA-17/SE and Nvivo-V12 were used for quantitative and qualitative analysis, respectively.

Results: The average time for completing each mock session was 5 min 17 s. The participants achieved an overall average accuracy of 89.9%. The average SUS score achieved was 87.5(±10.26). After analyzing the transcripts, five themes (app's contents are beneficial and straightforward, design is easy to understand, user's experience is uncomplicated, tech is intuitive, and app needs improvements) emerged.

Conclusions: The decision-T app can potentially increase HIV-care providers' engagement in offering smoking prevention and cessation behavioral and pharmacotherapy recommendations to their patients briefly and accurately.

Introduction

Tobacco use is the number one cause of preventable morbidity and mortality in the United States (US)[1] and Latin America.[2] The Centers for Disease Control and Prevention (CDC) estimated in 2017 that 19.3% of the US population over the age of 18 uses some kind of tobacco product, such as

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cigarettes, cigars, or electronic nicotine delivery systems (ENDS).[3] The most significant prevalence of smokers (22.5%) in the US is in the 25–44 age range.[4]

The diagnosis of chronic conditions such as HIV infection, cancer, and stroke, among others, represent potential teachable moments for delivering smoking cessation interventions for patients[5] During this period, patients are highly motivated to achieve recovery and are receptive to improving and preventing further diseases and conditions. These conditions necessitate ongoing, regular visits, which can be an opportunity for healthcare professionals to discuss with patients effective behavioral therapies, and pharmacological approaches for smoking cessation counseling.[5]

The prevalence of tobacco use, specifically cigarette smoking, among people with HIV (PWH) is often higher (>50%) than that observed among the general population.[6,7] Cigarette smoking is highly prevalent among PWH, a vulnerable group with high motivation to quit smoking but low cessation success and high relapse rates[8] because smoking cessation is not consistently integrated into HIV care. Although the introduction of highly active antiretroviral therapy (HAART) has reduced mortality and improved life expectancy,[9–11] a significant number of PWH are now experiencing morbidity and mortality as a result of smoking-related conditions.[12–14] HIV infection itself has been reported to be independently associated with a decreased likelihood of quitting smoking, imposing a challenge for cessation interventions for PWH;[15] thus, smoking prevention and cessation interventions should be tailored specifically for PWH. However, this has not always been the case despite the recognized benefits of implementing cessation services for patients with HIV (e.g., reduction in depression and anxiety, increased life satisfaction and expectancy, lower rates of bacterial pneumonia and cardiovascular disease, among others).[16,17]

With the massive technological advancements that have accompanied growth in recent decades, there has also been an increased interest in using mobile health (mHealth) technologies in the healthcare system.[18] In general, smartphone-based smoking cessation applications (apps) have been shown to improve smoking cessation outcomes among patients.[19] A meta-analysis of 12 studies conducted after 6 months of phone-based smoking cessation interventions found that smokers who received mHealth cessation support were 1.67 times more likely to stay smoke-free than those who did not receive this support.[20] After two months of follow-up in a randomized controlled trial with 98 individuals, smokers who were fully adherent to a novel smoking cessation smartphone app had four times the likelihood of quitting smoking compared to those who didn't use it.[21]

In the US, Australia, and the UK markets, there are currently over 500 available mobile-based smoking cessation apps where the end user is the patient interested in quitting smoking.[22] However, only one app, QuitMedKit, was built exclusively for healthcare providers.[23,24] However, this app had a passive design, was never pre-tested, and is not currently available. Therefore, to the best of our knowledge, no smoking cessation app is available for healthcare providers assisting patients with their quitting efforts. Better smoking cessation outcomes among patients diagnosed with chronic conditions can be achieved if healthcare providers can rely on mHealth tools to guide their counseling approach and pharmacotherapy recommendations for quitting smoking. In addition, despite the low reimbursement rate for tobacco cessation, initiating a quick, individualized smoking cessation session by healthcare professionals will significantly increase reimbursement through smoking cessation services.[25,26] For instance, an Alabama practice with 90,000 adult patient visits might generate an additional $190,697 in annual revenue if they offer each tobacco user a 3-min counseling session at every appointment.[25] Healthcare provider-operated apps such as Decision-T can guide these smoking cessation sessions with clear decisional recommendations for smoking prevention and cessation counseling and pharmacotherapy.

