Pilot randomised controlled trial of a culturally aligned smoking cessation app for American Indian persons

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► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/tc-2024-058665).

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Received 21 February 2024
Accepted 23 June 2024

To cite: Carroll DM, Jennings D, Stately A, *et al*. *Tob Control* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/tc-2024-058665

ABSTRACT

Objective To pilot test QuitGuide for Natives, a culturally aligned version of the National Cancer Institute's QuitGuide smartphone app for smoking cessation.

Methods This randomised controlled trial was conducted remotely during 2022–2023. American Indian adults who smoked and resided in the Midwest (n=115) were randomised to QuitGuide for Natives or the general audience QuitGuide smartphone-based intervention. Group differences in feasibility (times the app was initiated), usability, acceptability ('How likely would you be to recommend the app to a friend?'), fit of app with culture and preliminary efficacy (24-hour quit attempts, cotinine-confirmed self-reported 7-day abstinence) outcomes were examined.

Results QuitGuide for Natives versus the general audience QuitGuide did not differ in the number of times the app was opened (adjusted incidence rate ratio 0.94 (95% CI 0.63 to 1.40); p=0.743) nor in usability score (adjusted mean difference (aMD) 0.73 (95% CI: −5.00 to 6.46); p=0.801) or likeliness of recommending the app to a friend (aMD 0.62 (95% CI −0.02 to 1.27); p=0.058). Differences were observed for all cultural fit outcomes such as 'The app fits my American Indian culture (aMD 0.75 (95% CI 0.35 to 1.16); p<0.001). QuitGuide for Natives versus the general audience QuitGuide resulted in an average of 6.6 vs 5.1 24-hour quit attempts (p=0.349) and cotinine-confirmed 7-day abstinence was achieved by 6.9% vs 3.5% (p=0.679).

Conclusions Acceptability, cultural fit and preliminary efficacy findings are encouraging and will inform future, larger-scale evaluation of culturally aligned digital smoking cessation resources for American Indian adults.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Smoking cessation interventions that are in line with the culture and needs of American Indian (AI) persons are hypothesised to have greater efficacy relative to general audience interventions. However, the existing evidence is mainly derived from in-person studies that frequently experience high rates of participant attrition.

WHAT IMPORTANT GAPS IN KNOWLEDGE EXIST ON THIS TOPIC

⇒ Community-based participatory research and qualitative methods informed the cultural alignment of a smartphone app for smoking cessation, yielding a culturally aligned version. The culturally aligned versus standard audience version resulted in greater cultural fit ratings and a signal for greater efficacy, although no differences in app usage or in usability ratings.

HOW THIS STUDY ADDS

⇒ This study can serve as a blueprint for braiding together western and Indigenous knowledge and is a step towards identifying what works best for AI persons to quit smoking.

INTRODUCTION

In many American Indian (AI) communities, tobacco is used for ceremonial and spiritual purposes.[1 2] However, commercial tobacco use has risen dramatically among AI persons.[3 4] This is due to the US government establishing the 1883 Courts of Indian Offenses to prosecute AI persons who participated in traditional ceremonies, religious assimilation, lack of environmental jurisdiction on many tribal lands in the early 1900s,[5] tobacco industry marketing,[6–8] and other impacts of colonisation.[1 2] Culturally aligned cessation interventions may serve to curb commercial tobacco use among AI persons, but the evidence base is limited to in-person studies with high attrition.[9 10]

Digital interventions facilitated through smartphones can have broad reach (68%–78% of AI persons own a smartphone with internet access[11–13]) and can be culturally aligned. National Cancer Institute's (NCI) QuitGuide is a free smartphone app for smoking cessation. QuitGuide follows the US Clinical Practice Guidelines, connects people who smoke to other resources and includes interactive elements to aid users in tracking triggers and building quitting skills.[14] While QuitGuide resulted in a self-reported 30-day point prevalence abstinence of 18% at 12 months follow-up among AI and Alaska Native adults (N=80),[15] the app may better serve AI persons if culturally aligned.

