ORIGINAL ARTICLE

Treating Tobacco Dependency in National Health Service Workers in Greater Manchester: An Evaluation of a Bespoke Digital Service

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ABSTRACT

Introduction: Treating tobacco dependency in National Health Service (NHS) workers delivers substantial benefits at an individual, population, and health care system level. We report the outcomes from the Greater Manchester Integrated Care Partnership's tobacco dependency treatment program for NHS workers which includes 6-months' access to behavioral support and 12 weeks of treatment through a digital application.

Methods: Aggregate results for all participants across the program from January 1, 2022, to September 1, 2023, are reported including a deep-dive evaluation of 300 participants recruited to provide chemically validated outcomes.

Results: A total of 1567 NHS workers participated in the program within the evaluation period, completing 24,048 sessions with specialist advisors within the application, ordering 18,710 nicotine vape liquids, 6927 nicotine patches, and 297 short-acting nicotine products. Users reported achieving 89,464 smoke-free days, 1,258,069 less cigarettes smoked, and a financial saving of £622,231. The deep-dive evaluation revealed a CO-verified 12-week abstinence rate of 37% (111 of 300).

Conclusion: This evaluation provides assurance of clinical effectiveness within a bespoke digital tobacco dependency treatment program for NHS workers across an Integrated Care Partnership.

Keywords: Smoking cessation; Treating tobacco dependency; Nicotine replacement therapy; Vapes; Abstinence from smoking

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Introduction

Smoking tobacco is one of the leading causes of preventable death, leading to more than 90,000 deaths every year in the United Kingdom.[1] The National Health Service (NHS) employs approximately 1.5 million people in England making it the country's biggest employer.[2] An estimated 73,000 NHS workers currently smoke.[3] In a survey of nearly 600 NHS workers across Greater Manchester (GM), in which workers that currently smoked were well represented (19% of respondents), there was strong support for providing dedicated tobacco dependency treatment to NHS workers and supporting a smoke-free NHS workplace.[4] Tobacco dependency within the NHS workforce creates additional burden on the NHS due to higher rates of sickness absence, staff requirement for NHS care for smoking-related illnesses, and reduced productivity.[3,4]

The National Institute for Health and Care Excellence (NICE) guidance for treating tobacco dependency recommends combining behavioral support delivered to standards defined by the National Centre for Smoking Cessation and Training (NCSCT) alongside pharmacotherapy such as nicotine replacement therapy (NRT), nicotine analogue medication (e.g., varenicline), and nicotine-containing vapes.[5] Nicotine vapes provide an alternative source of nicotine delivery which is substantially less harmful than smoking tobacco and is an effective intervention to achieve abstinence from tobacco.[6,7]

Treating tobacco dependency (TTD) in NHS workers who smoke will release substantial benefits on an individual level, a population health level, and health care system level. For these reasons, NHS England have made funding available to integrated care systems (ICSs) to deliver a dedicated TTD service for NHS workers. Here, we report the outcomes from an evaluation of GM's TTD service for NHS workers.

Methods

Study Setting

NHS GM is an ICS in the North-West of England with a population of more than 3 million people. Within NHS GM, there are 10 localities, each with an acute care hospital. There are 63 primary care networks and two mental health secondary care trusts. The "Make Smoking History" (MSH) team is a funded regional tobacco control delivery team within the Population Health Board of NHS GM, which is responsible for delivering all aspects of the GM Tobacco Control Plan. The GM TTD in NHS workers service was initially implemented in one locality of GM (Manchester) and was subsequently rolled out across GM.

The GM TTD in NHS Worker Service

The MSH team implemented a digital service through an application (app), allowing a broad reach and accessibility across the region, especially for NHS workers who worked unsociable hours and may struggle to attend other services. GM partnered with the Smoke Free App (SFA) for this project. The Smoke Free app delivers evidenced-based behavior change interventions and interactions within the app, the ability to connect with a NCSCT-trained tobacco dependency advisor 24 hours a day and seven days a week, and the ability to order home delivery of NRT products, vaping devices, and nicotine liquids. Participants registered on the SFA through a dedicated access point provided to NHS workers and were given six months of free access to the app and 12 weeks of NRT or vaping supplies free of charge.

