Highjack: A Novel Method to Smoking Cessation in College Students

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Abstract: Highjack, an innovative smoking cessation solution, will combine a less harmful herbal inhalation device with a personalized, AI-powered mobile app. This approach will address the physiological and psychological aspects of nicotine addiction while minimizing the risks associated with traditional smoking. The app will track usage patterns, enabling Fema, a personalized AI assistant, to proactively intervene with tailored stress-relief suggestions across four categories: movement, laughter, socializing, and mindfulness. This multi-pronged intervention aims to reduce reliance on the herbal device over time, fostering healthier coping mechanisms and promoting sustainable smoking cessation. This research will investigate Highjack efficacy in reducing smoking frequency, enhancing user engagement, and supporting long-term behavioral change within a high-risk population.

I.   Motivation

The prevalence of tobacco and e-cigarette use among college students represents a significant public health concern with multifaceted implications. Despite advancements in tobacco control policies and increasing awareness of associated health risks, the college environment remains a hotspot for tobacco and e-cigarette experimentation and continued use. This is a significant public health concern, not only due to the immediate health risks associated with tobacco use, but also because of the potential development of chronic illnesses like cancer, heart disease, and lung disease later in life [1] .The rise of e-cigarette use among college students presents a particularly alarming trend. Often perceived as less harmful than traditional cigarettes, e-cigarettes can serve as a gateway to nicotine addiction, increasing the likelihood of transitioning to combustible tobacco products [2]. This exacerbates the health risks for young adults, setting the stage for a lifetime of battling addiction and potentially devastating long-term health consequences. Smoking cessation programs among college students include tobacco cessation programs, motivational interviewing, text message-based interventions, and targeted marketing and treatment programs. These efforts aim to increase students' readiness to quit, enhance their smoking cessation self-efficacy, and ultimately reduce the prevalence of tobacco and e-cigarette use on college campuses [2,3].

The use of new technology, such as mobile apps and text message-based interventions, has shown promise in supporting smoking cessation efforts among college students. Research has indicated that interventions based on the internet, software, mobile phones, and other electronic tools increase the likelihood of quitting tobacco and the number of cessation attempts[5] [6].

II.   Prior related work

Modern technology empowers smokers with innovative tools to support their cessation journey. Various technological interventions have been developed to aid in this process, spanning smartphone apps, just-in-time adaptive interventions (JITAIs), and digital games. The Smart-T2 app, in particular, offers a highly tailored and intensive intervention at a reduced cost compared to traditional counseling. This app utilizes algorithms to customize intervention content in real time, providing a dynamic and personalized support system [7]. A comprehensive systematic review and meta-analysis provides compelling evidence for the effectiveness of smartphone app-based interventions in smoking cessation. These interventions demonstrate the potential to significantly increase cessation rates, offering advantages such as ease of use, visual information delivery, and scalability [8]. AI-powered smoking cessation apps like Quit Sense provide targeted support to help users manage specific triggers associated with these locations [9]. Another study outlines a randomized controlled trial protocol for evaluating the effectiveness of a personalized smoking cessation intervention based on ecological momentary assessment (EMA) for smokers who prefer unaided quitting. This study discusses the intervention of EMA used to document all smoking triggers and smoking-related behaviors [8]. These technological interventions represent a significant advancement in augmenting traditional smoking cessation methods by providing tailored, accessible, and engaging support for individuals seeking to quit smoking [10] .

