Lessons from Practice: Designing Tools to Facilitate Individualized Support for Quitting Smoking

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ABSTRACT
Many health care providers, with a variety of trainings, counsel clients on quitting smoking on a day-to-day basis. In their clinical practice, they draw from and adapt guidelines and research-based strategies to fit individual client situations and challenges. Designers of technologies to support quitting smoking can learn from these real world practices to create tools that better adapt to individual differences. We present findings from interviews with 28 providers with diverse experiences in smoking cessation counselling. Through analysis of their individualization strategies, challenges, and perceptions of technology, we find that providers: (1) individualize context appropriate coping strategies by involving clients in brainstorming, (2) emphasize the need to support nicotine withdrawal in clients, (3) mitigate social triggers and mediate social support for clients, and (4) need to navigate dependencies with other providers for managing medications and comorbid health conditions of clients. With this empirical understanding, we extend the discussion on the design of technology to support quitting smoking, highlight current barriers to individualization, and suggest future opportunities to address these barriers.

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Smoking; health; individualization; counseling practice; behavior change; smoking cessation; personalization

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H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION
Approximately 40 million people in the United States smoke cigarettes [32,64]. Smoking is both a behavioral challenge and requires medical support [59]. Needs and challenges of people who want to quit smoking vary at the individual level [42,49]. Although, some people succeed in quitting cold turkey or in a single attempt, most others relapse multiple times [10,11,64]. Individualized external support for treatment and guidance on self-management of smoking behavior from providers, peers, or technology can help individuals cope with challenges in quitting effectively.

Over 70% of people who smoke are in frequent contact with physicians, nurse practitioners, counselors, therapists, and other clinicians [59]. We henceforth use the term *providers* to refer to this collection of practitioners. Strategies have been recommended for in-person smoking cessation counseling to tailor to specific needs of individuals [43,59]. However, primary care physicians and residents are known to face common barriers such as lack of training, time, and resources to support smoking cessation and conflicts in priorities while managing other health conditions [15,39]. Physicians are thus recommended to redirect clients to dedicated tobacco cessation counsellors and/or telephone based quitline counselors for specialized counseling on quitting smoking [39].

Technology has also emerged as an effective medium for the delivery and tailoring of interventions to support quitting smoking, due to its low cost, increasing availability, and computing power, [2,29,58]. Recent research has involved people who have quit or want to quit smoking in design activities to better understand their individual needs [42,49]. Design recommendations from these studies primarily emphasize the need for further individualization based on age, willingness to quit, quitting stage, smoking frequency, and personal goals and preferences such as optional social features [29,42,49]. Most current apps do not address these tailoring needs [1,29].

While previous studies describe client preferences from technology, it is also important to incorporate provider perspectives in design of technology for treatment of nicotine addiction [27,42]. Providers have a wealth of experiential knowledge in how to individualize counseling for people working to quit smoking. Related work using close-ended surveys with providers convey their perception of the importance of various features in technology [42,68]. Less is known about open-ended perspectives of providers on technology, such as why they consider certain features important, needs not met by technology, and how to design for these needs. An empirical understanding of practices and perceptions of providers on technology can help further efforts to understand needs and challenges of individualizing support for smoking cessation in real world contexts.

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In this study, we took an empirical approach of interviewing 28 providers in the United States with diverse experiences in counseling clients to quit smoking: primary care physicians, mental health care providers, and dedicated tobacco cessation and addiction counselors. In the process of counselling for smoking cessation, providers individualize and adapt to behavioral, medication, and social needs that vary from client to client. In addition, providers face major challenges in managing clients' comorbid health concerns and conflicting priorities of other providers. Our primary contribution is the empirical understanding of provider strategies and perspectives on needs from client-facing technology for smoking cessation. In our discussion, we draw our findings and on prior work's description of client needs to suggest design opportunities and to draw the attention of the HCI community to underexplored challenges in quitting smoking that might be addressed by technology.

RELATED WORK

Tobacco smoking continues to be the leading cause of preventable diseases and death in the United States, and is attributed as cause of over 480,000 deaths a year [32]. In 2014, the annual cost of medical care and loss of productivity due to premature death attributed to smoking-related health consequences was between $289 billion and $333 billion [32]. While smoking is a public health challenge, quitting smoking can be an intensely personal struggle [49].

Individualized nature of quitting smoking

Individuals report different triggers for smoking and relapsing, experience different levels of difficulty with nicotine withdrawal, or may use smoking as a coping strategy for comorbid mental health conditions such as anxiety and depression [16,49]. Comorbid addiction to illicit drugs and alcohol also contribute to relapses or switching to smoking as a drug of choice [54]. Unemployment, homelessness, lack of insurance, and lack of access to healthcare are some socio-economic barriers individuals face in accessing resources to quit smoking [28]. In their quit attempts, some individuals seek expert or peer support, avoid triggering activities and locations, or engage in activities to distract from thoughts of smoking [52]. Interestingly, these activities might function as successful coping strategies for some but act as triggers for others, which reinforces the need for individualized support for behavioral and medical interventions. We discuss "individualized" support or intervention consistent with Lauver et al.'s definition for patient-centered interventions: *"an intervention that is highly customized to a particular individual and that person's situation"* [37].