The Smoke Free App

In addition to 24/7 support from NCSCT-trained advisors, the app includes a quit coach chatbot that delivers the NCSCT's Standard Treatment Program in digital form and provides on-demand help with maintaining abstinence. The "Missions" are set of stop smoking tasks given daily for seven days before a quit date and for the first 31 days after; then they are given at increasing intervals up to the 90-day point. Each mission delivers at least one of the behavior change techniques (BCTs) used in face-to-face stop smoking services in the United Kingdom.[8] For example, mission day 6 (6 d after the quit date) asks users "What are the five biggest benefits you've found from giving up smoking? Write them down below." This mission contains the following two BCTs of "Boost motivation and self-efficacy" and "Identify reasons for wanting and not wanting to stop smoking."

In total, 20 different BCTs are used in the missions. The most frequently used are as follows: "Strengthen ex-smoker identity," "Boost motivation and self-efficacy," "Facilitate relapse prevention and coping," and "advise on and use social support," each one of which is used in at least 10 missions.

The chatbot is based on the NCSCT Standard Treatment Program.[9] The chatbot offers daily check-ins that provide motivation, walks people through their mission, and asks them to commit to the "Not a puff" rule.[10] The chatbot also provides on-demand support on choosing and using medications, being around other smokers, dealing with difficult situations, and recovering from lapse. Natural language processing is used to help deliver appropriate tips for dealing with cravings and withdrawal. Both the chatbot and missions have been found to increase quit rates compared with the core features of the app.[11,12]

Communications and Engagement

A specific communications toolkit was developed (Fig. 1) which provided a dedicated weblink and QR code to access the NHS worker offer in the SFA. The toolkit

Figure 1. Examples from the communications toolkit used to enable NHS workers to access the treating tobacco dependency offer in the Smoke Free App. NHS, National Health Service.

was shared across internal communication channels in primary and secondary care. Promotional events were held across multiple hospital sites where staff could be walked through the sign-up process.

Eligibility

All job roles were eligible. This included staff from administrative roles, porters, domestic services, corporate services, community services, medical professionals, and nursing and midwifery roles. The inclusion criteria included any NHS staff member who wanted to try to achieve long-term abstinence from tobacco.

Evaluation Design

The evaluation was designed in two parts. First, the aggregate data collected within the app from all GM NHS workers registered for this service were evaluated from January 1, 2022, to September 1, 2023. This allowed an analysis of: the number of participants, the number of sessions of app use, the average session length of app use, total treatment orders, 4-week self-reported abstinence, the total number of cigarettes not smoked, number of smoke-free days, and the amount of money saved and experience of care. Second, a deep-dive evaluation into a smaller cohort of participants was completed to provide a granular understanding of the outcomes of this service. For this evaluation, 300 NHS workers were recruited in two cohorts between February 2022 and February 2023. NHS workers who downloaded the SFA during this time frame were invited to participate in the deep dive evaluation; recruitment was completed once the target number of participants was achieved. Recruiting in two cohorts enabled us to implement the lessons learned from the first cohort. In cohort 1, 150 participants were recruited from the pilot locality (Manchester University NHS Foundation Trust) from February 1, 2022, to May 31, 2022. In cohort 2, a further 150 participants were recruited across all GM localities from September 1, 2022, to February 28, 2023. Any lessons learnt from cohort 1 led to service change implementations in cohort 2. The recruited participants provided self-reported (in-app survey, e-mail or text message link to an online survey or telephone follow-up) and chemically validated abstinence status at 4 and 12 weeks after enrolment to the program (iCOQuit home CO monitors delivered to their home address). The participants' level of nicotine dependence, age, sex, ethnicity, and area of NHS work were also collected, and their postcode was used to calculate an index of multiple deprivation score.

Study End Points

The primary end point of the study was CO-verified abstinence from smoking at 12-week follow-up. CO readings were measured using a home CO monitor from Bedfont Scientific Ltd. that was sent to all participants, with the cutoff point for abstinence set at less than 10 ppm as per NCSCT.[9] The secondary end points of this study were 12-week self-reported abstinence, 7-day self-reported point prevalence abstinence, 4-week self-reported abstinence, and experience of care. The outcome data for both primary and secondary end points were categorized as "abstinent from tobacco," "actively

smoking," or "no outcome data" (for nonresponders). Differences in outcomes between cohort 1 and cohort 2 were measured using a chi-square test in a two-by-two contingency table. Surveys (also containing self-reported outcome measures) asked participants about their experience of care. Participants were asked to rate the helpfulness of the service (scale 1–10 with 10 being "extremely helpful"), to rate the likelihood of recommending the service to a friend (scale 1–10 with 10 being very likely), and to provide free text comments about positive and negative aspects of the service. Costs of the service were captured and included the license cost for use of the SFA and the costs of provision and delivery of NRT or vaping devices and liquids. Cost per participant that is abstinent from tobacco at 12 weeks was calculated for the entire cohort (n = 300) within the deep-dive evaluation but also stratified by cohort and intervention used. Subgroup analyses were performed on sex, age, ethnicity, area of work, levels of nicotine dependence, and the type of treatment used (app only, NRT and app, vaping and app, NRT and vaping and app), and the analysis of variance method of statistical testing was used to determine whether the likelihood of abstinence at 12 weeks is influenced by these variables.