Overall, HIV care providers treat a challenging patient population with multiple medical problems that require life-long care. Under a multidimensional approach to chronic disease management, each clinical encounter for HIV care represents a unique teachable moment for the HIV care provider to promote tobacco prevention and cessation efforts among patients. The algorithm embedded in the Decision-T app is designed to assist these providers with clear decisional recommendations for smoking prevention and cessation counseling and pharmacotherapy to patients. If successful, our study will provide preliminary evidence that this mHealth tool can effectively simplify this process and augment the capacity of HIV care providers to prevent smoking-related conditions among PWH.

Therefore, the purpose of this study was to design and pre-test Decision-T, the prototype of an app specifically designed to assist healthcare workers as a clinical decision-making tool for providing personalized smoking prevention and cessation to their patients.

Methods

App design

The design of the app was based on the Transtheoretical Model (Stages of Change),[27] published scientific research,[28–31] the US Department of Health Clinical Guidelines for Treating Tobacco Use and Dependence,[32] the 5 A's model,[33] and published smoking cessation algorithms used in clinical settings.[34,35] Tobacco specialists with clinical and research expertise were also actively involved in the app design. Brief statements that healthcare providers could use to initiate communication with patients interested in preventing or quitting smoking were included in the app. Decision-T was designed for the Android operating system using the Dart v2 programming language

within the Flutter v2 framework, which internally uses the local file system and SQLite to persist data, which are securely transferred to a REDCap instance (Figure 1).

Study population and app pre-test procedures

The study used a mixed-methods approach to pre-test the Decision-T app among HIV care providers recruited from the Houston Metropolitan Area, United States. Inclusion criteria of the study participants included (1) Age $\geq$ 18 years; (2) healthcare provider with $\geq$ 50% time devoted to HIV patient care; and (3) had an active email address and phone number. We recruited both HIV care providers who self-identify as current smokers (individuals who smoke every day or some days during the past 30 days) were excluded from participation, as healthcare providers who smoke are less likely to assess patients' smoking status and advise them to quit smoking.[6]

Ethical considerations

Participation in the study was voluntary. The University of Texas Health Science Center Houston (UTHealth) approved the study under protocol number: HSC-SPH-20-1339. Informed consent was provided and obtained from all eligible HIV care providers prior to participation in the study.

Research procedures

Once the Decision-T app was developed, we created scripts that were used at the mock sessions. The scripts included a variety of smoking prevention and cessation scenarios. The smoking prevention cases used fictitious nonsmokers or former smokers, while the smoking cessation cases used fictitious current smokers who were either willing or unwilling to quit. At each mock session, a script was chosen randomly. Each HIV care provider was given at least one smoking prevention and one cessation script within the three scheduled mock sessions.

We computed the time invested by 18 HIV care providers at each of the three mock sessions and evaluated the app's accuracy, as well as its usability, both quantitatively (system usability scale [SUS]) and qualitatively (final individual interview). We also built REDCap data collection instruments for screening, enrollment, mock sessions, and structured interviews. REDCap was the electronic platform chosen due to its secure and efficient data collection and management processes. Healthcare providers' socio-demographic and practice information was collected at the screening and enrollment stages using the above-referred REDCap instruments.

Before these mock sessions took place, the enrolled HIV care providers were exposed to four short educational videos lasting between 2 and 6 min. The videos covered the following topics: (a) synopsis of the study; (b) health consequences of smoking; (c) how to use the Decision-T app; and (d) what to expect during the mock sessions.

At each of the three mock sessions, enrolled providers were asked to use the app, follow the built-in algorithm for providing personalized smoking cessation counseling and recommend pharmacotherapy to research staff members acting as patients. The goal was for the HIV care providers to use the algorithm built in the app for choosing the most appropriate smoking prevention or cessation counseling approach and pharmacotherapy according to the presented clinical scenario. After completing the three mock sessions, the enrolled HIV care providers were invited to participate in a mixed-method procedure to assess the app's invested time, accuracy, and usability (quantitatively and qualitatively). In addition, we carefully recorded each provider's invested time during each session. All the HIV care providers were compensated for their time and effort.

The accuracy of the Decision-T app was assessed by comparing the counseling and pharmacotherapy approach used by the participant to the approach of the tobacco specialist who designed the clinical cases.