Evidence-based interventions for quitting smoking

Quitting cold-turkey is occasionally successful, but not medically advisable. The US Clinical guidelines recommends both behavioral (5As: Ask, Advise, Assess, Assist, Arrange) and pharmacotherapy (7 FDA approved medications) [59] as the best practice for smoking cessation counseling. Theory-driven behavioral interventions for smoking cessation [41] include Cognitive Behavioral Therapy (CBT) [14], Acceptance and Commitment Therapy (ACT) [13,24], Contingency Management (CM) [17], and Motivational Interviewing (MI) [67]. The Behavior Change Taxonomy provides a summary of behavior change techniques (BCTs) [44]. The Behavior Change Wheel [45], which is also validated against the English Tobacco cessation guidelines, defines nine categories of interventions—modelling, environmental restructuring, education, persuasion, incentivization, coercion, training, restricting, and enablement. Clinical guidelines for smoking cessation counselling also recommend addressing social triggers, facilitating development of social support, and directing clients to quitline and local support networks [43].

When preparing a quit plan, US clinical guidelines [59] recommend that providers tailor behavioral strategies and medications based on the client's demographics, tobacco use, socio-economic costs of smoking, impact of smoking on others, motivation level, reasons clients want to quit, impact on comorbid health symptoms, concerns about quitting, withdrawal symptoms, and success and difficulties in past attempts at quitting. Interventions may be also tailored based on the individual's willingness to change (MI), Experiential Avoidance (ACT), or stages of change in Transtheoretical model [53]. Tailored interventions are proven to be more effective to support quitting than non-tailored interventions, and technology offers many accessible platforms for tailoring intervention delivery and feedback [58].

Designing individualized technology to quit smoking

Means of delivering technology-based interventions for smoking cessation include telephone conversations, text messaging, web-based applications (such as websites, online communities, social media), and smartphone applications [2,29]. Types of interventions include educational or motivational messages, communicating with counselors and peers [50,52], networking with social media [31,66], automated interventions, self-tracking, and game-based or gamified interventions. Over the years, the number of smoking cessation smartphone applications available for free or low cost has increased to 546 [1,12,29]. Some technology-based applications facilitate tracking cigarettes, monetary, and health benefits, motivational messages, provide a suite of interventions for individuals to choose from, others tailor based on questionnaires on stages of quitting, before assigning interventions [41,58]. However, from a recent content analysis, smartphone applications do not tailor interventions beyond providing trackers, calendars and calculators and rarely follow recommended tailoring guidelines of clinical practice [29].

Design studies recommend individualizing support through technology based on user's quitting stage, age, family situation, and socio-economic situations [49]. Individuals who want to quit also perceived benefits in self-tracking smoking behavior, novelty of information, immediate and meaningful rewards, and achievable coping tips. Clients also differ in preference for social support or consider quitting to

be a solo struggle. Some clients also prefer being connected to smoking cessation experts. A study of the QuittyLink app [50,51] showed potential for higher user engagement and increased motivation to quit when intervention messages were personalized by a quit-smoking helpline counselor who remotely reviewed the data users tracked data their mobile device and provided weekly messages.

Needs and perspectives of providers, who are also important stakeholders in the treatment of nicotine addiction, are relatively less studied to inform design of technology. Recent independent survey studies in the US [42] and Australia [68] showed providers have primarily positive attitudes towards potential use of technology for smoking cessation support. Both providers and clients preferred features in applications that allow users to track their progress, personalize, match, and adapt to changing interests and needs of clients, and help manage withdrawal symptoms and medication needs for nicotine addiction [27,42]. However, majority of providers did not consider current apps to be effective for smoking cessation [42]. Research is needed to further incorporate perspectives and expertise of providers on how these needs can be addressed through designing technology for individualized support. Understanding strategies and barriers to in-person counseling can provide insights into opportunities for technology to build upon these strategies and address challenges in practice. To develop an in-depth empirical understanding of provider practices and inform design for individualized needs, we investigated the following research questions:

1. *What are current individualization strategies and tools used by providers in smoking cessation counseling practice?*
2. *What are the challenges perceived by providers in individualizing smoking cessation counseling practice?*
3. *What are the opportunities for technology to facilitate individualized support for quitting smoking?*

METHODS

To answer these research questions, we interviewed 28 health care providers and smoking cessation counselors with diverse experiences across 12 states in the US. Our recruitment email stated that we aimed to interview "health-care providers and counselors assisting clients who want to quit smoking." We stated the purpose of our study to "understand providers' strategies and challenges to inform the design of mobile phone applications for quitting smoking." This may have biased our sample population toward providers who were already using technology or are willing to incorporate technology into their practice. However, we also received responses and interviewed providers who did not have any experience with client-facing technology. We sent our recruitment email to public contacts on websites of state-based helplines for quitting smoking in the US, country-wide mailing lists of tobacco cessation counselors and behavioral health counselors, and snowball sampling of researchers' contacts among health care providers and counselors affiliated with a large university health system. Interviews were conducted from November 2015 to January 2016. Our project was approved by the University's Institutional Review Board. Each participant was compensated $30 in appreciation of their time.