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Ethics

This was a national work program funded by NHS England. Ethical approval was not required as this project was not considered research using the UK Health Research Authority toolkit.[13] It was classified as a service evaluation. The protocol was approved by the local Caldicott Guardian.

Results

GM TTD in NHS Workers Service—Overall Outcomes

A total of 1567 NHS workers registered with the TTD in NHS workers service in the SFA within the period February 1, 2022, to September 1, 2023. These users completed 24,048 sessions within the app and average of 21 per user. The average length of session was seven minutes, and the average cumulative app use per user was 2 hours and 37 minutes. Total treatment orders were as follows: 18,710 nicotine vape liquids, 6927 nicotine patches, and 297 short-acting nicotine products (inhalator, mouth spray, and gum).

Using the average cost of a packet of cigarettes, we were able to estimate cost savings by calculating the number of cigarettes not smoked and multiplying this by the cost per cigarette. The number of cigarettes not smoked was obtained from participants who used the app at least four times in 7 days and reported not smoking in the app. Users reported achieving 89,464 smoke-free days at an average of 188 per user, preventing 1,258,069 cigarettes being smoked at an average of 2637 per user and saving £622,231 at an average of £1304 per user. A total of 345 users provided self-reported 4-week abstinence status, and 77% (265 of 345) reported being abstinent at 4 weeks, representing 17% (265 of 1567) of the entire cohort. For experience of care, 71% (383 of 541) said that they would be extremely likely to recommend this service to others and 58% (316 of 546) reported the app "helped hugely" with supporting abstinence.

Deep-Dive Evaluation—Demographics

Most of the participants were female (209 of 300, 70%) and of White ethnicity (278 of 300, 93%, Table 1). The most common age group being 18 to 34 years (96 of 300, 32%), and 43% (130 of 300) lived in communities with the lowest quintile of the deprivation index. The most common job roles were "nursing and midwifery" (89 of 300, 30%) and "administrative or clerical" (74 of 300, 25%) roles. Most of the participants reported moderate levels of tobacco dependency (213 of 300, 71%). Vaping was the most popular additional intervention selected by participants with 44% (132 of 300) selecting a vape and the app and 36% (107 of 300) selecting a vape plus NRT and the app. The demographics between the overall cohort and the 300 participants in the deep dive evaluation were similar (Table 1). The main difference was in the uptake of tobacco dependency treatment between the overall cohort and the deep dive evaluation cohort. Of the overall cohort, 36% used the app only as their tobacco dependency treatment, compared with 10% of the participants in the deep dive evaluation. This is most likely because the participants in the deep dive evaluation were required to provide CO readings at 12 weeks and thus were more likely to use the other tobacco dependency treatments available to achieve abstinence.

Deep-Dive Evaluation—Primary End Point

Overall, 44% (131 of 300) of the participants returned a CO reading. If all participants who did not return a CO reading are considered to be actively smoking tobacco, the CO-verified 12-week tobacco abstinence rate was 37% (111 of 300, Table 2). The CO-verified abstinent rate increased from 34% (51 of 150)

Table 1. Demographics of the Overall Cohort and the Cohort of Participants in the Deep-Dive Evaluation of the GM Treating Tobacco Dependency in NHS Workers Service