Usability was quantitatively evaluated using the SUS.[36] This 10-item scale with five response options ranging from Strongly Disagree (1) to Strongly Agree (5) includes the following questions: (a) *Do you think that you would like to use the app frequently?*, (b) *Did you find the app unnecessarily complex?*, (c) *Did you think the app was easy to use?*, (d) *Do you think that you would need the support of a technical person to be able to use this app?*, (e) *Did you find that the various functions in this app were well integrated?*, (f) *Did you think there was too much inconsistency in this app?*, (g) *Would you imagine that most people would learn to use this app very quickly?*, (h) *Did you find the app very cumbersome to use?*, (i) *Did you feel very confident using the app?*, and (j) *Did you need to learn a lot of things before you could get going with this app?* The SUS score was computed for each provider and later converted to percentile ranks. An overall percentile rank of 75% will indicate that the app has high perceived usability.

After the healthcare provider scored each one of the 10 items, the research staff used probes (e.g., *Why do you think so?, Can you give examples of what you are saying?, Can you describe more of that feeling?*, etc.) to elicit qualitative information (individual interview) about the app's usability. Additionally, two final questions were also included in the qualitative interview: (a) *Is there anything else you would like to share with me about the use of the app during this beta testing? (b) Please provide other suggestions on how the design of the smoking cessation app can be improved*. There was no prior relationship between the interviewers and the healthcare providers. Only the researchers and the participants were present during the structured interviews. The structured interviews were digitally recorded, de-identified, and transcribed.
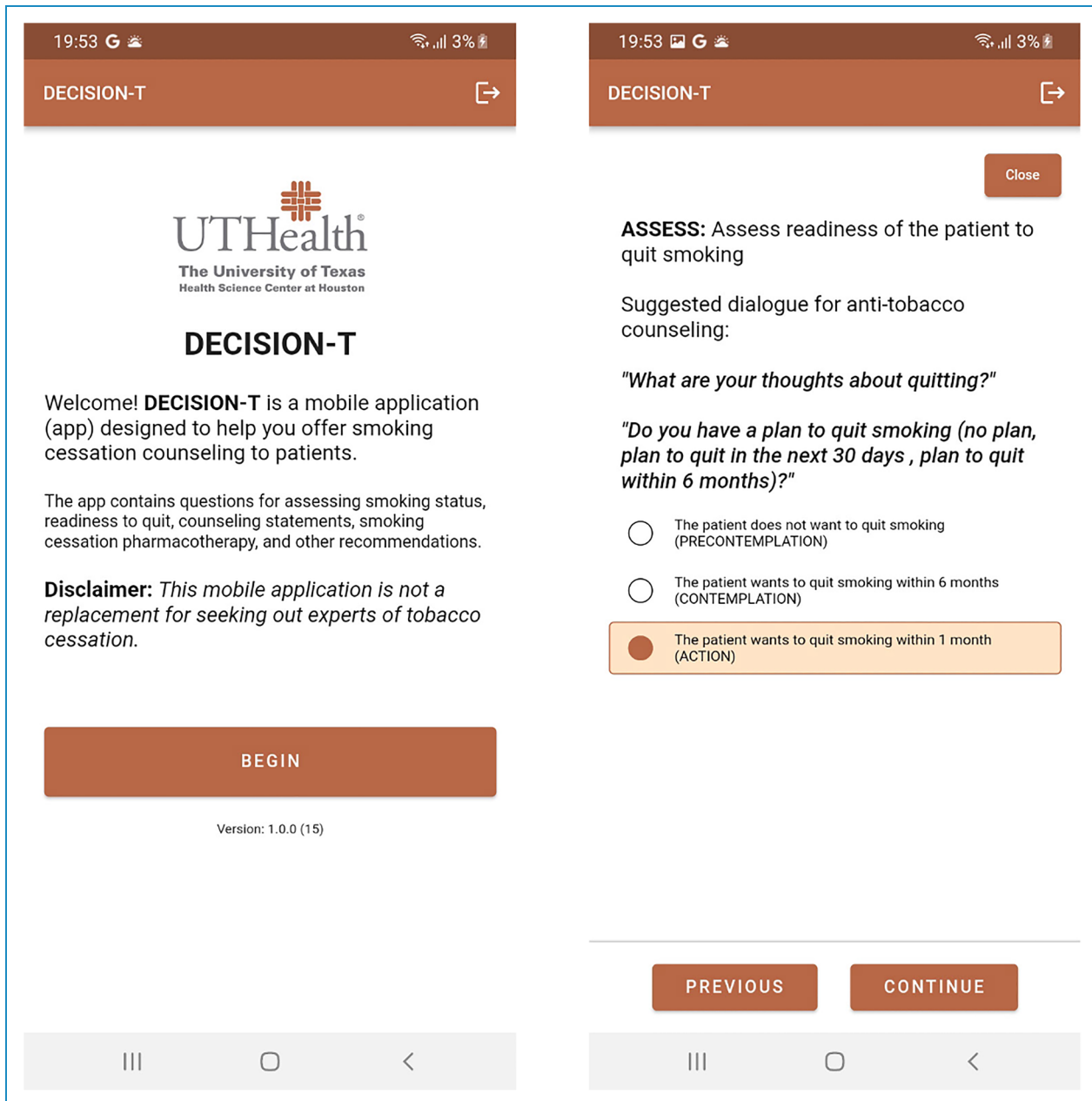
Figure 1. Selected screenshots from the decision-T app.