Participants

We interviewed 28 providers who reached out to us from twelve states in the US [WA (11), CO (4), NY (3), CA (2), ID (1), IL (1), KS (1), MA (1), NC (1), NH (1), OK (1), and TX (1)]. The professional background of our participants broadly fell into categories of dedicated counselors and nurses with tobacco cessation and/or addiction counselling training (C#, N=19), mental health care providers (M#, N=5), and primary health care physicians (P#, N=4). Table 1 provides a summary of professional experiences of our participants (detailed participant table in auxiliary materials, Appendix A). Participants reported having between 1 and 30 years of experience in counseling individuals (henceforth referred to as clients). Nine participants self-reported being ex-smokers and had quit smoking between 4-15 years before the interview. All 28 participants reported counseling clients with one or more mental health conditions (e.g., depression, anxiety), physical health conditions (e.g., respiratory and heart diseases), substance abuse (e.g., alcohol, illicit drugs), and also from vulnerable population groups among whom the smoking rates are high [32,59]. Eleven participants had counseled inpatients on quitting smoking in general wards, Intensive Care Units (ICUs), psychiatry (M5, M9), cancer (C26), and thoracic surgery (C14). This diverse range of counselling experiences in participants ensures triangulation of perspectives from multiple stakeholders in our data.

Gender	Female (N=18), Male (N=10)
Example Professional titles	Nurse practitioners, primary care physician, tobacco cessation counselor, addiction counselor, mental health practioner
Type of sessions	Group (N=1, C02), one on one (N=27), both group and one on one (N=6) Face to face (N=26), state based quitline via telephone (N=2, C17, C28), face to face and telephone counseling (N=5)

Table 1: Summary of professional experiences of participants

Study procedures

We conducted one-on-one semi-structured interviews with each participant to understand current individualization strategies and challenges in smoking cessation counseling. The average length of our interviews was 52 minutes (range: 30-84 min). Topics included (1) how participants began the process of counseling someone who wants to quit smoking, (2) modifications they make in their counseling strategies from one client to another, (3) relapse handling, (4) follow up strategies, (5) incorporating informal social support into counseling (friends, family, peers), (6) challenges they face in counseling, (7) current use of tools and technology to assist in counseling, and (8) perceptions of client use of tools and technology for smoking cessation.

We showed participants low-fidelity design sketches (storyboards and wireframes) of a wizard based design of a self-management mobile app illustrating prompts to guide clients to individualize interventions based on their reason to quit, concerns with quitting, interests, example interventions (e.g., mindfulness, yoga), and ways to log and visualize behavior related to smoking (auxiliary materials, Appendix B). These sketches helped elicit responses from the providers on their perceived needs for clients and technology to support quitting smoking. Twenty seven interviews were conducted over phone and one interview was conducted in-person. For phone interviews, we emailed a PDF of our design sketches to each participant. All interviews were audio-recorded with consent and transcribed.

Analysis

First, the first author (AB) randomly selected five interview transcripts and coded them inductively [56]. Next, she conducted affinity diagramming to develop higher level clusters and categories of the codes using both inductive and deductive approach informed by our research questions [30]. AB, the second author (RV) (who read 4 transcripts), and an independent researcher not familiar with the data, were involved in discussions and refinement of affinity clusters. AB used this set of codes to analyze the remaining transcripts while constantly comparing among interviews to understand patterns of similarities and differences across participant perspectives. AB wrote memos on codes and data and shared them with all authors after completing analysis of all interviews. To ensure validity, discussions on findings were conducted with the research team at all stages. We describe our findings that contribute to an in-depth understanding of provider perspectives to inform design of applications for quitting smoking.

FINDINGS

All participants recognized the diverse needs of their clients while quitting smoking and emphasized providing unique and individualized support for each client. While a majority of the participants said they set quit dates with their clients, they added that only a few of their clients succeeded in quitting "cold turkey", i.e. attempting to quit all their cigarettes simultaneously on a set quit date. Majority of their clients required individualized support to reduce smoking over a longer term with multiple setbacks. P10 describes the variation as, *"This [counseling approach] is actually very individualized. Some people find it easier to cut down slowly, but other people feel like if they do that then they will never quit. I have a lot of patients—probably more patients, that cut down slowly than they do quit cold [turkey]."*

Four primary themes in which individualization is key emerged from our analysis: (1) providers brainstorm context appropriate behavioral strategies with clients, (2) providers emphasize support for nicotine withdrawal, (3) providers need to mediate social support for clients, and (4) providers need to navigate dependencies with other providers. Across each theme, we summarize tailoring strategies providers use that are consistent with literature and then expand on perceptions of providers on how they further individualize from what is recommended, barriers they face, tools they use, and their insights on our design prototypes. We then summarize the perceptions of providers and their use of technology based applications for quitting smoking and their perceived barriers to adoption of smartphone applications.

Providers involve clients in brainstorming context-appropriate strategies

For behavioral counseling, strategies mentioned by providers can be roughly summarized by the intervention categories defined by Michie et al. [45]. Providers mentioned using specific sets of strategies for behavioral support based on their expertise or training: CBT (5), MI (8), ACT (1), 5 Ds [5] – Delay, Distract yourself, Deep breathing, Drink water, Discuss your feelings – (4), and clinical guidelines (5As) [59]. Providers said they primarily take on the role of educators and facilitators, emphasize informing clients about options available for support, and support client autonomy. No participant reported using coercion or scare tactics if clients were not ready to quit.