Community-based participatory research (CBPR) and qualitative methods were used to identify recommendations from AI persons to guide cultural alignment as described elsewhere.[16] The recommendations were used to introduce new content and edit existing QuitGuide content, which resulted

in QuitGuide for Natives. The present objective is to test the feasibility, acceptability and preliminary efficacy of QuitGuide for Natives among AI adults who smoke.

METHODS

Recruitment occurred through a clinic in Minnesota serving AI persons and a tribal nation in Wisconsin. Community partner representatives served on the study's community advisory board (CAB), which first convened to guide the formative research[16] and continued meeting quarterly to guide the development and pilot testing of the culturally aligned app. Participant recruitment was supplemented through a third party, which deployed an advertising campaign across digital networks. Eligibility criteria: (1) self-identify as AI; (2) ≥18 years; (3) smoked ≥3 cigarettes per day in the past 30 days; (4) interested in quitting smoking; (5) owned a smartphone and (6) resided in the Midwest. No exclusions were based on other commercial tobacco product use.

Participants were randomised, with random block sizes of 2 and 4 and equal probability, to either QuitGuide for Natives or the general audience QuitGuide. Participants completed a baseline survey, downloaded the app, set their quit date for one week later and entered their unique app ID. Participants were informed that they could reset their quit date if needed, and to use the app as they wanted to use it. At 5 weeks follow-up, participants completed an exit survey and were instructed to provide a saliva sample in a collection container which was mailed to participants with prepaid postage for return. Participants were compensated for each survey and their saliva sample and a bonus was provided for completing all.

QuitGuide is a free app developed for the general population.[17] V.2.43 was available during the study. More details are described elsewhere.[17] QuitGuide for Natives is a research version (ie, not publicly available) of QuitGuide created by making the following content modifications: (1) new app name 'QuitGuide for Natives'; (2) addition of culturally relevant smoking triggers that users can track such as 'being around commercial tobacco at traditional or ceremonial events' and 'feeling grief or experiencing loss'; (3) addition of three culturally aligned pages ('The Process of Healing,' 'Mindfulness and Storytelling,' 'Culture and Connectedness'); (4) addition of culturally aligned tips to the quit tips library (eg, 'Your existence is meaningful. Your presence matters. Your relatives need you.'); (5) imagery codeveloped with a native artist and (6) adding the word 'commercial' in front of the word 'tobacco' to clarify reference to commercial tobacco throughout original content. No functionality changes occurred.

The primary outcome was the number of times the app was opened over the 5 weeks, which was measured using objective app data and transferred to the investigators via a data-sharing agreement. Secondary outcomes included frequency of app use during the first week postrandomisation and following measures at 5 weeks: usability measured via the 10-item System Usability Scale (SUS; response options range from 0 to 100 and can be classified based on grade-based benchmarks[18]), and acceptability and fit of app with culture based on Likert-scale questions. Exploratory outcomes included 24-hour quit attempts, self-reported 24-hour, 7-day and 30-day abstinence, any use of pharmacotherapy for smoking cessation or other behavioural support (eg, quitline) as both are recommended in the app, assessment of saliva cotinine (<10 ng/mL) at 5 weeks for those with self-reported 7-day abstinence, and any other commercial tobacco product use as the app encourages quitting of all commercial tobacco.

Baseline characteristics were descriptively summarised. Likert-scale questions were converted to a numerical 1–5 scale. Negative binomial regression was used to investigate the effect of the condition. Secondary and exploratory outcomes were analysed using negative binomial, linear or logistic regression, adjusting for baseline outcome, if available. Estimates (incidence rate ratio (IRR) for negative binomial, mean difference (MD) for linear and OR for logistic) and 95% confidence intervals (CIs) were obtained. Fisher's exact test was used for some outcomes due to low cell counts. Adjusted models included covariates that differed between conditions using p<0.20 and investigator discretion. P values are two sided and a significance level of 0.05 was used. Statistical analyses were performed by using R (V.4.2.2, R Core Team).

