Facial-Aging Apps in HIV+ Patient Waiting Rooms for Smoking Cessation: Does Public Morphing Trigger Quitting? - Interventional Study

Dr. Titus J. Brinker, MD\textsuperscript{1,2,3*}; Dr. Christian M. Brieske, MD\textsuperscript{2}; PD Dr. Stefan Esser, MD\textsuperscript{2}, MD; Prof. Dr. Joachim Klode, MD\textsuperscript{2}; Prof. Dr. Werner Seeger\textsuperscript{4}, Prof. Dr. Alexander H. Enk, MD\textsuperscript{3}; Prof. Dr. Christof von Kalle, MD\textsuperscript{1}; Richard F. Schlenk, PhD\textsuperscript{5}; Prof. Dr. Dirk Schaadendorf, MD, PhD\textsuperscript{2}

1. *Corresponding author: Dr. Titus J. Brinker, MD, National Center for Tumor Diseases, Department of Translational Oncology, German Cancer Research Center, Im Neuenheimer Feld 460, 69120 Heidelberg, Germany; TEL: +4915175084347, E-Mail: Titus.Brinker@nct-heidelberg.de
2. University Hospital Essen, Hufelandstr. 55, 45122 Essen, Germany; TEL: +492017234342
3. Department of Dermatology, University Hospital Heidelberg, University of Heidelberg, 69120 Heidelberg, Germany
4. Department of Internal Medicine, Universities of Giessen and Marburg Lung Center (UGMLC), member of the DZL, Justus Liebig University, Giessen 35392, Germany.
5. National Center for Tumor Diseases, Trial Center, German Cancer Research Center, Im Neuenheimer Feld 460, 69120 Heidelberg, Germany

Abstract
Background
Addressing tobacco use in healthcare settings has a strong evidence base. However, only a minority of smokers receive cessation advice when visiting a hospital. Especially HIV-positive patients have a high smoking prevalence and are more vulnerable for associated disease. Repurposing waiting time for smoking cessation via photoaging technology integrated in waiting rooms might be a game changer, as it has the potential to passively expose almost all patients visiting the hospital without preluding physician-action needed.

Objective
To repurpose waiting time by the means of new technology implemented in patient waiting rooms.

Methods
To test our idea, we made use of the waiting room of our HIV outpatient clinic and developed a kiosk version of our 3D-facial-aging app “Smokerface”. A tablet with a facial-aging app running was placed on a table in the middle of the waiting room of our HIV outpatient clinic and connected with a large monitor hanging on the opposite wall. An interviewer counted all patients and initiated app use if they would not initiate it themselves after 30 seconds of waiting time.

Results
464 patients visited the waiting room in 19 days, 187 tried the app and 179 filled out a questionnaire. 55/67.9% of smokers said the intervention motivated them to quit (male=45/68.2%; female=10/66.7%); 41/51.3% said it motivated them to discuss quitting with their doctor (m=32/49.2%; f=9/60.0%) and 72/91.1% perceived the intervention as fun (m=57/90.5%; f=15/93.8%). 92/97.9% of non-smokers said it motivated them to remain abstinent (m=72/98.6%; f=20/95.2%).

Conclusions
Facial-aging apps implemented in waiting rooms provide a novel opportunity to motivate the majority of patients visiting a healthcare provider to quit smoking, to remain abstinent and to address quitting at their subsequent appointment and thereby encourage physician-delivered smoking cessation.
**Introduction**

Addressing tobacco use in healthcare settings has a strong evidence base [1-11]. However, only a minority of smokers receive cessation advice when visiting a hospital [12, 13] with the reasons for this known to be versatile and hard to change [14]. Especially HIV-positive patients have a high smoking prevalence [15], are more vulnerable for associated disease [16-19] and effective interventions remain scarce [20-29].

Facial-aging interventions, in which a selfie is altered to predict future appearance, indicated effectiveness in different behavioral change settings [30-47] mainly due to the high importance of appearance on a persons’ self-concept [48].

In smoking cessation, a randomized trial by Burford et al. demonstrated an increased six months abstinence in 18-30-year-old adults by the help of a 2D-facial-aging desktop program (27.5% vs. 6.3% for controls) [49]. However, the photographs were captured requiring the time of another person, are not freely available and do not address the poor initiation of guideline-recommended smoking cessation by doctors [50].

Repurposing waiting time for smoking cessation via photoaging technology has the potential to become a game changer, as it is able to passively expose almost all patients visiting the hospital without preluding action by the physician needed.

**Methods**

To test our idea, we made use of the waiting room of our HIV outpatient clinic and developed a kiosk version (Fig. 1) of our 3D-facial-aging app “Smokerface” [51].
Figure 1: Start screen of the kiosk version of our facial-aging app “Smokerface”, ran on an iPad (iOS).

A tablet with the kiosk-version of the facial-aging app running was placed on a table.
in the middle of the waiting room of our HIV outpatient clinic and connected with a large monitor hanging on the opposite wall (Fig. 2).