The integration of modern technology with established behavioral models, such as the Health Belief Model (HBM), enhances the effectiveness of smoking cessation efforts. The HBM is a widely used framework for understanding and predicting health-related behaviors, including smoking cessation [11] . The HBM posits that individuals are more likely to take health-related action if they perceive themselves to be susceptible to a particular health problem, understand the severity of the consequences, recognize the benefits of taking action to reduce the risk, and perceive few barriers to taking that action [12]. When applied to smoking cessation, the model considers various factors such as demographic variables, personality traits, and psychological factors, including perceived susceptibility to illness, perceived benefits of quitting, and cues that can influence smoking behavior . Research has shown significant connections between the components of the HBM and the intention to quit smoking,

particularly among specific populations such as female smokers. The model's appeal lies in its simplicity and its ability to account for individual and situational differences, making it a valuable tool for understanding and addressing smoking cessation efforts [10 , 12]. A systematic review uses the health belief model as a framework, examines the perceptions of smoking youths regarding addiction and health risks associated with tobacco cigarettes [14].

Highjack, our proposed smoking cessation intervention product, addresses key aspects of the HBM for college students who smoke, specifically cue to action, perceived barriers and self efficacy. Highjack subtly communicates the risks of chronic nicotine use, redirects users to alternative stress relief methods, displays visualizations of smoking habits and health data to users, builds community and support around smoking cessation, and provides relief for nicotine withdrawals. This comprehensive approach fosters long-term success in quitting smoking while empowering users to manage stress without nicotine.

III.   Solution and innovation

Highjack is a multifaceted smoking cessation solution designed specifically for college students. It integrates two core components: a nicotine-free and marijuana-free herbal inhalation device (often termed a "fake vape") and a mobile app powered by a generative AI companion. The herbal blend, including options like chamomile, hops, mullein, damiana, and passionflower, aims to mitigate withdrawal symptoms, such as appetite and sleep disturbances, potentially easing the cessation process [15]**.** Additionally, the device seeks to mimic aspects of the smoking experience, facilitating a smoother behavioral transition. The AI component provides personalized stress-relief support, aiming to reduce reliance on the herbal device over time and promote the development of healthier coping mechanisms.

Upon using the herbal vape device, the Highjack app launches, introducing users to Fema, a voice-activated AI assistant powered by LLMs like GPT-4. A voice-activated interface offers a more interactive and accessible experience than a traditional chatbot, potentially increasing engagement for users who might be less inclined to navigate menus independently. Fema provides empathetic, non-judgmental support, prompting the user to select from four distinct stress relief methods: movement, laughter, socializing, and mindfulness. Research suggests that conversational AI interventions, including chatbots, can effectively support smoking cessation, demonstrating positive outcomes and high user acceptance**.**[16] Personalized messages sent through AI-driven systems

proved significantly more effective in smoking cessation by targeting individual behaviors and motivations, enhancing engagement and outcomes compared to generic messages [16].

Movement as a stress relief option can include the following: guiding the user to a mood-boosting location, suggesting an outdoor walk, providing an enjoyable workout routine, prompting specific forms of movement, or playing music the user loves for dancing. Laughter options could involve directing the user to content they find funny, showing humorous videos from social media, suggesting playful activities, delivering tailored jokes, or prompting a call to someone who makes them laugh. For socializing, the app might suggest events of interest to the user, encourage a call to a supportive individual, highlight hobbies with potential communities, advertise volunteering opportunities, display cherished photos, or suggest reaching out for professional support. Mindfulness options could include playing soothing sounds, accessing spirituality apps, reminding the user of grounding practices, or guiding them through meditation and breathing exercises. The purpose of these activities is to replace the smoking habit with healthier alternatives that closely mimic the behavioral patterns of addiction. This "habit hijacking" offers a realistic cessation tool with the convenience and repetitive actions associated with smoking, but without the harmful nicotine intake.

Highjack would gather data from various sources on the user's device to personalize interventions. This could include data from social media, messaging apps, calendars, fitness apps, and music preferences. Users could opt to rely solely on information they directly provide to Fema, in which case the app would tailor suggestions for movement, laughter, mindfulness, and socializing based on those interactions and user feedback. Recognizing the importance of support in smoking cessation, the Highjack platform would incorporate features designed to foster community and provide encouragement. This would include achievement badges for milestones, redeemable rewards (potentially through university partnerships), progress tracking tools with visual goal setting, and a virtual community. This community would allow users to connect, share experiences, find accountability, and receive real-time support, particularly during vulnerable moments when relapse risk is high.