RESULTS

Participants were randomised between December 2022 and September 2023. As shown in online supplemental figure 1, 116 individuals were randomised; however, 1 was incorrectly assigned the condition opposite their randomised condition and removed from analyses. Among the 115 participants, 43% (n=49) resided in the state of Minnesota, followed by 23% (n=27) and 17% (n=20) residing in South Dakota and Wisconsin, respectively. App usage data were available for all 115 participants. There was no difference by condition in the proportion of participants who completed the exit survey (93% vs 95%; p=0.717) or that returned their saliva sample within two weeks of their exit survey (60.3% vs 55.4%; p=0.642).

Online supplemental table 1 shows participant characteristics. QuitGuide for Natives versus QuitGuide condition had a lower mean response to the Likert-scale statement 'I have spent time trying to find out more about being AI such as its history, traditions and customs' (p=0.020), was on average older (p=0.063) and correspondingly had a longer average smoking duration (p=0.066).

As shown in table 1, no differences were observed in either unadjusted or adjusted analyses for the primary outcome frequency of app openings (mean: 15.3 vs 14.9; adjusted IRR (aIRR) 0.94 (95% CI 0.63 to 1.40); p=0.743) as well as the secondary outcome number of days using the app (mean: 11.3 vs 10.7 days; aIRR 1.00 (95% CI 0.71 to 1.40); p=0.990). Likewise, within the first 7 days postrandomisation, there were no differences in a number of times using the app or days using the app.

No differences were observed for the SUS (mean: 72.4 vs 71.9; adjusted MD (aMD) (p=0.801), 'helpfulness of the app in helping you quitting smoking' (p=0.341) or 'interest in using the app in the future if needed' (p=0.208).

Acceptability measure 'likeliness of recommending the app to a friend' was higher in the QuitGuide for Natives versus the control in unadjusted analyses (mean: 5.6 vs 4.9; unadjusted MD 0.64 (95% CI 0.02 to 1.26); p=0.043), but this difference was not significant in adjusted analyses (aMD 0.62 (95% CI −0.02 to 1.27); p=0.058). In both unadjusted and adjusted analyses, significant differences (ps<0.001) between QuitGuide for Natives versus the control were observed for all three cultural fit measures (eg, 'The app fits my American Indian culture…' (mean: 3.9 vs 3.1; aMD 0.75 (95% CI 0.35 to 1.16); p<0.001))'.

No differences were observed for the exploratory outcomes; however, the directionality suggests a signal for efficacy (online supplemental table 2). Mean number of 24-hour quit attempts was 6.6 and 5.1 in the QuitGuide for Natives versus QuitGuide condition, respectively (aIRR 1.25 (95% CI 0.79 to