Demographics		Deep Dive Evaluation Cohort, n (%)	Full Cohort, n (%)
Sex	Male	79 (26)	409 (27)
	Female	209 (70)	1000 (67)
	Prefer not to say	12 (4)	89 (6)
Age	18-34 y	96 (32)	490 (33)
	35-44 y	83 (28)	425 (28)
	45-59 y	84 (28)	521 (35)
	60+ y	35 (12)	61 (4)
Ethnicity	White	278 (93)	1336 (89)
	Asian	4 (1)	55 (4)
	BAME	4 (1)	23 (2)
	Mixed	4 (1)	50 (3)
	Prefer not to say	10 (3)	33 (3)
Deprivation index (1 = most deprived, 5 = least deprived)	Quintile 1	130 (43)	583 (39)
	Quintile 2	59 (20)	290 (19)
	Quintile 3	36 (12)	167 (11)
	Quintile 4	20 (7)	108 (7)
	Quintile 5	16 (5)	56 (4)
Job role	Nursing and midwifery	89 (30)	481 (32)
	Admin and clerical	74 (25)	281 (19)
	Corporate services	6 (2)	23 (2)
	Allied health professionals	24 (8)	133 (9)
	Clinical support staff	21 (7)	132 (9)
	Domestic services catering	21 (7)	104 (7)
	Portering and estates	18 (6)	82 (5)
	Medical professional	12 (4)	64 (4)
	Other	31 (10)	121 (8)
Nicotine dependence	Low dependency	74 (25)	615 (43)
	Moderate dependency	213 (71)	768 (53)
	High dependency	11 (4)	61 (4)
Uptake of tobacco dependency treatment	Vape + app	132 (44)	374 (25)
	Vape + NRT + app	107 (36)	479 (32)
	NRT + app	30 (10)	113 (8)
	App only	31 (10)	532 (36)

App, application; GM, Greater Manchester; NHS, National Health Service; NRT, nicotine replacement therapy.

to 40% (60 of 150) in cohort 2, but this was not statistically significant ($p = 0.185$).

Deep-Dive Evaluation—Secondary End Points (12 wk)

A total of 71% (214 of 300) of the participants provided 12-week self-reported outcomes. Data completeness also increased across the two cohorts from 62% (93 of 150) to 81% (121 of 150). The 12-week self-reported continuous abstinent rate was 39% (117 of 300, Table 2), and this increased from cohort 1 (31%, 47 of 150) to cohort 2 (47%, 70 of 150), but this was not statistically significant ($p = 0.354$). The 12-week 7-day point prevalence of abstinence from tobacco was 52% (155 of 300, Table 2), and this increased from cohort 1 (44%, 66 of 150) to cohort 2 (59%, 89 of 150), but this was not statistically significant ($p = 0.791$).

Deep-Dive Evaluation—Secondary End Points (4 wk)

A total of 79% (238 of 300) of the participants provided 4-week self-reported outcomes. Data completeness increased across the two cohorts from 72% (108 of 150) to 87% (130 of 150). The continuous abstinence rate at 4 weeks was 49% (148 of 150, Table 2), and this increased from cohort 1 (42%, 63 of 150) to cohort 2 (57%, 85 of 150), but this was not statistically significant ($p = 0.326$).

Deep-Dive Evaluation—Subgroup Analysis

The subgroup analysis was performed using the 12-week self-reported outcomes as the data completeness was highest for self-reported outcomes and 12 weeks provides the longest follow-up outcome data. None of the evaluated variables (age, sex,

Table 2. Outcomes in the Deep-Dive Evaluation of the GM Treating Tobacco Dependency in NHS Workers Service

Outcome		Total (n = 300), n (%)	Cohort 1 (n = 150), n (%)	Cohort 2 (n = 150), n (%)	*p* Value
Primary outcome					
12-wk CO-verified abstinence	Abstinent from tobacco	111 (37)	51 (34)	60 (40)	$p = 0.185$
	Active smoking	20 (7)	13 (9)	7 (5)	
	No outcome data	169 (56)	86 (57)	83 (55)	
Secondary outcomes					
12-wk continuous abstinence	Abstinent from tobacco	117 (39)	47 (31)	70 (47)	$p = 0.354$
	Active smoking	97 (32)	46 (31)	51 (34)	
	No outcome data	86 (29)	57 (38)	29 (19)	
12-wk 7-d point prevalence	Abstinent from tobacco	155 (52)	66 (44)	89 (59)	$p = 0.791$
	Active smoking	59 (20)	27 (18)	32 (21)	
	No outcome data	86 (28)	57 (38)	29 (19)	
4-wk continuous abstinence	Abstinent from tobacco	148 (49)	63 (42)	85 (57)	$p = 0.326$
	Active smoking	90 (30)	45 (30)	45 (30)	
	No outcome data	62 (21)	42 (28)	20 (13)	

GM, Greater Manchester; NHS, National Health Service.

ethnicity, deprivation, job role, level of nicotine dependence, or type of tobacco dependency intervention used) were associated with higher abstinence rates at 12 weeks (Table 3). As the vast majority of the participants were White, with very small numbers being different ethnic groups, meaningful statistical evaluation for this variable was not possible.