IV.   Design of the solution

Herbal Vape Component

Highjack will resemble a familiar e-cigarette/vape form factor for ease of use, while featuring robust materials for everyday carry. The carefully formulated herbal blend, including herbs like chamomile,

hops, mullein, damiana, and passionflower. These herbs are traditionally known for their calming properties and potential to mitigate withdrawal symptoms, including sleep disturbances, which are common during smoking cessation. The device will produce a light, non-intrusive vapor and may offer subtle flavoring to enhance the behavioral transition away from traditional smoking.

Highjack Mobile App:

The Highjack mobile app prioritized an intuitive, visually appealing interface with progress tracking features, including graphs and charts, provided visual motivation. At the heart of the app was Fema, the AI assistant, offering empathetic, supportive conversations that adapted to the user's preferences over time. To combat stress, the app offered diverse relief activities: movement suggestions (location-based, guided workouts, dance-along music), curated humor for laughter, socializing prompts (events, support groups, reminders to connect with friends), and mindfulness tools (guided meditations, breathing exercises, calming sounds).

Data Collection & Analysis:

The app collects usage patterns and location data (with consent) to understand the user's smoking habits. Machine learning algorithms utilizes this data to identify high-risk moments, enabling the app to provide timely personalized interventions. To foster motivation, a community and rewards system was implemented, featuring achievement badges, gamification through a points system, and a virtual community for peer support.

V.   **Empirical Assessments and Plans**

A.   *Testing/evaluation plan*

To evaluate the effectiveness of Highjack, a randomized controlled trial (RCT) will be conducted, recruiting participants from college campuses via flyers, email invitations, and university social media announcements, targeting individuals interested in smoking cessation and stress relief. To ensure sufficient statistical power, a power analysis was conducted, determining a required sample size of 36 participants, based on an expected medium effect size (Cohen's d = 0.5), a desired power level of 0.80, and a significance level (alpha) of 0.05. Considering potential dropouts or incomplete data, the aim is to

recruit a total of 40 participants. Inclusion criteria encompass college students aged 18 and above who are current smokers or recent ex-smokers, while exclusion criteria include individuals with significant health issues. Participants will be randomly assigned to either the intervention group, receiving access to Highjack and its accompanying app, or the control group, which will receive standard smoking cessation resources such as nicotine replacement therapy and counseling. Compensation in the form of gift cards will be provided. These research questions and hypotheses will guide our study :

B.   *Research questions*

   a. What is the effectiveness of personalized stress relief interventions, optimized by ML algorithms, in improving smoking cessation outcomes?
   b. What factors influence long-term success in smoking cessation?
   c. How do different demographics of participants engage with each stress relief method?
   d. Does a participant's preferred method of smoking affect their experience and usage of Highjack as a smoking cessation tool?
   e. Can continued use of Highjack over time lead to addiction transfer or reliance on alternative stress relief methods?
   f. How does the herbal extract inhaled by the user impact lung health compared to previous smoking habits?

C.   *Hypothese*

   a. Personalized stress relief interventions will result in a decrease of nicotine dependency over time.
   b. Demographic factors such as age, socioeconomic status, type of nicotine addiction, gender, race, ethnicity and Highjack hardware of preference for smoking cessation will influence the long-term success in smoking cessation.
   c. Stress relief method preferences will be influenced by demographic data.
   d. Participants who smoke nicotine primarily through vapes will have different user experience with Highjack than participants who smoke nicotine through tobacco products with marijuana or hookah.
   e. Participants will not become addicted to alternative stress relief methods or the herbal substitute.
   f. Participant's lung health will experience less physiological harm compared to frequent inhalation of nicotine and participant's diet and sleep will be improved.