Statistical analysis

Quantitative data: Descriptive statistics were used to characterize the socio-demographic information collected from the study participants. The descriptive analysis results were presented as mean, standard deviation, and/or proportion.

The average time invested by the HIV care professionals providing personalized smoking cessation counseling and recommended pharmacotherapy was computed, along with the standard deviation, for each of the three mock sessions. The accuracy percentage for each mock session was calculated by comparing the correctness of the approach used by the participant in the session to the approach of the tobacco specialist who designed the clinical cases. The overall accuracy of the three mock sessions was also computed. The SUS score of the Decision-T app was computed for each study participant by scoring their response to the SUS questions, and the overall average SUS score was reported in mean and standard deviation. All quantitative data analyses were performed with STATA, Version 17.0 (Stata Statistical Software: College Station, TX: Stata Corp LP).

Table 1. Demographics of study participants.

Characteristics	(N = 18, 100%)
Age	42.0 ($\pm$12.26)
Gender	
Male	3 (16.7%)
Female	15 (83.3%)
Race/ethnicity	
White/Caucasian	1 (5.6%)
Black/African American	10 (55.6%)
Hispanic/Latino	7 (38.8%)
Highest level of education	
Some college degree or less	8 (44.4%)
Bachelor's degree	4 (11.1%)
Professional degree or more	8 (44.5%)
Healthcare role	
Physician	3 (16.7%)
Nurse (registered/LVN)	6 (333%)
Patient care technicians/medical assistants	5 (27.8%)
Others[a]	4 (22.2%)
Percentage devoted to patient care	
50–74%	4 (22.2%)
75–100%	14 (77.8%)
Ask patient about tobacco use at the initial visit	
Yes	18 (100.0%)
No	0 (0.0%)
Provide smoking cessation treatment/referral at the initial visit	
Yes	16 (88.9%)
No	2 (11.1%)
Ask patient about tobacco use at the follow-up visit	

Table 1. Continued.

Characteristics	(*N* = 18, 100%)
Yes	18 (100.0%)
No	0 (0.0%)
Provide smoking cessation treatment or referral at the follow-up visit	
Yes	15 (83.3%)
No	3 (16.7%)

aClinical Research Coordinator, Clinical Pharmacist, Mental Health Professional, Dependency Counselor.

Qualitative data: A content analysis of the structured interview transcripts was conducted to assess usability qualitatively. This process was supported by the NVivo Version 12.0. An initial reading of three transcripts was conducted by two members of the research team trained in qualitative analysis. A preliminary codebook was developed and subsequently refined through in-depth reading of all transcripts. Codes with similar patterns were grouped into major themes focusing on the app's usability.

Results

Demographic characteristics of participants

Eighteen HIV care providers agreed to pre-testing the Decision-T app and signed an informed consent form. The socio-demographic characteristics of our study participants are shown in Table 1. The providers' average age was 42.0 (±12.26). Most of the HIV care providers participating in our study were female (83.3%), Black/African Americans (55.6%), and nurses (33.3%). The majority of healthcare providers (77.8%) devote at least 75% of their work time to patient care, with the remaining 22.2% devoting 50–74% of their work time to patient care. All the participants reported asking their patients about tobacco use during initial and follow-up visits.

Invested time

A counseling session conducted by the HIV care providers using the Decision-T app took an average of 5 min and 17 s (±1 min 3 s). The average time at each smoking cessation counseling decreased gradually: 5 min and 51 s (±1 min 29 s) in the first mock session to 5 min and 11 s (±1 min 55 s) in the second mock session, to 4 min and 49 s (±1 min 21 s) in the last mock session.