Deep-Dive Evaluation—Experience of Care

A total of 67% (201 of 300) of the participants responded to the experience of care survey. The average "helpfulness" score was 8.3 of 10, and the average "recommendation" score was 9.0 of 10. Qualitative feedback also suggests that participants found this program helpful. Furthermore, 67% of the comments left about the program or the app were categorized as "very highly positive" or "highly positive." Of the responses, 16% were "somewhat critical" due to problems with vape, delivery issues with NRT, and some problems related to the app.

Deep-Dive Evaluation—Costs

The overall cost per participant who is abstinent from tobacco at 12 weeks was £273 (Table 4). This was calculated using the cost of the quit aid and the cost for the license of the app. The costs per quit of using vaping alone, vaping plus NRT, and NRT alone were £168, £353, and £345, respectively. For all interventions, the cost per abstinent participant for cohort 2 was less than that of cohort 1.

Discussion

The GM TTD in NHS workers service has revealed good uptake with more than 1500 users of a bespoke digital treatment program. We have revealed considerable engagement of the users with the app with nearly 25,000 app sessions lasting an average of 7 minutes per session. Participants continued to engage with the app even after they had received their 12-week free supply of NRT or vaping device; this suggests that some participants found the behavioral support provided by the SFA a useful adjunct in achieving abstinence. This is reflected in the qualitative feedback results (Table 5). There are high self-reported 4-week abstinence rates at 77% in those providing outcome data, and we have validated this evidence of efficacy with a deep-dive evaluation of chemically validated outcomes in 300 users which reveals a 37% 12-week abstinent rate. If this same abstinent rate were applied across the entire service program, it would equate to approximately 580 users abstinent from tobacco at 12 weeks. Nearly half of users within this deep-dive evaluation are from communities within the lowest decile of deprivation. The cost per NHS worker who achieves abstinence was £273. This evaluation, therefore, provides supporting evidence for the feasibility, acceptability, efficacy, and cost-effectiveness of a bespoke digital treatment program for tobacco-dependent NHS workers. Our results revealed an increase in abstinence rates from cohort 1 to cohort 2. After interim analysis of the results from cohort 1, changes were implemented before recruitment for cohort 2. These changes were based on qualitative feedback of informal interviews conducted with participants from cohort 1.

Table 3. 12-Week Self-Reported Outcomes Based on the Demographics of Participants in the Deep-Dive Evaluation of the GM Treating Tobacco Dependency in NHS Workers Service

Variable		Abstinent n (%)	Not abstinent n (%)	Nonresponder n (%)	*p* Value
Sex	Male	30 (38)	26 (33)	23 (29)	$p = 0.303$
	Female	79 (38)	69 (33)	61 (29)	
	Prefer not to say	8 (66)	2 (17)	2 (17)	
Age	18–34 y	36 (38)	30 (31)	30 (31)	$p = 0.470$
	35–44 y	39 (47)	25 (30)	19 (23)	
	45–59 y	31 (37)	29 (34)	24 (29)	
	60+ y	9 (26)	13 (37)	13 (37)	
Ethnicity	White	106 (38)	93 (34)	79 (28)	NA
	Asian	1 (25)	0 (0)	3 (75)	
	BAME	2 (50)	0 (0)	2 (50)	
	Mixed	2 (50)	1 (25)	1 (25)	
	Prefer not to say	6 (60)	3 (30)	1 (10)	
Deprivation index	Quintile 1	51 (39)	40 (31)	39 (30)	$p = 0.952$
	Quintile 2	25 (42)	21 (36)	13 (22)	
	Quintile 3	11 (31)	9 (25)	16 (44)	
	Quintile 4	7 (35)	8 (40)	5 (25)	
	Quintile 5	7 (44)	5 (31)	4 (25)	
Job role	Nursing and midwifery	35 (39)	34 (38)	20 (23)	$p = 0.758$
	Admin and clerical	30 (41)	25 (34)	19 (25)	
	Other	9 (29)	9 (29)	13 (42)	
	AHPs	12 (50)	6 (25)	6 (25)	
	Clinical support staff	9 (43)	4 (19)	8 (38)	
	Domestic and catering	7 (33)	3 (14)	11 (53)	
	Portering and estates	8 (45)	6 (33)	4 (22)	
	Medical professional	4 (33)	6 (50)	2 (17)	
	Corporate services	2 (50)	1 (25)	1 (25)	
Nicotine dependence	Low	29 (39)	22 (30)	23 (31)	$p = 0.252$
	Moderate	81 (38)	73 (34)	59 (28)	
	High	5 (46)	2 (18)	4 (36)	
Uptake of tobacco dependency treatment	Vape + app	44 (41)	34 (32)	29 (27)	$p = 0.725$
	Vape + NRT + app	56 (42)	46 (35)	30 (23)	
	NRT + app	11 (37)	8 (26)	11 (37)	
	App only	6 (19)	9 (29)	16 (52)	

App, application; AHP, allied health professional; GM, Greater Manchester; NHS, National Health Service; NRT, nicotine replacement therapy.