In addition to asking clients initial assessment questions such as their smoking behavior and health condition [59], all providers emphasized assessing the context that each client associated with smoking before setting a quit plan and also after relapses. This assessment helped providers to recommend example strategies to break the association of specific contexts with client's smoking behavior, such as by restructuring the environment. Context was explained by providers as the time of the day, environmental cues, social factors, and the activity that a client engaged in before, during, and after smoking. Providers said they ask clients if they had already identified challenges or factors that triggered their craving in specific contexts, such as if their most difficult cigarette to quit is the morning cigarette or the one at work. C02 also explained context in terms of time of the year and events significant to the client: *"In my experience, people need that one year of birthdays, holidays, anniversaries, season changes et cetera, where they get support around staying tobacco free or nicotine free."*

Recommending intervention strategies after assessing context was a collaborative process between the client and the provider. Providers described this as a process of "*brainstorming*." To facilitate brainstorming, providers suggested examples from evidence based practices or by modelling, and provided prompts for clients to think about strategies or to come up with their own ideas based on their interests, abilities, likes, and dislikes. As a result of this process, the strategies were highly individualized to fit into the context of the client's daily life and to give clients concrete and actionable strategies to work with. For example; C21 explained, *"Our strategy is to include the patient in brainstorming or developing coping skills to manage some of their biggest challenges, rather than giving them more of a cookie cutter or scripted strategy to help them*

to deal with their biggest challenges. That varies from individual to individual."

As tools to assess client smoking behavior and context, most providers rely on verbal recall from clients, but some encourage clients to use paper-based tools between sessions to note these factors such as worksheets, journaling, or index cards with header cues (e.g., "*note your most difficult cigarette to quit*" (M01)). Few providers mentioned maintaining paper based records for themselves, which they referred to during follow-ups. Physicians (N=5) and quitline counselors (N=2) had access to their internal online system for note taking. Quitline counselors share a database linked to the unique id of the caller. However, for some providers, especially in inpatient units (N=11), follow up was not possible to iterate on or determine effectiveness of strategies.

In our design prototype, we anticipated that the user could follow a specific intervention each day (Appendix B, page 16 to 11). Providers however highlighted the need to design a tool that can help clients understand different contexts of smoking within the day and then list strategies for that context. For example, M01 conceptualized, *"[Prompt clients to] 'make a comprehensive list of all the different contexts and all the different situations you're smoking'. Example, in a car, after a meal—because certain coping mechanisms might be more useful in certain contexts than others. So, could be that in a car it's really easy to listen to very loud music but at work, going out on a break, that's really hard […] You might also wanna have that when the app takes a log of the context that you're smoking—which means you might wanna tie the app notifications to the pertinent event."*

To facilitate brainstorming like process, providers envisioned an app that would prompt suggestions based on what was feasible and actionable for clients, and guided them through complex tasks such as yoga. For example, C11 suggested that the tool should prompt, "'*What can you do if you have an urge to smoke? —some people wanna call the crisis line, some people wanna call a friend, go outside, open a window, eat a vegetable, you know that kind of thing—chew on some gum.' Things that they do already, things they can afford, things they like to do."* Participants particularly liked intervention designs that let the clients create and save their own list of activities to do during quitting (Appendix B, page 23). They suggested it let them enter their own *"specific personal goals"* based on interests and benefits that clients perceived from quitting, such as quitting for a surgery or "*be a transplant candidate*" (C03).

Providers emphasize support for nicotine withdrawal

As per guidelines, medications need to be tailored based on the number of cigarettes, prior successful use of medication, tolerance or ease-of-use, out-of-pocket patient cost, likelihood of adherence, dentures (chewing gum), dermatitis (patch), and comorbid conditions like depression [59]. Twenty six participants reported they recommend the 7 FDA approved quit smoking medications to clients. A common concern expressed by providers was that some clients have misinformation and are fearful of medication side-effects leading to issues of non-adherence and inadequate dosage, which increased clients' struggles with withdrawal symptoms. To alleviate such fears and misconceptions, providers said they first need to educate clients about the physiological components of nicotine addiction and emphasize that addiction is not merely a behavioral or moral issue. Many providers shared paper based tools with clients, such as brochures, handouts, or booklets [3,46,47,61] containing information on addiction and medication. One provider (P08) who did not have brochures in her clinic, printed out information about side-effects of prescribed medication, "*If someone's thinking about starting a medication to quit smoking, I'll print off usually the patient information form of the side-effects and what to expect because I think patients are little bit less scared if they know what to expect out of a medication."*

Even after working with clients on side-effects, preference, and cost of medication, providers mentioned that adherence to right dosage for smoking cessation medications was a major challenge. Specifically, two providers (C02 and C20) said that they have had clients who were not able to taper off of nicotine replacement products as recommended and continued to stay addicted to nicotine in over the counter products for longer periods of time (over 5 years in case of C02's client). According to providers, medication usage required guidance for self-management on clients' side.

In our design prototypes, we did not provide any option to track medications. Some providers highlighted that technology should support the client in managing their medication. For example, C02 explained the need to incorporate support for information and self-management of medication dosage in our design prototype, *"I'd put something in there [design probe]…about exploring the idea of using medication—and they may or may not want to use products. But if they are using [nicotine replacement] products, that will need support and benefits for they will usually use them wrong. And [clinic_name] has studied this and they say that most people, when they are using an over the counter nicotine product, they under dose and they don't dose long enough."*

Some providers, especially those who had experience quitting smoking themselves (N=9), brought to our attention that outcomes for behavioral tracking features shown in our design sketches – such as mood, alertness, cravings, and appetite (Appendix B, page 19)– will vary dynamically due to variations in withdrawal from nicotine and how clients supplement it with pharmacotherapy. For example, C25 who quit smoking herself, explained, *"Depending on how they're quitting it, if they're not using any pharmacotherapy, they could have some of these things be really high and then work down to low. If they're using good pharmacotherapy, these may stay low, but that would also reinforce that, "Hey, the pharmacotherapy is working for me. I'm not having to deal with withdrawal symptoms!"* Providers emphasized the need

for appropriate feedback, and guidance to clients to be self-aware, not feel discouraged, and understand trends in their outcomes, especially, in their initial days of quitting. They also suggested that type of behavioral intervention, timing and frequency of reminders and logging prompts be individualized to the dynamic needs of nicotine craving to not remind clients about smoking when they are not craving: depending on the number of cigarettes clients smoke and their medication intake.