Accuracy

We observed an overall average of 89.9% accuracy by comparing the counseling approach and pharmacotherapy recommended by the participating HIV care provider using the app with the counseling approach and pharmacotherapy recommended by the tobacco specialist who designed the clinical cases. The average accuracy at the first mock session was 88.9%, 83.3% at the second mock session, and 94.4% at the third mock session

Usability

The SUS score of the Decision-T app was 87.5 (±10.26). During the qualitative assessment of the interview transcripts, 28 codes were used, from which five themes containing groups of similar codes were identified.

Theme 1: app's content is appropriate and straightforward. This theme grouped seven codes: helpful resources, helpful smoking cessation language, multiple quitting plans, straightforward, appropriate contents, no previous knowledge needed, and consistent output. This theme encompasses ease of use based on the app's content.

> …[the app] provides good suggestions…on what to say to the patients when they want to quit smoking, or…when they are not willing to yet. (25-year-old female Hispanic physician)

> …*you* [as a healthcare provider] *don't need extra help. It* [the smoking prevention and cessation information and guideline] *is right there. Everything is written down plainly* [within the app]*, …just follow the instructions.* (51-year-old female Black patient care technician)

Theme 2: app's design is easy to understand. Two codes formed this theme: "simple design" and "organized pattern." Rather than describing the app's ease of use based on its contents, this theme discussed the app design, algorithm, and user interface.

> [The app is] straight to the point, easy to maneuver… and the functions are understandable…. (48-year-old female Black medical assistant)

…the app follows…like a flow chart. …if you click [on] *something, automatically… the app tells you what to do.* (25-year-old female Hispanic physician)

Theme 3: app's user experience is uncomplicated.
This theme describes the providers' perceptions regarding the concise and uncomplicated data entry process, as well as the limited time-consuming experience while using the app.

…if I'm in a hurry. It is not going to take me too much [time and effort] *to use* [the app] *with the participant.* (27-year-old Male Hispanic Clinical Research Coordinator)

…it [the app] *did not require too many clickings* [to have a prevention or cessation plan for the patient].... (25-year-old female Hispanic physician)

…there wasn't a lot of drop-down boxes [in the app], *so it wasn't hard* [to use the app]. (37-year-old Female Black Patient Care Technician)

Theme 4: app's tech is intuitive.
In this emergent theme, healthcare providers described how any person could use the app, regardless of the individual's level of technological savviness.

Unless I run out of battery or…. broke the phone…. I shouldn't need anybody to help with the app. …it [the app] *is not difficult to deal with.* (53-year-old Male Hispanic Physician)

…[the app] *is super simple. Everyone can use it. I think I can teach my grandpa to use it* [the app]. (27-year-old Male Hispanic Clinical Research Coordinator)

Theme 5: app needs improvement.
This theme encompasses some of the few negative remarks and suggestions provided by 2 of the 18 HIV care providers who tested the app. Some of the codes include trouble choosing treatment options, structural changes, too much information, app's messaging needs change, technical issues, and time-consuming, among others. This theme also encompasses suggestions that were made by the HIV care providers, such as like addition of a timer, increase in font size, dark mode, improvement in the app's messages, clarity of the content, and prior practice with the app before using it with patients.

It [the app] takes a lot of our clinician time. (a 47-year-old Female Hispanic Physician)

…, having the font color [in] *a different color* [to indicate] *when you're supposed to speak* [to the patient] *the…*

counseling points. (36-year-old Female White Clinical Pharmacist)

It [the app] has too much information, and I didn't feel confident to read all that information in front of my patient. (47-year-old Female Hispanic Physician)

Discussion

Smoking in chronic conditions like HIV infection can increase morbidity and mortality and subsequently burden health significantly.[37] Integrating the use of mHealth tools into clinical care can improve patients' disease outcomes and quality of life.[37] The Decision-T app can potentially enhance the role that healthcare providers, like HIV care providers, could play in preventing tobacco use and encouraging and supporting patients with chronic conditions during their quitting efforts.

Despite the negative feedback we obtained from two study participants, the average counseling time while using the app was 5 min and 17 s (±1 min 3 s). This indicates that the Decision-T app can be easily incorporated into patient visits without significantly increasing the consultation time. The Decision-T app allows healthcare professionals to get better and faster at using the app. Our study revealed a notable reduction in average time spent providing smoking cessation counseling the more the app was used. There was a noticeable decrease in the time invested when comparing the first to the third mock session.