D.   *Measures*

Baseline assessments would be conducted to collect demographic information , smoking history, nicotine dependence levels, and current stress levels . Follow-up assessments would be scheduled at regular intervals (e.g., 3 months, 6 months, and 12 months) to evaluate changes in smoking behavior, stress levels (Table 1).

Characteristics, Smoking Factors and Stress Levels	Category	Data Collection Timeline
Demographic		
Age		
Gender	Male Female Non-Binary Other	
Education level	High School Some college Bachelor's or equivalent Some graduate education Master's or equivalent	Baseline
Smoking Factors		
Initiation age of smoking		
Vape smoking frequency		
Cigarette smoking frequency		
Hookah smoking frequency		
Cigar smoking frequency		
Marijuana smoking frequency		
Quit smoking	Yes No	
Re-starting smoking	Yes No	
Reason for re-starting smoking	Stressful incident General stress Environmental impact Inability of continuing the treatment Lack of motivation	
Fagerström score [17]		
How soon after you wake up do you smoke your first cigarette (minutes)?		
Do you find it difficult to refrain from smoking in a place where it is forbidden?		
How often do you smoke?		Baseline 3-Months 6-Months 9-Months 12-Months
Do you smoke more frequently during the first hours after waking than the rest of the day?		
Do you smoke even if you are so ill that you are in bed most of the day?		
Perceived Stress Scale [18]		

To evaluate participants' engagement with the Highjack app and their satisfaction with the intervention, we will employ a combination of user surveys and app usage analytics. Through the System Usability Scale (SUS) questionnaire[19] , we will gather insights into various aspects of participants' interaction with the app. Additionally, we will utilize app usage analytics to track objective metrics such as the frequency of logins, duration of sessions, specific features used, progress tracking behaviors, interactions with support resources, and changes in engagement over time.

VI.   Analysis

For the analysis phase of the study evaluating the effectiveness of Highjack in smoking cessation among college students, several key approaches will be employed. Descriptive statistics will first be utilized to provide a comprehensive overview of participant demographics and smoking-related factors. This will include summarizing demographic characteristics such as age, gender, and education level, along with smoking behaviors such as initiation age, cigarettes smoked per day, and quit attempts, including reasons for relapse. Additionally, the distribution of Fagerström scores and Perceived Stress Scale scores will be presented at baseline and at each follow-up assessment time point.Following this, comparative analyses will be conducted to assess baseline equivalence between the intervention and control groups, ensuring randomization effectiveness. This will involve independent t-tests or chi-square tests as appropriate for continuous or categorical variables, respectively. Moreover, demographic differences between successful quitters and non-quitters would be explored.

To examine changes in smoking behavior and stress levels over time within each group, repeated measures ANOVA or non-parametric alternatives will be employed if assumptions are violated. Engagement metrics between intervention and control groups will also be compared using appropriate statistical tests.Outcome analysis will focus on evaluating the success rate of smoking cessation using logistic regression or survival analysis techniques, considering time to relapse as an outcome. The impact of the Highjack intervention on smoking cessation outcomes will be assessed while controlling for potential confounders such as demographic factors and baseline smoking characteristics.

Subgroup analyses will explore whether the effectiveness of Highjack varies across different demographic groups using interaction terms in regression models or subgroup analyses. Longitudinal analysis will involve examining the trajectory of smoking behavior and stress levels over the follow-up period using growth curve modeling or mixed-effects models.

Furthermore, predictors of long-term success in smoking cessation will be investigated using survival analysis techniques. If applicable, mediation or moderation analysis will explore potential mediators or moderators of the relationship between the intervention and smoking cessation outcomes using appropriate techniques such as bootstrapping or interaction tests. These analyses will provide a comprehensive understanding of the effectiveness of Highjack and its impact on smoking cessation outcomes among college students.