The following changes were implemented for cohort 2:

1. Improved accessibility and interaction between tobacco dependency advisors and participants by introducing a welcome call for participants at the start of their quit attempt.
2. More options of tobacco dependency interventions (vaping and NRT products) were offered. In particular, different vape devices and more vape flavor options were provided to give participants a wider variety of choice. A 24-hour nicotine patch was included into the product options, to cater for participants with high nicotine dependence.
3. Further education was provided around the use of the tobacco dependency interventions. Emphasis was placed on training the advisors about how to use vapes so that this information could be cascaded down to the participants.
4. Participants in cohort 2 were encouraged to set quit dates far enough in the future to allow time for the tobacco dependency products to arrive before starting

Table 4. Costs per Participant Abstinent at 12 Weeks Stratified by Type of Tobacco Dependency Intervention Selected and by Cohort

Type of Intervention, (Number of Abstinent Participants)	Total	Cohort 1	Cohort 2
All participants (117):	£273	£310	£248
Vape + NRT + app (56):	£353	£412	£323
Vape + app (44):	£168	£199	£141
NRT + app (11):	£345	£450	£285
App only (6):	£161	£263	£58

App, application; NRT, nicotine replacement therapy.

Table 5. Comments From Qualitative Feedback by Participants, Categorized as Either VHP, HP, MP, or SC

Comment	Category
The app and 24-h support is extremely helpful, always someone to talk to when the cravings start.	VHP
Superb support	VHP
Agents really helpful	VHP
This app has been brilliant, cannot recommend it enough	VHP
This has been really helpful. Helped having someone there 24/7	VHP
Amazing has really helped me	VHP
Thanks for all your help. The NRT provision was excellent	VHP
I have found the twice daily check ins very helpful as a trigger to keep going.	VHP
It is the best thing that happened lately. Smoking is not cool anymore, and replacing it with a vape is not healthy either. But the amounts of benefits you have for using the vape are enormous and you could actually quit for good.	VHP
Brilliant scheme, I would highly recommend	VHP
Fantastic scheme that has finally helped me quit! I cannot thank you enough	VHP
I am incredibly grateful for all the support I have had from the app and especially the advisors, knowing someone is there if I need it really helps, the best tip I have learned is that cravings only last 15 ish minutes and I have learned to distract myself. I cannot say it has been a piece of cake but easier than I would expected. Thank you	VHP
Thanks for all you help and support. You guys have really made the difference	VHP
I accept that I needed to be ready to stop smoking (after 30 y); however, I have found the app really very useful. The twice daily check ins in the early weeks was a big incentive to me to keep going. The daily challenges were also very useful. I had looked at other smoking cessation apps before and found this one to be extremely simple and easy to navigate.	VHP
I used the app so much in the first few weeks to motivate myself I keep going, particularly looking at the money saved.	VHP
I would just like to say a big thank you for this app I am a good 2 and half months or more smoke free and feel it has largely to do with the app and visually seeing my achievements have given me a massive boost.	VHP
App very helpful, thank you	VHP
I have found the app extremely useful. I know I had to be ready to quit myself but I really found this app incredibly useful. I found the twice daily check ins invaluable in the early few weeks. As the time increased and the check ins became less frequent I was initially worried that I would miss the support but actually it meant I stopped thinking about it so much.	VHP
I would like to say a massive thank you for the app as it has had me smoke free for 3 months now I feel great and think the app has had a major impact on me not smoking at all.	VHP
The app has been extremely helpful, thank you	VHP
Excellent app that has finally helped me to get smoke free.	VHP
Fab scheme that has helped me so much. Thank you	VHP
Brilliant scheme	VHP
I would just like to say a massive thanks to all of you. I could never imagine how well I have done now without the help and support I received. I continue to recommend this service to colleagues.	VHP
The staff have been very helpful and lovely	VHP
The app is brilliant very helpful and very informative it is one of the best apps I have used and have recommended it to all my friends. Love the daily motivators too and the reminders.	VHP
Very supportive	VHP
Great app with great support when you need it.	HP
Excellent app, plenty of support and helpful guidance	HP
It is so good to have someone available when you feel like things are going wrong. Someone to explain that what your feeling is correct and shows things are working	HP
I have 100% used the chat room support, the money calculator and the health bits as motivation to keep going.	HP
4 wk down today and feeling as strong as ever	HP
I feel a lot better in myself the vape has really helped me not to smoke	HP
Very supportive	HP
The info provided and support is great. Although not completely stopped gone from 20 a day to 7. Now looking at changing daily routine as a method to stop. thank you x	HP
I feel much better in myself even though I had a blip I am back on track	HP
Great service	HP
I have done really well thanks to having this support	HP
I have found this a very helpful app, thank you very much	HP
I am now 3 mo smoke free with no intention of going back.	HP
I have smoked for 30 y and I am now a nonsmoker for 12 wk and I am so grateful and happy.	HP
Thank you very much	HP