When comparing the counseling approach and pharmacotherapy recommended by the participating HIV care providers using the app with the counseling approach and pharmacotherapy recommended by the tobacco specialist, we observed an average overall accuracy of 89.9%. This high accuracy ensures that the healthcare provider can make the best smoking prevention and cessation decisions for their patients.

The SUS score for Decision-T App was 87.5%, which was higher than the 75-percentile benchmark for high perceived usability, indicating that the app provides the effectiveness, efficacy, and overall ease of use that a healthcare provider requires to navigate the app successfully. While there are no healthcare provider-operated smoking cessation apps to compare the usability scores shown by the Decision-T app, our findings are encouraging. A systematic review of the usability of three healthcare provider-operated cardiopulmonary resuscitation smartphone apps revealed SUS scores of 87.5 (HELP Notfall), 55.0% (HAMBURG SCHOCKT), and 32.5% (Mein DRK).[38] Another systematic review of 33 healthcare provider-operated postoperative mobile apps revealed an average SUS score of 87.0%.[39] This result demonstrated that the Decision-T's usability is comparable to that of other apps currently used by healthcare professionals; thus, it can be easily incorporated into clinical settings without

causing significant discomfort and/or disruption during patients' visits.

Several positive aspects of using the Decision-T app were identified by almost three-quarters of this study's participants. According to many of the HIV care providers, the app provided a patient-specific smoking prevention and/or cessation guide. Furthermore, the provision of multiple personalized plans and helpful resources for quitting smoking were some reasons why some participants would want to use the app with their patients. The app's straightforwardness and simple design were positive usability characteristics that most interviewees recognized and credited. Because the app required little or no technological literacy, healthcare providers may readily accept the Decision-T app in more extensive implementation efforts. Participants also emphasized the importance of Decision-T as a time-saving app that does not interfere with consultation time and requires little or no prior knowledge, consistent with the smartphone app's usability performance.[40,41]

The Decision-T has the potential to be used alongside other smoking cessation resources for helping PWH with their quitting efforts. Counseling sessions with the Decision-T app could present an excellent entry point for healthcare providers to connect their patients with other existing smoking resources such as smokers/patients-operated smoking cessation apps, text-messaging smoking cessation programs, and quitlines, among others.

While it was noticed that only two participants in our study sample thought the app might not be helpful for patient counseling, we acknowledge some of their structural and functional suggestions for refining the design of the Decision-T app in its future version. Among the structural changes were the addition of an app timer, increasing the font size, indicating the text that the provider should say to the patient, and the availability of a dark mode. Improvements to the app's messages and wording and clarity of the app's contents were among the functional changes. Some participants recommended practicing with the app before using it with patients in real-time while providing smoking prevention and/or cessation counseling and pharmacotherapy.

Limitations and strengths

Our study has limitations that deserve to be mentioned. First, we experienced recruitment difficulties due to the app being available only on the Android platform. However, we facilitated Android devices with the Decision-T app preinstalled to enrolled participants. Second, many study participants had a rough first mock session as they were adjusting to the idea of the "fake" patients, as well as using the information and algorithm built into the Decision-T app for providing smoking prevention and cessation services. Nevertheless, we observed a reduction in the time invested as the participants navigate from the first to the third mock session. As this research effort focused on beta-testing an app prototype, we only recruited a small number of HIV care providers into our study. However, we recorded a group of providers with diverse roles, allowing us to conclude that this app could be used by physicians and non-physicians healthcare providers interested in offering their patients smoking prevention and cessation services. It is important to notice that, unlike other apps for smoking cessation, Decision-T was designed for healthcare professionals, not the patients. Thus, the app provides these professionals with clear decisional recommendations based on any given situation presented by patients who smoke cigarettes. However, it is up to the healthcare facility to document the cessation outcomes of each session in the electronic health records to provide smoking cessation services in an optimal manner.

Although the app works intuitively at presenting to healthcare providers the most appropriate pharmacotherapy for smoking cessation based on patient's profile, systematic arrangements must be implemented at each healthcare unit to facilitate an effective delivery of prescription-only medications for smoking cessation (e.g., nicotine inhalers, nicotine spray, bupropion, and varenicline). In this sense, we recommend a teamwork approach where healthcare providers unable to prescribe medications and using the Decision-T app to work closely with other members in the HIV care team with prescriptive authority.