VII.   Scientific significance

Highjack's proposed approach to smoking cessation holds significant scientific value due to its focus on addressing a persistent public health challenge through innovative means. While herbal-based products cannot claim to fully eliminate the harm associated with inhalation, they offer a potential path for risk reduction compared to conventional smoking and vaping. By combining a potentially safer inhalation alternative (herbal) with AI-powered, personalized stress management, Highjack targets both the physical and psychological aspects of nicotine addiction. Based on existing research, specific herbs may mitigate the intensity of nicotine withdrawal symptoms and offer some temporary satisfaction, potentially aiding in cessation success[20 , 21].

Despite the inclusion of herbs, any form of inhalation carries inherent risks[22]. Highjack aims to mitigate these effects by utilizing machine learning algorithms to predict moments of high vulnerability in users, proactively offering AI-driven interventions . This model, emphasizing habit replacement and harnessing technology for behavioral support, could offer valuable insights into the efficacy of herb-based interventions, the potential of AI for personalized support, and the mechanisms underlying successful long-term habit modification.

VIII.   Societal significance

The development of a multifaceted smoking cessation device that integrates a targeted herbal blend with a generative AI-based stress management intervention offers a novel and potentially impactful approach. There has been a significant increase in vaping among American teens, with 37.3% of 12th graders reporting usage in the past year, up from 27.8% in 2017. This represents a 78% increase among high school students to 3.6 million (about 21% of all U.S. high school students) and a 48% rise among middle school students[23]. To address this challenge, the device aims to mitigate the negative physiological side effects of withdrawal, provide accessible cues for healthier stress relief, and offer a potential mood enhancement substitute. While studies have explored herbal remedies for symptom management and psychological theory supports "habit hijacking," there remains a crucial gap in research.

Highjack's integrated approach, combining herbal inhalation with an immediately accessible, AI-driven stress management capability, aims to assist in the cessation of smoking intentions. Device has the potential to address both the physical and psychological aspects of nicotine addiction.Integrating movement, laughter, socializing, and mindfulness as stress relief interventions, generative AI can tailor these activities to individual preferences, creating personalized routines that promote relaxation and

well-being [24]. However, developing this solution requires careful consideration of ethical implications, the risks associated with any form of inhalation, and thorough evaluation methods to assess its efficacy. Understanding these complexities is essential for determining the true societal impact and potential benefits of this approach for smoking cessation.

Ethical considerations

This study addresses several crucial ethical considerations.Participants must be fully informed about the study's objectives, procedures, potential risks and benefits, and their right to withdraw at any time. This transparency extends to the use of artificial intelligence (AI) in the Highjack app and data collection processes. Participants should understand how their data will be used, stored, and anonymized to ensure confidentiality. Additionally, the study protocol must be reviewed and approved by an Institutional Review Board (IRB).

Risks and Limitations of the Solution

While herbal inhalation poses less risk than nicotine, it's important to acknowledge and minimize potential harm. Long-term effects of regular herbal inhalation are not fully understood and could include respiratory irritation or dependence. Highjack addresses this by employing machine learning algorithms to predict moments of high vulnerability, proactively offering stress-relief alternatives through Fema. While this personalized approach aims to reduce reliance on the herbal device, it's important to note that the AI's predictions may not be perfect. Additionally, users should be informed about the potential for habit transfer, where reliance on the herbal vape could replace nicotine dependence.

IX.   Future Scope

Highjack envisions a comprehensive ecosystem to support smokers at every stage of their cessation journey. To meet users where they are, the system will expand beyond the herbal vape component to include vape mods and lighters. These devices will serve as data collection points, sending signals to the Highjack app upon use. This allows Fema to continue offering personalized interventions even if the user isn't fully ready to quit nicotine. The expanded data set will enhance the AI's ability to predict high-risk moments, optimize stress-relief suggestions, and support the user's progress towards their goals, whether that involves immediate or gradual nicotine reduction.

X.   References

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