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Short communication

Missing the mark for patient engagement: mHealth literacy strategies and behavior change processes in smoking cessation apps

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ABSTRACT

Objective: To examine how Transtheoretical Model (TTM)'s processes of change and mHealth literacy strategies are employed in mobile smoking cessation apps.
Methods: A purposive sample of 100 iTunes apps were coded to assess descriptive (price, type, developer, user-rating) and engagement metrics, including processes of change and mHealth literacy strategies (plain language, usability, interactivity). One-way ANOVAs and independent samples *t*-tests examined associations between descriptive and engagement metrics.
Results: Over half of the apps included 7 (78%) processes of change. Fewer included self-liberation (36%) and reinforcement management (34%). Most apps incorporated plain language, but few integrated usability and interactivity strategies. Hypnotherapy and informational apps included more behavioral processes of change than apps incorporating a combination of features, including gaming, cigarette trackers, and motivational coaching ($p < 0.01$).
Conclusion: Apps included behavior change processes but rarely incorporated usability and interactivity features to promote patient engagement. Engagement metrics did not vary by app user-ratings, price-to-download, or developer, including for-profit organizations or government and educational institutions.
Practice implications: Providers should acknowledge the popularity of smoking cessation apps as potential cessation aids and communicate their benefits and drawbacks to patients. Future efforts to improve smoking cessation apps should focus on enhancing the quality of tailored and interactive content.

1. Introduction

Health care providers refer patients struggling with smoking cessation to telephone quit lines, national health care organization websites supporting tobacco-free initiatives, and, more recently, text-based message cessation programs [1]. Smoking cessation mobile health (mHealth) apps are interactive tools synced to mobile devices and provide real-time feedback to support quit attempts. Smoking cessation apps are more popular than mainstream support, including telephone quit-lines [2]. One study found that nearly 800,000 smoking cessation apps are downloaded per month from popular systems, including iTunes [2]. Evidence-based smoking cessation apps are not readily available [2–5], which may be why health care providers are not recommending them to patients. However, mHealth technologies hold great promise in tobacco control [6]. Health care providers who recommend interactive, easy-to-use [4] and theory-based [7,8] smoking cessation apps may put smokers in control of their quit attempts and ultimately alleviate the burden of tobacco-related morbidity and mortality.

Smoking cessation is a process-oriented behavior. Cessation occurs as people who smoke tobacco transition through a variety of stages using cognitive/affective and behavioral processes of change. The Transtheoretical Model (TTM) provides a framework for understanding these stages of behavior change and the processes that explain how change occurs [9]. Smoking cessation interventions that use cessation aids and TTM processes of change can help people successfully quit smoking [10,11]. In addition to incorporating behavior change processes, smoking cessation apps

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Table 1
Operational Definitions of Patient Engagement Metrics with Relevant Examples.

TTM Processes of Change[9,17]	Operational Definition
Cognitive/Affective Processes	
Consciousness Raising	Finding and learning new facts, ideas, and tips that support smoking cessation • Presents statistics about annual smoking rates and deaths; • Provides general information about the dangers of smoking and benefits of quitting
Self-Reevaluation	Identifying smoking as part of one's identity • Asks user to image him or herself as a smoker or non-smoker
Dramatic Relief	Experiencing the negative emotions that go along with smoking tobacco • Tracks cigarette cravings • Discusses how emotions are altered by smoking tobacco and/or quitting
Environmental Reevaluation	Realizing the negative impact of smoking on the social and physical environment • Describes how smoking tobacco has an effect on other people • Reminds users about the social benefits of quitting smoking
Behavioral Processes	
Self-Liberation	Making a firm commitment to quit smoking • Establish a quit date, with the possibility to share it with online friends/community
Counterconditioning	Substituting smoking tobacco with an alternative healthy behavior • Instructs user to press "smoke" or "crave" options on the app, play a game provided by the app, or talk with someone or exercise when they crave cigarettes
Helping Relationship	Using social support to quit smoking • Provides users the opportunity to exchange information on social media or email; • Allows users to communicate through an online community
Reinforcement Management	Increasing the rewards for quitting and decreasing awards for smoking • Receives awards, badges, or updates on a daily, weekly, or monthly basis • Receives push-button notifications to messages or alert users of their progress
Stimulus Control	Removing cues to smoke and adding cues to resist the temptation to smoke • Shows user the time/date/mood where they are most likely to smoke/crave • Instructs users to avoid locations and people where cigarette cravings occur
mHealth Literacy Strategies[13,18]	**Operational Definitions**
Plain Language Dimension	
Paragraph Length	• Paragraphs are less than 8 sentences or 250 words
Meaningful Headings	• Headings are shown and they are descriptive or accurate to the page
Non-Technical Language	• Simple, non-scientific or technical jargon
Sentence Length	• Sentences are less than 20 words
Personal Pronouns	• User is referred to as "you" or the app system as "we"
Present Tense	• Present or future tense is used; past tense is avoided
Active Voice	• Sentences are formatted in the active voice, not the passive voice
Usability Dimension	
Search/Browse Bar	• In-app search functionality is available
Screen Control Options	• The font and its size can be adjusted in the app settings
Homepage Accessibility	• Top/bottom menu always provides a "home" or "dashboard" option
Linear Navigation Path	• App is navigated in a linear fashion (e.g., pg 1 to pg 2 to pg 3; not pg 1 to pg 3)
Navigation Menu	• App pages are easily accessible (e.g., has page/function icons at the bottom/top)
Images for Learning	• Images (e.g., charts, graphs, photos) are displayed and supplement page content
Color Scheme	• Dark fonts and light backgrounds are used, not dark background and light font
Interactivity Dimension	
Online Community	• App integrates with an online community/discussion forum unique to the app
Email Integration	• App integrates with a user's email address for easy sharing and contact
Social Media Integration	• App integrates with social media (e.g., Facebook, Twitter) for sharing and contact
Audio/Visual Multimedia	• Videos or audio are used to supplement and navigate the content on the app
Tailored Content	• Demographic information, number of cigarettes/cravings, and money spent per cigarette pack is monitored and used to guide tracking features and education.

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