An additional limitation to consider in our pilot study is the lack of more granular data on the type of existing cessation services or resources available to the HIV providers participating in this research effort, especially when 89% of them reported offering smoking cessation treatment or referral at the initial visit. While this limitation could have biased providers' impressions of the Decision-T app, our findings set the foundation for future studies with larger samples that can take into account sampling variability based on cessation resources, reimbursement, provision of time for providing cessation counseling during HIV visits, and self-efficacy in treating tobacco use.

Conclusion

Despite the above limitations, the design, and functionality of the Decision-T app were perceived by the study participants as straightforward and easy to use. While the Decision-T app was tested among HIV care providers, we can anticipate that it could be used by any healthcare professional regardless of the level of care: primary care (e.g., family doctors or general practitioners in physician's offices, nurse practitioner offices, community health centers, and nursing stations), secondary care (e.g., specialists with certain expertise in community hospitals or limited specialized services), and tertiary care (e.g., specialists typically in large community care facilities or hospital settings with access to specialized equipment).

In conclusion, the Decision-T app has the potential to be a user-friendly mHealth tool for healthcare professionals to provide effective and time-efficient behavioral treatment and pharmacological approaches for smoking prevention and cessation counseling to their patients.

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References

1. Sealock T and Sharma S. Smoking cessation. *StatPearls*, https://www.ncbi.nlm.nih.gov/books/NBK482442/ (2022, accessed 12 September 2022).
2. Palloni A, Novak B and Pinto-Aguirre G. The enduring effects of smoking in Latin America. 2015. *Am J Public Health* 2015; 105: 1246–1253.
3. Wang TW, Asman K, Gentzke AS, et al. Tobacco product use among adults – United States, 2017. *MMWR Morb Mortal Wkly Rep* 2019; 67: 1225–1232.
4. Adams TN and Morris J. Smoking. *Lancet* 2022; 127: 1177.
5. Xiang X. Chronic disease diagnosis as a teachable moment for health behavior changes among middle-aged and older adults. *J Aging Health* 2016; 28: 995–1015.
6. Asfar T, Al-Ali R, Ward KD, et al. Are primary health care providers prepared to implement an anti-smoking program in Syria? *Patient Educ Couns* 2011; 85: 201–205.
7. Mdodo R, Frazier EL, Dube SR, et al. Cigarette smoking prevalence among adults with HIV compared with the general adult population in the United States: cross-sectional surveys. *Ann Intern Med* 2015; 162: 335–344.
8. Triant VA, Grossman E, Rigotti NA, et al. Impact of smoking cessation interventions initiated during hospitalization among HIV-infected smokers. *Nicotine Tob Res* 2020; 22: 1170–1177.
9. Helleberg M, Gerstoft J, Afzal S, et al. Risk of cancer among HIV-infected individuals compared to the background population: impact of smoking and HIV. *AIDS* 2014; 28: 1499–1508.
10. Workie KL, Birhan TY and Angaw DA. Predictors of mortality rate among adult HIV-positive patients on antiretroviral therapy in Metema Hospital, Northwest Ethiopia: a retrospective follow-up study. *AIDS Res Ther* 2021; 18: 1–11.
11. Rajeev A and Sharma A. Mortality and morbidity patterns among HIV patients with prognostic markers in a tertiary care hospital in southern India. *Australas Med J* 2011; 4: 273–276.
12. Calvo-Sánchez M and Martinez E. How to address smoking cessation in HIV patients. *HIV Med* 2015; 16: 201–210.
13. Nahvi S and Cooperman NA. Review: the need for smoking cessation among HIV-positive smokers. *AIDS Educ Prev* 2009; 21: 14–27.
14. Robinson W, Moody-Thomas S and Gruber D. Patient perspectives on tobacco cessation services for persons living with HIV/AIDS. *AIDS Care - Psychological and Socio-Medical Aspects of AIDS/HIV* 2012; 24: 71–76.
15. Regan S, Meigs JB, Grinspoon SK, et al. Determinants of smoking and quitting in HIV-infected individuals. *PLoS One* 2016; 11(4): e0153103.
16. Reddy KP, Kruse GR, Lee S, et al. Tobacco use and treatment of tobacco dependence among people with human immunodeficiency virus: a practical guide for clinicians. *Clin Infect Dis* 2022; 75: 525–533.
17. Ledgerwood DM and Yskes R. Smoking cessation for people living with HIV/AIDS: a literature review and synthesis. *Nicotine Tob Res* 2016; 18: 2177–2184.
18. Majumdar A, Kar SS, Ganesh Kumar S, et al. mHealth in the prevention and control of non-communicable diseases in India: current possibilities and the way forward. *J Clin Diagn Res* 2015; 9: LE06.
19. Rajani NB, Weth D, Mastellos N, et al. Adherence of popular smoking cessation mobile applications to evidence-based guidelines. *BMC Public Health* 2019; 19: –8.
20. Whittaker R, Mcrobbie H, Bullen C, et al. Mobile phone-based interventions for smoking cessation. *Cochrane Database Syst Rev* 2016; 4(4): 19–43.
21. Zeng EY, Vilardaga R, Heffner JL, et al. Predictors of utilization of a novel smoking cessation smartphone app. *Telemed J E Health* 2015; 21: 998.
22. Regmi K, Kassim N, Ahmad N, et al. Effectiveness of mobile apps for smoking cessation: a review. *Tob Prev Cessat*. 2017; 3(12): 1–12.
23. Alexander PML. QuitMedKit: an essential guide to tobacco cessation app. *iMedicalApps. Alexander, Prokhorov Mario, Luca*, https://