Thus, providers emphasized that tools individualize educational interventions for different information needs of a client about medications, encourage adequate dosage, and enable dynamic tracking and feedback based on individual differences in clients' behavioral and physiological responses to withdrawal.

Providers mediate social support for clients

As all clients did not have similar social situations, providers needed to individualize treatment by mediating offline social factors for clients both in terms of negative social triggers and positive social support. Providers perceived that a key barrier to quitting for clients is having a family member or someone with whom they live who also smokes. According to providers, these people prompt clients to smoke and often also contribute to misinformation about smoking, which can make the clients less receptive to treatment and counseling. Some providers believe that even negative pressure from family members who did not smoke can make some clients resistant to counseling, such as nagging the client and/or inflicting emotions of hurt, anger, guilt, or blaming the client for exposure to passive smoking.

To manage social triggers, providers advise clients to not smoke with friends and family who smoke. However, they encourage clients to maintain relations with them outside of smoking activities, as providers also did not want the client to feel socially isolated. All providers emphasized the need and benefits of having social support for quitting smoking from family, friends, a buddy, and/or peers. Their strategies include educating the client and the family together, encourage friends and family members to quit together, and some even arrange for cost-free support for the client and the person who lives with them. C13 explained, *"In fact, our program that we offer for free—for our orientations, I told my boss, 'We need to offer that for anybody living in the household. I don't care if it's a roommate or if it's a family member. If they live with the patient, they can come for free to our program.'"*

For clients who do not have support from close social ties, providers help them identify people in their extended social circle could be their "buddy" – someone they could talk to or call when they have a craving, and can remind them to not smoke. Providers encourage clients to reach out to this person through different means, for example; someone at work, local recreational communities such as the YMCA, or local peer support groups. Interestingly, many providers explained that even people who smoke and do not want to quit with the client could be of support or be a buddy, provided they "promise" to not smoke in presence of the client and not cue the client to smoke.

Few providers said they hand paper-based resources to clients and their social circle on how to ask someone for support (e.g., worksheets, writing letters in workshop) or how to support someone on quitting smoking, respectively. Providers urged clients to call the quitline as a form of expert social support during cravings. For example, M05 explained, *"The reason that [quitline] is probably real good is because the impulse or the urge to use after quitting can last just a few minutes. And so a phone call could make the difference."* Participants perceived that calling, texting, or sharing and connecting with peers online for social support is an effective strategy to counter real time cravings. For example; C28 shared her client's narrative of getting instantaneous conversational support on an online post on their craving*: "One of my clients said to me, 'I had a craving, I went to the app and I put on the app…' I think it was some Facebook app. And he said, 'I am having a craving right now' and right away somebody answers the app and helped him ...you know, support system. 'Don't do it, why do you want to smoke right now?' and they went back and forth on a little chat and then that helped him not to have that one cigarette."* Providers also envisioned that technology could benefit clients by locating and connecting them with offline social support, such as local support groups, and by encouraging clients with appropriate prompts to proactively identify "buddies" in their social circle similar to their counselling process.

Providers need to navigate dependencies

Preferences for medication and struggles with comorbid health conditions vary from one client to another and these are major factors in individualizing smoking cessation counseling. However, a single provider is not equipped with resources to cater to all these needs. Therefore, providers have to individualize treatment for nicotine addiction not only based on client needs but also depending on their own care context, training, resources they have available, and client access to other providers. We found that providers need to redirect clients to other providers for three main activities: (1) specialized counseling and follow up for smoking cessation, (2) prescribing smoking cessation medications, and (3) adjusting treatment for smoking alongside comorbid health conditions. Unresolved conflicts surfaced in this redirection process.

Physicians (N=4) have the ability to prescribe medications, but consistent with prior work [15,39], they are constrained for time. Physicians direct clients to nurses or support staff with tobacco cessation training and/or quitline who are able to dedicate time and are skilled in counseling on quitting smoking. However, nurses and dedicated cessation counselors (N=19) explained that they cannot prescribe medications and need to redirect clients to consult a primary care physician if the client prefers prescription drugs, such as Chantix or Wellbutrin. It was a common perception among

providers that each state's quitline gives out nicotine replacement products free of cost, and so they recommend clients call the quitline. Quitline counselors, however, reported that the availability of free nicotine replacement products is timely (e.g., once a year (C17)), depends on their funding program, eligibility of the client depending on a medical assessment and insurance coverage. C28, a quitline counselor, summarized: *"Sometimes we have programs in which they [clients] could get free patches, but they will still have to go through protocol before they can get the patches…Some insurance would rather pay for the Chantix instead of the patches... We never really give Chantix because that has to be prescribed by their physician."* Thus, quitline counselors also relayed the client back to their physician for prescribed medications.