Table 1 Primary and secondary outcomes

	All participants (N=115)	QuitGuide (N=57)	QuitGuide for Natives (N=58)	Unadjusted IRR*, mean difference† or OR‡ (95% CI)	P value	Adjusted§ IRR*, mean difference† or OR‡ (95% CI)	P value
Number of times using the app in 35 days, mean (SD)	15.1 (16.6)	14.9 (17.8)	15.3 (15.5)	1.03 (0.7 to 1.5)	0.897	0.94 (0.63 to 1.40)	0.743
Number of days using the app in 35 days, mean (SD)	10.7 (9.0)	10.1 (8.8)	11.3 (9.3)	1.11 (0.8 to 1.55)	0.518	1.00 (0.71 to 1.40)	0.990
Number of times using the app in first 7 days, mean (SD)	4.0 (4.4)	3.7 (3.6)	4.3 (5.1)	1.17 (0.82 to 1.67)	0.372	1.13 (0.78 to 1.64)	0.513
Number of days using the app in first 7 days, mean (SD)	2.7 (1.9)	2.6 (1.8)	2.8 (2.0)	1.08 (0.83 to 1.39)	0.575	1.01 (0.77, 1.32)	0.939
Systems Usability Scale,¶ mean (SD)	72.2 (14.4)	71.9 (13.3)	72.4 (15.6)	0.43 (–5.11 to 5.96)	0.878	0.73 (–5 to 6.46)	0.801
Overall, how helpful has the app been in helping you to quit smoking?¶ Mean (SD)	3.0 (1.1)	2.9 (1.2)	3.1 (1.1)	0.19 (–0.24 to 0.62)	0.392	0.22 (–0.23 to 0.66)	0.341
Did the app help you to make decisions that were supportive of quitting and staying quit?¶ Mean (SD)	2.9 (0.7)	2.9 (0.7)	3.0 (0.8)	0.11 (-0.17 to 0.39)	0.422	0.11 (-0.18 to 0.41)	0.449
Would you be interested in using the app in the future if needed?¶ Mean (SD)	3.4 (1.3)	3.2 (1.4)	3.6 (1.2)	0.37 (–0.11 to 0.86)	0.128	0.32 (–0.18 to 0.83)	0.208
How likely would you be to recommend the app to a friend?¶ Mean (SD)	5.2 (1.6)	4.9 (1.6)	5.6 (1.6)	0.64 (0.02 to 1.26)	0.043	0.62 (–0.02 to 1.27)	0.058
The app fits my American Indian culture such as its history, traditions and customs¶ mean (SD)	3.5 (1.1)	3.1 (1.1)	3.9 (0.9)	0.76 (0.38 to 1.14)	<0.001	0.75 (0.35 to 1.16)	<0.001
The app makes me feel more connected to my American Indian culture such as its history, traditions and customs¶ mean (SD)	3.2 (1.1)	2.8 (1.1)	3.7 (0.9)	0.90 (0.51 to 1.29)	<0.001	0.93 (0.52, 1.33)	<0.001

Continued

Table 1 Continued

	All participants (N=115)	QuitGuide (N=57)	QuitGuide for Natives (N=58)	Unadjusted IRR*, mean difference† or OR‡ (95% CI)	P value	Adjusted§ IRR*, mean difference† or OR‡ (95% CI)	P value
The app helped me learn more about my American Indian culture, such as its history, traditions and customs¶ mean (SD)	3.1 (1.1)	2.7 (1.2)	3.5 (1.0)	0.79 (0.38 to 1.2)	<0.001	0.78 (0.35, 1.22)	<0.001
Saliva returned within 2 weeks of exit survey,** n (%)	66 (57.9)	31 (55.4)	35 (60.3)	1.23 (0.58 to 2.6)	0.590	1.12 (0.51, 2.47)	0.771
Saliva returned by end of study, n (%)	79 (68.7)	38 (66.7)	41 (70.7)	1.21 (0.55 to 2.67)	0.642	0.99 (0.43, 2.27)	0.982

Response scales: Systems Usability Scale: 50–100; Overall, how helpful has the app been in helping you to quit smoking? (1) Not at all helpful, (2) slightly helpful, (3) moderately helpful, (4) very helpful, (5) extremely helpful. Did the app help you to make decisions that were supportive of quitting and staying quit? (1) Definitely no, (2) mostly no, (3) mostly yes, (4) definitely yes; Would you be interested in using the app in the future if needed? (1) Not at all interested, (2) slightly interested, (3) moderately interested, (4) very interested, (5) extremely interested; How likely would you be to recommend the app to a friend? (1) Extremely unlikely, (2) unlikely, (3) somewhat unlikely, (4) neither likely no unlikely, (5) somewhat likely, (6) likely, (7) extremely likely; the app fits my American Indian culture such as its history, traditions and customs; The app makes me feel more connected to my American Indian culture such as its history, traditions and customs; The app helped me learn more about my American Indian culture, such as its history, traditions and customs: (1) strongly disagree, (2) disagree, (3) neither agree or disagree, (4) agree and (5) strongly agree.
*Negative binomial regression was used with a main effect for treatment group.
†Linear regression was used with main effect for treatment group.
‡Logistic regression was used with main effect for treatment group.
§Adjusted for age and 'I have spent time trying to find out more about being American Indian such as its history, traditions and customs.
¶Among those who completed the exit survey, which was not completed among four in QuitGuide condition and three in QuitGuide for Native condition.
**Date of saliva return is missing for one participant, and therefore, unknown if this was within 2 weeks of exit survey.
IRR, incidence rate ratio.