www.imedicalapps.com/2018/05/quitmedkit-an-essential-guide-to-tobacco-cessation-app/ (2018, accessed 23 September 2022).

24. Douglas M. Top Medical Apps for summer 2018. *Journal of The Uniformed Services academy of Family Physicians* 2018; 11: 18–20.

25. Reimbursement for Tobacco Cessation. *Edward Anselm, MD*, http://www.edwardanselmmd.com/reimbursement-for-tobacco-cessation (accessed 9 April 2023).

26. Karadogan D, Önal Ö and Kanbay Y. How does reimbursement status affect smoking cessation interventions? A real-life experience from the Eastern Black Sea region of Turkey. *Tob Induc Dis* 2019; 17(1): 1–9.

27. Prochaska JO and Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot* 1997; 12: 38–48.

28. Cropsey KL, Jardin BF, Burkholder GA, et al. An algorithm approach to determining smoking cessation treatment for persons living with HIV/AIDS: results of a pilot trial. *J Acquir Immune Defic Syndr* 2015; 69: 291.

29. Beneventi D, Bevers T, Blalock J, et al. Tobacco cessation algorithm - adult tobacco cessation algorithm - adult (2021, accessed 23 September 2022).

30. Hertzel G. *McMaster textbook of internal medicine*. https://empendium.com/mcmtextbook/ (2021, accessed 23 September 2022).

31. Hughes J. An algorithm for choosing among smoking cessation treatments. *J Subst Abuse Treat* 2008; 34: 426.

32. Tobacco Use and Dependence Guideline Panel. *Treating tobacco use and dependence*: 2008 Update, https://www.ncbi.nlm.nih.gov/books/NBK63952/ (2008, accessed 23 September 2022).

33. WHO.*Toolkit for delivering the 5A's and 5R's brief tobacco interventions in primary care. World Health Organization*. Geneva: World Health Organization. 2014,

34. MDA. Tobacco cessation. MD Anderson Cancer Center, https://www.mdanderson.org/research/departments-labs-institutes/programs-centers/endtobacco-program/tobacco-cessation.html (2018, accessed 23 September 2022).

35. QuitNowTXT. QuitNowTXT text messaging library. Catalog, https://catalog.data.gov/dataset/quitnowtxt-text-messaging-library (2019, accessed 23 September 2022).

36. Brooke J. *SUS: A quick and dirty usability scale system usability scale view project fault diagnosis training view project*, https://www.researchgate.net/publication/228593520 (1995).

37. Agnihothri S, Cui L, Delasay M, et al. The value of mHealth for managing chronic conditions. *Health Care Manag Sci* 2020; 23: 185–202.

38. Sasson C, Rogers MAM, Dahl J, et al. Predictors of survival from out-of-hospital cardiac arrest a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes* 2010; 3: 63–81.

39. Patel B and Thind A. Usability of Mobile health apps for post-operative care: systematic review. *JMIR Perioper Med* 2020; 3: e19099.

40. Dawson RM, Felder TM, Donevant SB, et al. What makes a good health "app"? Identifying the strengths and limitations of existing mobile application evaluation tools. *Nurs Inq* 2020; 27: e12333.

41. Gupta D. *Features & challenges of mHealth development*, https://appinventiv.com/blog/mhealth-development-features-and-challenges/ (2022, accessed 25 September 2022).