While working with clients who have comorbid physical and/or mental illnesses, providers prioritized treatment for smoking differently. For physical illnesses (cancer, respiratory and heart diseases), providers said they prioritize and catalyze client motivation to first quit smoking by educating them on how their smoking habits can aggravate these symptoms. Even though, quitting smoking improves people's mental health, due to differences in receptiveness and abilities of clients with mental illness, 4 out of 5 mental health providers and all others perceived the need to stabilize clients' mental health symptoms before proceeding with counseling a client for smoking. They acknowledged that clients used smoking as a coping strategy for mental health symptoms and struggled to educate clients on misinformation of impact of smoking on mental health. P10, a primary care physician, explained, *"A lot of them are not really listening to you when you're talking to them about health consequences of smoking. So if you're trying to help them stop smoking— if they are very depressed— it's just not gonna work. So you really have to treat the depression before you can focus on the cigarettes."*

Counselors who do not have assessment tools for mental health, relevant background, or appointments with mental health facilities, relied on their subjective discernment of severity of mental health symptoms. These providers said they redirect clients to consult with their primary care physician or mental health care physician to get a diagnosis and readjust treatment. For clients with unstable symptoms, providers emphasized the need to be careful with possible side-effects of medication supplements for nicotine withdrawal (such as irritability, insomnia, and even possible concerns of suicidal and homicidal ideations for drugs such as Chantix [62,63], and monitor clients closely. C14 explained her concerns in recommending Chantix to her clients with depression due to perceived concerns of inducing suicidal and/or homicidal ideations.

Perceived priorities differed in treating clients with comorbid addiction in two ways: (1) treating clients for quitting smoking together with other drugs and alcohol and (2) treating clients for quitting other drugs first, and then treat them for quitting smoking. Providers who assigned equal priority to quitting smoking perceived alcohol as a common trigger and said that clients also need support to quit alcohol and drugs that impair senses and self-control, at the same time as quitting smoking. C14 explained, "*What's going to happen is you will have quit, maybe it's for a few days, a few weeks, a few months, and you go out drinking, and you look down, the next thing you know, you've got a half a pack of cigarettes and you smoked half a pack… you've clouded your ability to make that decision about what you really wanted.*" They expressed discontent with lack of support for quitting smoking while quitting other substances. The second group of participants considered quitting smoking to be of lower priority than quitting other substances they perceived to be more harmful (harm reduction model [54]) or encouraged client choice in which substance they wanted to quit first. For example, C26 described: *"We had somebody recently who came in and smoking was very low priority because she was drinking very heavily and was wanting to quit drinking, and our psychiatrist wanted her to actually check into an inpatient facility before we would even treat her [for smoking]."* There is evidence that quitting smoking at the same time does not negatively impact drug abuse outcomes and on-going efforts are integrating of substance abuse treatment with smoking cessation [36].

Due to these differences in expertise and priorities, the need to re-direct clients to other providers for medication or mismanaging comorbidities hinder treatment for nicotine addiction. Current technological solutions do not support ways for either providers or clients to manage comorbidities while quitting smoking.

PROVIDER PERCEPTIONS ON USE OF TECHNOLOGY

Consistent with related work [42,68], providers perceived technology to have many benefits to support quitting smoking. Table 2 summarizes current technology-based tools that participants recommend to their clients, and their perceived functions. Providers primarily use technology to share information, follow up with clients over email, phone, or text messages, and/or to broadcast information to clients over longer term on mailing lists. Participants expressed the need to understand the application's source, cost, agenda, whether they are based on evidence based practices, and preferred recommending federal or state affiliated sources and websites. For example, M04 said, *"I do worry, when someone tells me they found a new app, I worry initially like who created it, where they get their funding? Kinda what's their motivation? I like it when they're created by reputable sources…I really worry— is there any hidden agenda or is the science sound."* They also reported that clients perceive benefits from features on smartphone apps such as tracking and viewing "cigarette free time", number of cigarettes, personal health benefits, and money saved. Providers acknowledged that some people are more likely to prefer technology for support over provider visits due to reasons such as perceived stigma, not wanting to appear vulnerable or seek help, and personal choice and privacy.

Type	Tool examples	Functions of tool in counselling as perceived by providers
Websites or Online tools	SmokeFree.gov, NYSmokeFree, tobaccofreeco.org, the EX plan: becomeanex.org, state quitline websites, online communities and anonymous forum boards for peer support, provider's personal website, Facebook, Google docs, question answer forum (Quora)	▪ Access information on quitting smoking resources and coping strategies ▪ Refer to interactive online tools to help clients create quit plan (Ex Plan) ▪ Refer to mobile apps that clients could download ▪ Providers answer questions on forums (Quora) ▪ Clients maintain records of their smoking behavior (Google docs) ▪ Clients look up medications and side-effects before asking providers ▪ Clients connect with peers online to get support and share experiences
Mobile phone applications	*Smoking:* QuitSTART (teens), QuitNow, Tobacco Quit And Save, This is Quitting *Others:* Mood management, mindfulness, diabetes tracking, weight management apps, sleep, pedometer, medication list, Fit Bit, learning CBT techniques	▪ Self-management in absence of provider support ▪ Tracking cigarettes, health, money, mood, physical activity ▪ Counting down time not smoked ▪ Learning coping skills for triggers of smoking ▪ Connecting with peers ▪ Games to keep their hands and mind busy

Table 2: Functions of technology-based tools recommended by providers or perceived used by their clients

C16 explains: *"I think the challenge with the younger people—at least in my experience, has been they don't think they need help. Whereas if they've got an app on their phone, they may have more tendency to use it because no one else will know they're using it...I've done cessation groups at military bases. Often times, they don't want to appear weak."* The younger population makes up the majority of users of smartphone apps for quitting smoking (median age 31 years, range 18-67 years) [9] and quitline services (mean age 39.4 years) [25]. Stigma is also a major barrier to accessing in-person health care treatment for those with concerns of addiction [40] and mental health challenges [7].