1.98); p=0.349). Cotinine-confirmed 7-day abstinence was achieved by 6.9% vs 3.5% in the QuitGuide for Natives versus QuitGuide condition, respectively (OR 2.02 (95% CI 0.28 to 23.26); p=0.679). Due to the small number of participants who achieved cotinine-confirmed 7-day abstinence, adjusted analyses were not conducted. Any other commercial tobacco product use in the past 30 days was reported among 30.9% vs 49.1% in the QuitGuide for Natives versus QuitGuide condition, respectively (aOR 0.47 (95% CI 0.19 to 1.11); p=0.09).

DISCUSSION

A culturally aligned version of NCI's QuitGuide app for AI adults was cocreated with community partners. Specifically, QuitGuide for Natives was created through the addition of culturally relevant app pages, which promoted healing, learning about traditional tobacco and cultural connectedness, tracking of culturally relevant smoking triggers and culturally aligned quit tips and imagery.[16] This pilot trial found no difference in app usage or in usability when comparing the culturally aligned app to the general audience app. Results on acceptability and cultural fit outcomes, however, are promising. Furthermore, differences in 24-hour quit attempts and cotinine-confirmed 7-day abstinence may provide a signal for greater efficacy in the culturally aligned condition.

The observance that the primary outcome, app usage, did not differ by condition is potentially a reflection of usability. Specifically, in both conditions, the average SUS score reflects a 'C grade' on an A–F scale. Some members of our CAB experimented with the app and voiced that navigating the app was not as effortless or intuitive as newer apps (eg, TikTok). Given usability is a prerequisite for widespread uptake,[19] these findings underscore the need for apps like QuitGuide to continue to evolve so that they are as user-friendly as other apps on the marketplace.

A promising finding is that QuitGuide for Natives resulted in higher likeliness to recommend the app to a friend and significantly higher ratings across cultural fit measures. These data points suggest that QuitGuide for Natives is more aligned with AI cultures and worldviews than the general audience QuitGuide. The directionality of the exploratory outcomes provides a promising signal for QuitGuide for Native's efficacy. Specifically, QuitGuide for Natives versus the QuitGuide condition resulted in an average of 6.6 vs 5.1 24-hour quit attempts and 6.9% vs 3.5% of participants with a cotinine-confirmed 7-day abstinence. While these differences are not statistically significant, a twofold increase in abstinence provides justification for larger scale evaluation with the hypothesis that QuitGuide for Natives will be perceived as having greater cultural fit, and therefore, will drive smoking abstinence among AI adults to a greater extent than the general audience QuitGuide.

There are limitations to this study. First, results are not likely generalisable to AI adults who smoke from other and regional locations or those without a smartphone. Second, we are not able to assess which modifications to QuitGuide made QuitGuide for Natives a greater cultural fit. Third, there was no verification that the participants provided their own saliva sample or that they were smoking at baseline.

In conclusion, this CBPR study reflects the braiding together of western and Indigenous knowledge[20] and is a step towards reducing the number of AI lives lost due to smoking. Our findings

support the recommendation for cessation apps to keep pace in terms of usability with contemporary apps. The acceptability, cultural fit and efficacy findings for QuitGuide for Natives are encouraging and will be leveraged to inform larger-scale testing.