(continued)

Table 5. Continued

Comment	Category
The weekly check in was really good and supportive	HP
Fab scheme	HP
Yes the app is informative and helpful, I would recommend it	HP
Staff are lovely and very helpful	HP
I like the quit coach. It takes a couple of minutes every day but it is the push you need every single day to remain focused.	HP
This app has been great. To be able to read others that have given up and the encouragement given is a great help	HP
Its great getting the NRT and having experts to talk too	HP
It has been a great aid	HP
Great app and support	HP
Great service	HP
Great app	HP
App has managed to keep me on track. Only had a ciggie once in the last two weeks	MP
Perhaps consider 24-h patches for people who smoke during the night. The app is helpful though	MP
The app helps you feel supported and also knowing how much the CO_2 level has reduced	MP
The app makes you feel supported	MP
I have just had a little glitch with smoking at the minute but always help on the app	MP
Pretty good.	MP
The smoke blower app thing would not rest password so I do not have a clue what my score is. Did not really bother with the app only to order but gave up as vape leaked constantly and I could not be bothered going through two sets of people to get help to sort it never got response from totally wicked. Overall response time was great. Sometime a bit too much check-ins. Felt a bit pressured. But I was having a bad time personally. I have a disposable vape and have the occasional cigarette.	MP
My CO machine is not working but I am feeling much better since giving up, I do still vape though	MP
Yes. The vape is a good alternative but is still addictive. I will soon quit vaping too	MP
I did get the vape and one lot of liquid but I did not need any more than that as have been trying to not use the vape - but knowing I had it there for those first few times socializing at the pub gave me the confidence to have a:drink and not worry about smoking.	MP
I found the daily challenges really useful, some more than others but I liked having a daily target - it kept me on track.	MP
Only partly helped. In the end what helped more was cost of living.	MP
Had given up using patches and support from the app for 2 1/2months but then had a relapse due to home circumstances. Will be trying again next week using the vape.	MP
Despite finding patches really helpful in cutting down I would have found it easier to just have the full 12 wk delivered at once as was difficult being in to receive the parcel with my shifts. All the advisers were great to talk to on the instant chat though!	MP
It was helpful, personal I just would have done better quitting in a group	MP
Definitely helping me just a long road ahead	MP
Maybe my timing was wrong to try and stop, just has not worked for me and I am still smoking. I do however, strongly feel it was my attitude and not the support available, just at this time can't handle the not smoking too	MP
It is good to see the plus side of giving up smoking. Also online support helps a lit.	MP
Some of the missions seem less relevant than others but guess you cannot tailor it to every single person	SC
My vape pen did not work but I have been using disposable vape pens	SC
The vape that I received was broken and just spat liquid out when I inhaled so I got my own.	SC
I have been abroad with friends and smoked a few cigarettes	SC
Never received the patches I requested and I feel these would have helped me quit completely. I have been vaping a lot and have had the occasional cigarette which is a lot better than my previous smoking but I would have thought I would be able to stop completely with the help of patches too.	SC
Please have some more input for the group chat room, the responses from advisors are delayed and I think this is why not many people are using the chat room	SC
I am continuing to try hard to stop completely	SC
Vape was very helpful, did not always get the app notifications	SC
The bot stopped working properly when I stopped having daily check-ins. The messages were all sent in foreign languages	SC
Where can I get a CO_2 reader	SC
I maybe a techno dino - I found the interface of the app a little hard to engage with. Having said that - your advisors were very helpful in guiding how / where to find blitz your quiz and such	SC
Great communication, app a little difficult. much appreciated	SC