Figure 2. Set-up of the facial-aging intervention in the waiting room of our HIV outpatient clinic; after homescreen: “Tap ‘Start’ to see how smoking affects your face!”; original set-up was in German language.

An interviewer counted all patients visiting the waiting room estimating age, gender and measuring their total waiting time. The interviewer also encouraged all patients visiting the clinic to try the app (Fig. 3a/b) if they would not do so themselves after 30 seconds of waiting time per standardized protocol. All participants were asked to fill out a pretested anonymous paper pencil questionnaire measuring their perceptions
of the intervention, smoking status and sociodemographic data.
Fig. 3a/b 9 years of aging without/with smoking a pack a day (screenshot taken from the iPad directly).
Results

Levels of participation
464 patients were counted in a waiting room over 19 days (male=365/78.7%). 358/77.16% of the participants were encouraged to try the app after 30 seconds of entering; n=34/7.33% tried it themselves within 30 seconds of entering; the remaining 72/15.51% did not enter the room or waited for less than 30 seconds. 187 patients tried the app and 179 agreed to fill out a questionnaire thereafter (male=139/79.0%; smokers=84/46.9%; median age=42; range=23-76 years). 102/21.98% watched another patient without trying it themselves, so a total of n=289/62.28% of the 464 patients were exposed to the intervention (average waiting time=21 minutes).

Overall perceptions of the intervention
55/67.9% of smokers said the intervention motivated them to quit (male=45/68.2%; female=10/66.7%); 41/51.3% said it motivated them to discuss quitting with their doctor (m=32/49.2%; f=9/60.0%) and 72/91.1% perceived the intervention as fun (m=57/90.5%; f=15/93.8%). 92/97.9% of non-smokers said it motivated them to remain abstinent (m=72/98.6%; f=20/95.2%).

Other people in the waiting room when the app was tried
In 30/17% of cases, only the interviewer was in the room. 1-3 other people (plus the interviewer) were in the room in 86/48.9% of cases, 4-6 people in 56/31.8% of cases and 7-10 people in 3/1.7% of cases (and in one case more than 11 other people).

Reactions (Only for those with at least one other person plus the interviewer in the room): How did the other people in the room react to your public selfie?

<table>
<thead>
<tr>
<th>Likert 1-2 (totally false/false)</th>
<th>Tried the app themselves</th>
<th>Quitting was a topic afterwards</th>
<th>I was encouraged to quit / stay non-smoker</th>
<th>They were astonished</th>
<th>The reactions were very strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients</td>
<td>84 / 63.6% vs. 48 / 36.4%</td>
<td>61 / 44.2% vs. 77 / 55.8%</td>
<td>70 / 55.6% vs. 56 / 44.4%</td>
<td>81 / 61.4% vs. 51 / 38.6%</td>
<td>90 / 68.7% vs. 41 / 31.3%</td>
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In summary, Table 1 reveals that prior app-use appears to initiate sequential app-use in a considerable fraction of cases (48/36.4%) and appears to initiate a discussion on quitting in the waiting room in the majority of cases (55.8%) and even more so when smokers use the app (64.1%). 59.3% are encouraged to quit by their environment after using the app (Table 1) which appears to be often accompanied by quit advice (54.8%; Table 2).

*How did you perceive those reactions? (Only for those with at least one other person plus the interviewer in the room)*

The reactions to the intervention were largely perceived as helpful (70.2% of cases for smokers and 63.4% for non-smokers), motivating to quit (61.2%=smokers; 78.4%=non-smokers) and even entailed quit advice (54.8%). However 15/9.8% of smokers and 19/17% of non-smokers received no reactions at all.

*Sensitivity Analysis*
Within 19 days, 289 patients were exposed in one waiting room which amounts to ~5,500 patients per waiting room per year and to 176,000 patients/year if implemented in all 32 waiting rooms at our University Hospital in Essen. Assuming the prospective effects measured by Burford et al. for 18-30 year old young adults (=21.2% of patients quit) can be transferred to this intervention and assuming a smoking prevalence of ~30% in these patients, ~11,000 smoking patients would quit per year. In our sample, the median age was 42 years, meaning 9 life years would be saved per patient on average (=99,000 saved life years in total/year) [52]. The total cost was 1,500 USD for one waiting room amounting to 0.48 USD per saved life year. However, this analysis is highly speculative as transferability is not proven and prospective effects might be weaker for older patients. In our sample, just 22 of the 179 people who filled out the questionnaire were 18-30 years old (12.3%). Thus, if the intervention had no effect at all for patients with a different age but only for 18-30 year olds, the costs per saved life year would be 3.90 USD.

Discussion

To our knowledge, this is the first study that implements new technology in waiting rooms in order to repurpose waiting time for smoking cessation. The results show potential for large scale exposure of patients visiting healthcare providers and effects of future long-term studies are likely to consists of both; the intervention itself, but also the group interaction / change in subjective norm due to its setting in the waiting room.