When asked who would not benefit from technology, participants attributed client preferences for in-person social support as a potential reason for non-use of technology. For example, C02 who was a peer support group facilitator, perceived that "*people who turn to coming to the support group aren't real mobile app kinda people*." She reported that she also regularly communicated with her clients between sessions on smoking related concerns via phone calls, text messages, and emails, but she preferred technology to initiate contact and for follow-ups or checking with clients, *after* in-person connection was established. P06 perceived that lack of self-motivation in his clients was a key reason his clients seek provider help over use of mobile phone applications to quit smoking: *"The problem most of my patients have is internal motivation—self-drive. And to have a phone saying, ok now go do your yoga when they are homeless on the street or—cigarettes are one of the least of their addictions— it really relies on patient's internal self-motivation. Many of my patients, if they have that [self-motivation], they wouldn't be in my clinic."*

While giving feedback on our design prototypes, providers also explained that while most clients have smart phones, some of their clients either did not own smartphones or will not be able to use smartphone applications for quitting smoking. The specific population groups that providers mentioned include older population (55 years and above), rural population, low income groups, people facing homelessness, people with learning disabilities and symptoms of comorbid health conditions that prevent them from using smartphones, and people with comorbid addiction. Few providers observed that clients mainly use their smartphones for calling features and had difficulty using apps or text messaging features. For example, C21 explained a range of difficulties that could act as barriers to using smartphones for her clients, *"The population I serve, really has challenges with technology. Sometimes, especially if they have a mental health challenge or a learning disability, or if they're a little bit older… [or] don't have as many resources or don't have as many learning experiences. The applications and more advanced technologies – sometimes, not all the time— is outside of the scope of their abilities."* Providers explained this with the caveat that there are exceptions to individuals in these population groups who own smartphones and will be able to use them. Though the rate of use of technology for health care needs is low in older adults [38] and population with challenges of mental health [8,21] and homelessness [33], it is increasing.

DISCUSSION

To summarize, providers work to individualize smoking cessation treatment to specific contexts that clients associate with smoking behavior, differences in client access to and usage of medications for withdrawal symptoms, different social situations that act as trigger or support for clients, and differences in treatment of their comorbid health conditions. We discuss opportunities on how to integrate lessons learned from these findings with needs identified from prior work to better adapt the design of technology for quitting smoking. Our design prototypes were specific to smartphone applications, but we believe these opportunities are applicable across various platforms and tools that providers and clients are comfortable using.

Contextualizing Interventions

We identify three main steps for technology to support interventions that adapt to an individual's context: (1) help

the client identify their specific context of smoking, (2) help the client plan for actionable steps to take in those specific contexts, and (3) enable clients to execute the intervention at the time of craving. Current efforts in the design of smoking cessation technology support Step 1 and some in Step 3. There has been less exploration on efforts to support client choice and input through technology while planning interventions in Step 2.

Enabling users to record and visualize situation (similar to activities in context), time, and location of smoking has potential to increase client's self-awareness about their smoking behavior and motivation to quit [50,51]. This design can be extended to allow logging and integration with other elements of context during smoking: people, environmental cues, and special events. Allowing users to label the contexts (such as, in which it is most difficult to quit) could facilitate prioritizing the context to tackle, first. The Ubicomp community continues advance automated sensing technology [55], and we urge for this to continue to be a priority as it can better facilitate tracking contexts than user-initiated logging, which may be difficult and/or socially stigmatizing . Systems may also not need to achieve very high accuracy: they could potential record smoking or craving contexts in the moment. Later, at an opportune moment, they could ask users to verify each and, if an actual craving, to rate its difficulty. Reviewing the captured data plus any data later entered by the user could also support the process of planning interventions to try the next time they are in a similar context.

Just in Time Adaptive Interventions (JITAI) aim to detect specific triggering contexts and "push" micro-randomized interventions to clients [35]. Clients, however, prefer "pull" over "push" messages due to the perception that poorly timed interventions run the risk of reminding them about smoking or they tend to dismiss them [27]. Clients also prefer interventions that are of interest to them, tips that are achievable and relatable to them [48], and rewards that are meaningful to them. Given the rapidly changing physiological and behavioral needs while quitting smoking, there is a need that technology should leverage the knowledge of clients about their varying context and enable clients with skills to respond effectively in vulnerable contexts, such as during cravings.

We found that providers currently individualize to these needs by guiding client input in brainstorming through prompts and examples. To design for a similar process, coping strategies could be grouped into clusters of pertinent contexts tagged by crowdsourcing, expert, or peer feedback similar to how many card sorting programs work. Clients and providers can then work together to make matched suggestions to contexts that trigger smoking in clients. When combined with user feedback or tracked behavior, the crowdsourced clusters can be further matched to an individual's context using machine learning techniques [55] or after a self-experimentation process [34]. Clients can then select, modify, and save lists of strategies per context and revisit them, or the system can remind them of these strategies when similar contexts are detected.

Another way to facilitate such brainstorming might be to scaffold the development of decision rules for which interventions clients will use in which situations. This could even take the form of supporting end user programming [60], such as in If This Then That (IFTTT) [69] and in some other contexts of health [6,22,23]. For example, client can be shown a list of their triggering contexts and a list of coping strategies, which they can match; software could then then help them implement these rules. Opportunities for such client initiated planning could be before anticipated trigger or reflecting after lapsing [52].