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Acknowledgements We would also like to thank our research participants and our CAB for their support and input throughout the life cycle of the research. CAB members included several coauthors as well as the following individuals: Ashley B. Cole, Jennifer Cash, Casey Dorr and Carol Hernandez.

Contributors DMC was primarily responsible for the literature review, methodology, identification of measures, data and funding acquisition, and drafting of the manuscript. DMC and WP jointly were responsible for overseeing day-to-day research activities and communicating regularly with community partners/sites. DJ and AS are community partners and were responsible for representing a recruitment site and provided guidance on all aspects of this research project. CC and AK were responsible for day-to-day activities of the study (eg, enrolment, follow-up). AE trained staff and oversaw all regulatory requirements. KT created the statistical analysis plan and conducted the analyses. All coauthors reviewed and approved of this manuscript.

Funding This research was funded by the National Cancer Institute of the National Institutes of Health grant number R21CA261078 (to DMC) and the National Institute on Minority Health and Health Disparities of the National Institutes of Health, grant number K01MD014795 (to DMC). Research was also supported by the Minnesota Cancer Clinical Trials Network. All statistical analyses were carried out in the Biostatistics Shared Resource of the Masonic Cancer Center, supported in part by National Cancer Institute Cancer Center Support grant P30CA077598. REDCap (Research Electronic Data Capture) services were provided by grant UM1TR004405 from the National Center for Advancing Translational Sciences of the National

Competing interests No, there are no competing interests.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and was approved by University of Minnesota IRB STUDY00016190 and by the representatives of the community partners. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

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Supplementary Table 1. Socio-demographics, smoking history, and cultural identity

Variable	All (N=115)	QuitGuide (N=57)	QuitGuide for Natives (N=58)
Age, Mean (SD)	43.1 (11.4)	41.1 (10.5)	45.1 (11.9)
Sex, n (%)			
Female	86 (76.8%)	41 (73.2%)	45 (80.4%)
Male	26 (23.2%)	15 (26.8%)	11 (19.6%)
Race, n (%)			
American Indian only	103 (89.6%)	51 (89.5%)	52 (89.7%)
American Indian and another racial group	12 (10.4%)	6 (10.5%)	6 (10.3%)
Ethnicity, n (%)			
Not Hispanic/Latino	111 (97.4%)	55 (96.5%)	56 (98.2%)
Hispanic/Latino	3 (2.6%)	2 (3.5%)	1 (1.8%)
Education, n (%)			
No college	49 (42.6%)	24 (42.1%)	25 (43.1%)
Some college or more	66 (57.4%)	33 (57.9%)	33 (56.9%)
Used tobacco for ceremonial prayer or in a sacred way, n (%)			
Earlier today	15 (13.0%)	6 (10.5%)	9 (15.5%)
24 hours ago	8 (7.0%)	5 (8.8%)	3 (5.2%)
2-7 days ago	17 (14.8%)	11 (19.3%)	6 (10.3%)
8-30 days ago	17 (14.8%)	10 (17.5%)	7 (12.1%)
Over 30 days ago	43 (37.4%)	17 (29.8%)	26 (44.8%)
Never	15 (13.0%)	8 (14.0%)	7 (12.1%)
I plan on trying to find out more about my American Indian culture, such as its history, traditions, and customs (Response: Yes), n (%)	110 (95.7%)	55 (96.5%)	55 (94.8%)
I have spent time trying to find out more about being American Indian such as its history, traditions, and customs, Mean (SD)	3.6 (0.6)	3.7 (0.5)	3.4 (0.7)
I identify with American Indian culture, Mean (SD)	3.8 (0.4)	3.9 (0.4)	3.8 (0.4)
American Indian culture is a big part of my daily life, Mean (SD)	3.4 (0.7)	3.4 (0.8)	3.4 (0.7)
American Indian identity score, Mean (SD)	3.6 (0.5)	3.6 (0.6)	3.6 (0.5)
Cigarettes smoked per day, Mean (SD)	12.9 (7.1)	12.4 (7.0)	13.4 (7.1)
Smoking duration (years), Mean (SD)	25.6 (11.7)	23.6 (10.0)	27.6 (12.9)
Quit contemplation ladder, Mean (SD)	6.5 (1.4)	6.5 (1.4)	6.6 (1.4)
FDA-approved cessation medication use (NRT or prescription) in the past 30 days, n (%)	27 (23.5%)	12 (21.1%)	15 (25.9%)
Any other commercial tobacco use[1] in the past 30 days, n (%)	67 (58.3%)	35 (61.4%)	32 (55.2%)