(continued)

Table 5. Continued

Comment	Category
Did not start due to vape sent was not working waiting for replacement was told I would get patches too which never came	SC
The vape is very poor quality. It switches itself on randomly when I am not even near it, the first coil did not work at all and the second feels very harsh like it is burning out constantly, even though it is brand new so I have not really used it. I have been buying my own disposable vapes.	SC

app, application; HP, highly positive; MP, moderately positive; SC, somewhat critical; VHP, very highly positive.

their abstinence journey and allowed time for troubleshooting.

The 12-week chemically validated abstinence rate of 37% that we found in this evaluation compares favorably with the published outcomes within tobacco dependency treatment services and research trials. A review of 43 pharmacotherapy interventions found 12-week quit rates of 20% for NRT.[14,15] Trials of UK stop smoking services that combined behavioral support with pharmacotherapy reported quit rates between 14% and 23% at 12 weeks.[16,17] The 4-week continuous abstinence rate of 49% in this program is comparable with the 54% rate within community stop smoking services reported to NHS Digital.[18]

This evaluation has suggested feasibility and acceptability of the digital approach to this service that ensures accessibility across a region, minimizes costs, and acknowledges the shift working pattern of NHS workers that might prevent accessing normal working hour services. Nevertheless, we must be aware of the risk of digital exclusion and the risk of widening any health inequalities. The most common age range was 18 to 34 years, with just 12% of users aged above 60 years, consistent with the age profile of a working population, and this may help to minimize the risk of digital exclusion. It is also important to note that our method of recruitment (inviting SFA users to participate in the deep dive evaluation) may have introduced selection bias if only the most motivated and engaged users responded. The results may therefore not be reflective of all app users.

Approximately half of the users live within communities from the most deprived decile in GM. This provides some reassurance that our study targeted communities that experience the most from the harms of tobacco dependency. Implementation of this digital tobacco dependency program on a larger scale may have a substantial impact on lung cancer rates as the incidence of lung cancer in the most deprived areas of England is almost three times higher than in the least deprived areas.[19] Nevertheless, our data do raise concern about the accessibility of this service by minority ethnic groups and whether this service is accessible across a diverse range of ethnic communities, especially where English is not a first language. Targeted interventions and adaptations to ensure accessibility across ethnic communities is the next priority workstream for this project. It must be highlighted that the clinical effectiveness revealed within this program relates to a younger and educated cohort, which does not make the digital service transferable to other populations without the appropriate evaluation.

Numerous studies, NICE guidelines, and NICE technology appraisals have revealed the value of nicotine analogues such as varenicline and cytisine in TTD, often with improved efficacy over other treatments, such as NRT and bupropion.[14,20] Both varenicline and cytisine are not currently available in the United Kingdom, but should they become available in the future, this would add significant value to the available treatment options within this service and further enhance the reported outcomes.

The financial impact of NHS employees who smoke tobacco has been estimated to be a loss of £2800 per smoking staff member per year (due to clinical time spent on smoking breaks and smoking-related illness causing absence from work and requirement to seek NHS-funded care).[3] Our study found that the cost of supporting a staff member to become abstinent from tobacco for 12 weeks was £273, revealing considerable return on investment from this program in comparison to the costs of continuing to smoke.

This evaluation of a digital tobacco dependency treatment service for NHS workers across an ICS provides assurance of feasibility, acceptability, clinical effectiveness, and cost-effectiveness. This has far-reaching benefits at an individual, population, and health care service levels.

CRediT Authorship Contribution Statement

Matthew Evison: Conceptualization, Visualization, Methodology, Supervision, Project Administration.

Kavita Sivabalah: Formal Analysis, Visualization, Writing - original draft, Writing - review and editing.

David Crane: Formal Analysis, Investigation, Data Curation, Writing - review and editing.

Samantha Neville: Writing - review and editing.

Mandy Hancock: Writing - review and editing.
Anthony Ryan: Writing - review and editing.
Bincy Ajay: Writing - review and editing.
Jane Coyne: Writing - review and editing.
Elizabeth Benbow: Writing - review and editing.
Andrea Crossfield: Writing - review and editing.
Sebastian Bate: Formal Analysis.

Disclosure

Dr. David Crane is the CEO of Smoke Free and derives income from it. The remaining authors declare no conflict of interest.

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