It may also be possible to combine this approach with self-experimentation [34], to guide the end-user to generate and test hypotheses on effectiveness of an intervention in a particular context. This has the potential to improve client knowledge firsthand about the effectiveness of different coping strategies. Designs that help clients internalize this knowledge may reduce their dependence on the system for support and help them make decisions next time they face a similar context.

There are many possible approaches to gathering client input about potential interventions, and it is important that research continue to develop them and designers implement them. Gathering client input is an important element of both current provider practices and the *Shared Decision Making* (SDM) model [20] in patient-centered care which encourages clinicians to inform clients, provide them with choices, and help clients make their own decisions in treatment. While such a process can increase the cognitive load on the client, SDM has been shown to be an effective model to help improve patient engagement and outcomes in clinical care [20]. Design research should explore the feasibility and trade-offs of facilitating client input in deciding interventions.

Opportunities to mitigate barriers to individualization

Addressing some barriers to individualization—such as conflicting treatment priorities and medication access—will require public health reforms and policy changes. We hope awareness of these barriers can help designers consider the limitations of technological solutions, and help them identify niches to which they can contribute. Some crucial opportunities for technology to reduce barriers to individualizing care include: catalyzing social support, supporting withdrawal management, and inclusion of individuals who are at high risk and/or facing comorbidities, to also benefit from technology for quitting smoking.

Catalyzing social support

Providers highlight the difficulty a client faces in quitting when their offline social circle is not supportive. Education programs for a client's social circle are not feasible in every clinical setting due to cost, time, and willingness to engage. An area of future research might be to design a closed social networking platform for a selected group of people in offline

or online networks of the client, where the provider or client could broadcast tips and recommended strategies that are helpful to support someone to quit [4]. More importantly, these efforts can help reduce stigma and isolation in a client's immediate network, adding to social incentives to quit. However, prior research suggests that not every client may prefer social support [27,49]. For facilitating nuanced preferences, clients may make visible to the network what kind of support they are seeking or not seeking during quitting smoking [57] (if they wish to disclose). Such a design could enable clients to set type and time of support needed, (such as, "need someone to walk with during most difficult morning cigarette"), and social reminders for the buddy. Letting clients nominate more than one "buddy" in the network, and can help share responsibilities, wherein different people can intervene at different times or contexts.

Supporting withdrawal management

Both providers and clients consider features to support nicotine management medications important [27,42], but commercial apps for smoking cessation do not support medication [1,29]. For prescribed medications, close monitoring and dosage adherence can be encouraged through networked apps between provider and client, where the provider enters dosage information and client logs medication intake [19]. Technology should encourage the user to seek assistance on medication support from experts in situations such as undesirable side-effects and emergency support (such as a phone call button) when a facing crisis situation. To facilitate information needs and autonomy, smoking cessation applications should integrate medication information (e.g., instructions on adequate dosage and side-effects when clients or providers enter names of over-the-counter products) and tracking functionalities such as those in the app *Drugs.com* [70].

Clients need apps to adapt to their changing needs during nicotine withdrawal [27]. Insights from providers help us envision a system that can model and predict withdrawal from client logs of smoking intensity and medication intake. For example; in the initial days of quitting, if the client's physiological measures (e.g., mood, alertness) degrade due to withdrawal, the client's motivation may benefit if shown examples—either system generated or from a peer—for how response patterns are expected to vary during quitting. Such feedback can help the client normalize and manage their expectations during quitting. Predicting and projecting expected improvements in behavioral outcomes in far future can encourage clients to continue logging and not smoke. Also, crisis situations can be detected and averted by setting thresholds – such as, if mood levels persistently drop below a threshold level indicating increase of depressive symptoms, the client can be alerted to contact their buddy or care team.

Comorbidities in high-risk population

In addition to supporting or recommending different treatment options for a specific health challenge, there is also a need for tools that can help people better prioritize and coordinate treatment for comorbid health conditions. For example; data-soloing may lead to people receiving conflicting advice from different health applications they use to work on different health goals. Similarly, if someone uses different applications to address comorbid challenges, such as depression, nutrition, and smoking, each application might currently ask them to separately and redundantly track mood, increasing user burden unnecessarily. For those who struggle with comorbid substance addiction, tools should also integrate contextualizing interventions based on specific contexts and patterns of cravings for substance use.

To support quitting needs for people who have comorbid health challenges and socio-economic challenges, for whom smoking rates are also prevalent [32], designers should consider how low cost support can be facilitated—for example, designing for compatibility with low cost devices, minimizing or avoiding cost of data access, and utilizing shared resources such as systems in community based shelters [18]. Designers should also incorporate diverse usability and accessibility needs for aging population and for those with psychiatric symptoms, cognitive and motor difficulties [26,65]. While applications that support integrated features to manage comorbidities and are universally accessible are ideal, feasibility of how to design such applications optimize user-burden needs to be explored.

CONCLUSION

In this study, we examined everyday counseling practices and challenges of providers, and incorporated their insights to inform design of technology that can better assist the complex process of quitting smoking. Future research should explore client perspectives on context-appropriate interventions, the feasibility of technology to facilitate client input for planning context appropriate interventions, and opportunities to support clinical interactions. We suggest several promising research and design opportunities, such as enhancing positive social support, supporting medication management to temper nicotine withdrawal, and including needs of high risk population in design of quitting tools. More effective and individualized tools for smoking cessation can potentially enable more individuals to quit smoking, ultimately reducing risks of serious diseases, while improving their health and quality of life.

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