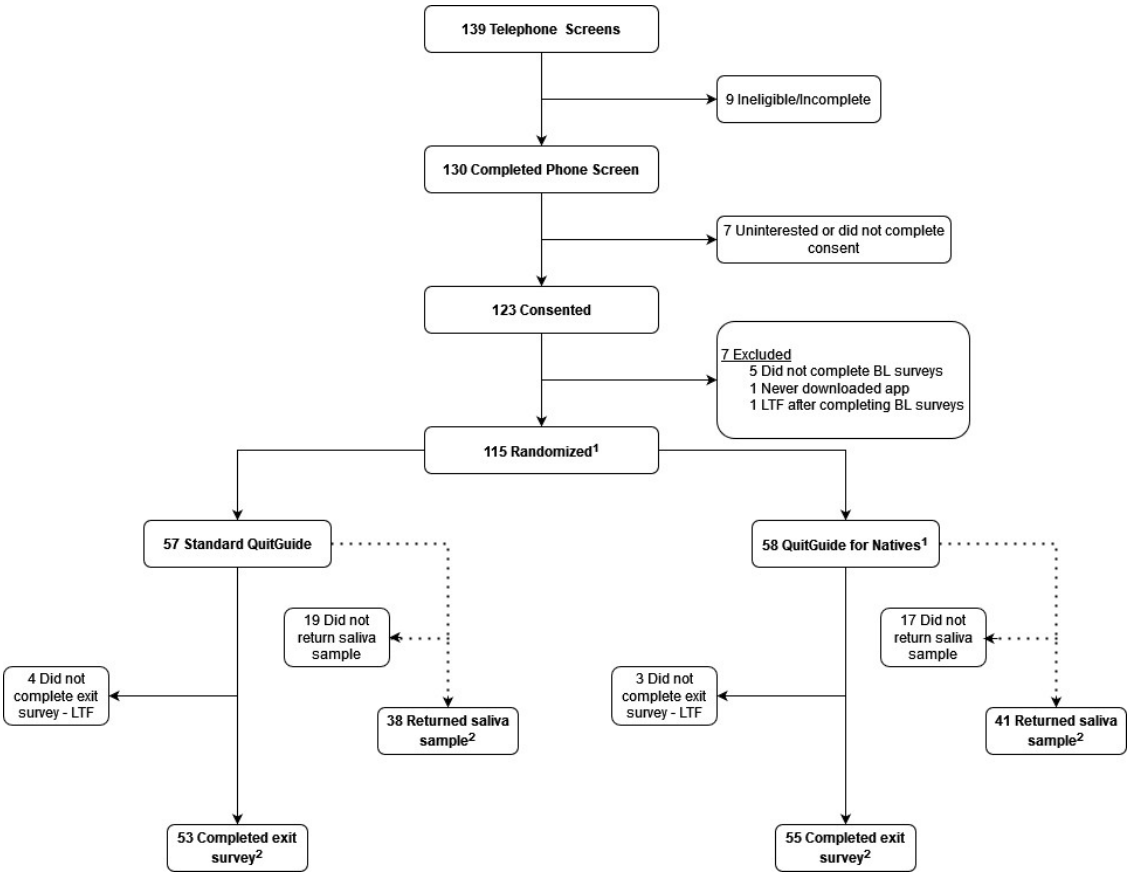
1: Includes e-cigarettes, smokeless tobacco and snus, cigars/cigarillos/little cigars