Our approach shows promise to contribute to a solution for non-adherence of physicians to smoking cessation guidelines due to lack of time, role incongruence, no financial reimbursement or lack of education [14] as patients are more likely to address the topic themselves demanding quit advice.

However, our results also point to limitations and open questions that future research needs to address:
Modes of initiation

In our study, we had the interviewer intervene with the passive exposure of the intervention by inviting patients to try the app if they would not do so themselves within 30 seconds of waiting. We made this decision due to the fact that a) it is an unusual busy waiting room with average waiting times of only 21 minutes and b) a low number of patients waiting (24 per day on average from 7:30 am to 4:45 pm) and c) due to the nature of HIV-patients described by the experienced head of our HIV outpatient clinic as rather shy in healthcare settings. However, 34/7.33% of patients tried the app within 30 seconds without any additional trigger needed indicating the likelihood of successful passive exposure if given more time or in settings with higher patient density and longer waiting times. 48/36.4% of patients claimed that another patient would try the app due to them trying the app right afterwards, which further strengthens the hypothesis on a lower need of external motivation in fuller waiting rooms.

Adverse or unanticipated events

We received no complaints by patients feeling bullied and the large majority of smokers perceived the intervention as fun (72/91.1%). However, the question of feeling bullied could be addressed more explicitly in future research due to the nature of the intervention. What we did observe was that the intervention caused interaction where there was none before. Usually, the patients sit silently in the room obsessed with their smartphones or a newspaper or just staring to the ground. When the intervention was implemented, patients entered into dialogue about the smoking cessation intervention with one another and had found a common topic they would discuss. Our interviewer reported that the overall atmosphere of these conversations was encouraging and positive which is also reflected by the self-reported data (Tables 1 and 2). Former quitters would share their advice or even encourage addressing the topic at the subsequent appointment which 19/45.2% of smokers also reported in the questionnaire (Table 2).

Addressing quitting at the subsequent appointment

These data should be obtained directly from the physicians treating those patients in future studies. Clinicians reported an increased rate of questions on how to quit but this was not objectified. 41/51.3% of smokers said the intervention motivated them to
address the topic at the upcoming appointment.

Loss of data due to short waiting times
Many patients were in the middle of filling out the questionnaire when the nurse would call them. We knew this before and put the individual perceptions of the intervention and important sociodemographic data / smoking status on top so that the loss of data in these initial items was relatively low.

Effects on people who just watch
Based on our data, 48/36.4% of patients tried the app right after they watched another person do it. On top of initiation, it is reasonable to speculate that just watching the intervention and maybe engaging in a conversation evolving around it in a full waiting room initiates quitting due to potential change in the subjective norm of the person who watches [53].

Limitations due to the nature of the survey
Our study only reports cross-sectional data and the influence on actual behavior may only be estimated. However, behavioral predictors, such as the behavioral intention to perform a certain behavior indicate effectiveness in accordance with the theory of planned behavior [53]. In addition, while anonymity decreases social desirability bias, it might be that patients filling out the questionnaire still felt urged to answer in a social desirable way as the interviewer was present in the room. However, patients were left to themselves when filling out the questionnaire which they could throw into a sealed box after completion to further decrease the risk for bias.

Waiting room interventions in today’s healthcare context
Being a physician is an extremely stressful occupation in modern times, since both; the amount of bureaucracy and the amount of patients per doctor have increased. Interventions that help the physician identify smokers willing to quit and also indicate to have a direct effect on quitting-behavior themselves [49] have the potential to increase population health and thereby decreasing the work load for the medical profession, winning the fights against tobacco-attributable-diseases for them. Our intervention specifically appears to encourage conversations and exchange of support between strangers.
Conclusion
Facial-aging apps implemented in waiting rooms provide a new enjoyable opportunity to motivate the majority of patients visiting a healthcare provider to quit smoking, to remain abstinent and to address quitting at their subsequent appointment and thereby encourage physician-delivered smoking cessation. Future studies will focus on long-term abstinence rates, analyze the impact in different patient subgroups and the interplay of waiting times and necessary modes of initiation.

Competing Interests
None.

Funding
No external funding was obtained.

Ethics approval
The study was approved by the ethics committee of the University of Essen where it was conducted.

Authors Contributions
TJB initiated and designed the study, set up the intervention, instructed data collection, analyzed the data and wrote the letter. SE, CMB, JK, CvK, AHE, RFS, WS and DS supported the design and conduction of the study, supported statistical analysis and proofread the letter. All authors had full access to the data.

References
2. Lasser KE, Quintilian LM, Truong V, Xuan Z, Murillo J, Jean C, Pbert L: Effect of Patient Navigation and Financial Incentives on Smoking Cessation Among Primary Care Patients at an Urban
Safety-Net Hospital: A Randomized Clinical Trial. *JAMA internal medicine* 2017, **177**(12):1798-1807.


arguments against providing tobacco dependence treatment in the hospital setting. BMC public health 2014, 14(1):1182.


Ammunition in the War Against Smoking: A Photoaging App. Journal of Medical Internet Research 2017, 19(9):e326.