Supplementary Table 2. Exploratory Outcomes

	All randomized participants (N=115)	**QuitGuide (N=57)**	**QuitGuide for Natives (N=58)**	**Unadjusted IRR[1] or OR[2] (95% CI)**	**P-value**	**Adjusted[3] IRR[1] or OR[2] (95% CI)**	**P-value**
Number of 24-hour quit attempts,[4] Mean (SD)	5.9 (7.5)	5.1 (7.0)	6.6 (7.9)	1.29 (0.83, 2.02)	0.258	1.25 (0.79, 1.98)	0.349
Self-reported 24-hour abstinence,[5] n (%)	65 (56.5%)	31 (54.4%)	34 (58.6%)	1.19 (0.57, 2.5)	0.647	1.06 (0.48, 2.3)	0.891
Self-reported 7-day abstinence,[5] n (%)	25 (21.7%)	12 (21.1%)	13 (22.4%)	1.08 (0.44, 2.66)	0.86	1.05 (0.41, 2.69)	0.911
CO-confirmed self-reported 7 day abstinence,[4,5] n (%)	6 (5.2%)	2 (3.5%)	4 (6.9%)	2.02 (0.28, 23.26)	0.679	-	-
Self-reported 30-day abstinence,[5] n (%)	7 (6.1%)	3 (5.3%)	4 (6.9%)	1.33 (0.28, 7.04)	0.715	1.29 (0.24, 7.21)	0.762
FDA-approved cessation medication use (NRT or prescription) in past 5 weeks,[4] n (%)	25 (23.1%)	14 (26.4%)	11 (20.0%)	0.61 (0.23, 1.57)	0.307	0.53 (0.18, 1.44)	0.222
Other behavioral support in past 5 weeks,[4] n (%)	12 (11.1%)	11 (20.8%)	1 (1.8%)	0.07 (0, 0.53)	0.002	-	-
Any other commercial tobacco use in past 30 days,[6] n (%)	43 (39.8%)	26 (49.1%)	17 (30.9%)	0.45 (0.19, 1.02)	0.06	0.47 (0.19, 1.11)	0.09

[1]For number of 24-hour quit attempts, this was based on the questions 'Think back on the entire time you were asked to use the app-which has been the past 5 weeks. During this time did you try to quit smoking completely, even if you made it less than one day?' and 'If yes, when you were trying to quit smoking, how many times were you able to stop smoking for one day or longer?'. Negative binomial regression was used with main effect for treatment group; [2]Logistic regression was used with main effect for treatment group, and adjusted for baseline value of each outcome, if available. Due to low cell counts, Fisher's exact test was used for some outcomes. [3]Adjusted for age, 'I have spent time trying to find out more about being American Indian such as its history, traditions, and customs' and baseline outcome if available; [4]Among those who completed the exit survey, which was not completed among 4 in QuitGuide condition and 3 in QuitGuide for Native condition; [5]Imputed as not abstinent for those who did not complete the exit survey. [6]Includes e-cigarettes, smokeless tobacco and snus, cigars/cigarillos/little cigars, hookah.

Supplementary Figure 1. Recruitment, Randomization, and Retention of Participants



[1] One participant was randomized to the QuitGuide for Natives group, but was incorrectly instructed to download the Standard QuitGuide app. They were lost to follow up prior to the scheduled exit survey and their data was excluded from the randomization count and final analyses.

[2] Saliva samples and exit surveys were separate steps of the study. Participants may be represented in one, both or neither of the groups, hence the totals exceeding that of their randomization group.