A service evaluation of the integration of a digital smoking cessation offer across London Boroughs: a service evaluation

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Approvals and Declarations

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Abbreviations

CI	Confidence intervals
CPD	Cigarettes Per Day
IMDQ	Index of Multiple Deprivation Quintile
ITT	Intention to Treat
LA	Local Authority
LBTH	London Borough of Tower Hamlets
LSBU	London South Bank University
LTA	London Tobacco Alliance
LTFU	Lost to follow up
NCSCT	National Centre for Smoking Cessation and Training
NICE	National Institute for Health and Care Excellence
NRT	Nicotine Replacement Therapy
OSF	Open Science Framework
OR	Odds ratio
P	Probability
RCTs	Randomised Controlled Trials
SSL	Stop Smoking London
SSS	Stop Smoking Service

Contents

Background and Introduction

Smoking causes 55,000 cancer deaths in the UK every year and is largely concentrated among those from lower socio-economic backgrounds. Consequently, smoking remains the largest driver of cancer and other health inequalities[1,2]. Reducing tobacco smoking is the most impactful approach to prevent avoidable cancers. Smoking cessation also positively impacts all 5 key clinical areas of health inequalities in NHS England's Core20PLUS5 approach, but the long-term decline in smoking prevalence has plateaued in recent years, currently at 11.6%[3]. The Government's 2030 smoke-free target (smoking prevalence <5%) will be missed under current trends, by at least 7 years (and 10+ for those most deprived)[4]. To achieve this target, more support for cessation is crucial, especially for those not accessing traditional services[5].

Smoking prevalence is currently at 11.7% in London, similar to the national prevalence of 11.6%[3], equating to approximately 827,000 Londoners who smoke, with an estimated financial burden on the NHS, costing the London economy £5.25 billion each year in lost productivity[6].

In 2023, the government announced its plan to create a Smokefree Generation via legislation to raise the age of sale of tobacco each year[7]. The plan aims to protect children and vulnerable people from the health harms of smoking and to help them live longer, healthier lives. The current government has continued this commitment. In November 2024, the government proposed the Tobacco and Vapes Bill that sets out to gradually phase out the sale of tobacco and vape products to anyone born on or after 1 January 2009, and to control the advertising and promotion of tobacco, vapes and other products. Alongside commitment to legislative change, the government has invested £70 million a year to support local authority public health teams with stop-smoking service provision. In London this additional funding totals approximately £10 million per year across the 33 boroughs[8].

All 33 of London's Directors of Public Health (DsPH) agreed to pool some of this new funding to deliver a pan-London digital service though the London Tobacco Alliance (LTA) and Stop Smoking London (SSL) programmes to combine and accelerate efforts to make London smokefree by 2030 and reduce health inequalities. LTA is a partnership of local authorities, directors of public health, healthcare professionals, sector experts and other key stakeholders and delivers "once for London" resources (e.g. position statements, educational webinars and communications toolkits). The London Borough of Tower Hamlets (LBTH) on behalf of the London boroughs and the Association of Directors of Public Health in London, hosts the LTA and SSL (the public facing identity of the LTA).

Digital support for smoking cessation offers the opportunity to make a meaningful contribution to reducing smoking prevalence by expanding reach to smokers who may not use traditional services. This has received much attention over the past decade with the surge in the development of several smartphone applications offering smoking cessation support, with over 100 smoking cessation apps available on Google Play and iPhone App stores[9]. While evidence from systematic reviews does not currently support the effectiveness of digital smoking cessation applications as standalone interventions this may be due in part to the lack of randomized controlled trials (RCTs) to examine this[10,11]. There is some evidence that digital apps combined with pharmacotherapy are effective[9].

The Smoke Free app is one of the world's most widely used evidence-informed smoking cessation digital applications, with over 6 million downloads to date and 70,000 new users each month[12]. Evidence of effectiveness from two RCTs suggests SmokeFree and stop smoking aids produced quit rates similar to national averages for Stop Smoking Services (SSS;[13]), and among motivated smokers who downloaded the app, quit rates were higher compared to brief advice to quit alone[12].

Expanding services to include the provision of support via digital application aligns with NHS England's commitment to a National Digital Tobacco Treatment Service Framework[14] that aims to ensure adult smokers have access to one or more digital tobacco treatment applications.

Digital intervention to extend current services

Between April 2023 and Mar 2024, 26,300 London residents accessed local stop smoking services, with 13,900 successfully quitting smoking at 4 weeks after setting a quit date[15]. However, with approximately 827,000 people who smoke in London, many smokers do not access local stop smoking services for support to quit smoking. Expanding service provision to offer support to smokers in new ways may extend reach to those for whom traditional services do not appeal.

To extend the existing provision and increase system capacity for smoking cessation LBTH introduced a pilot integrated digital smoking cessation service (using the Smokefree App) in London, with the aim of offering a 24/7 service complementary to that of traditional smoking cessation services.

LSBU has been commissioned by LBTH to evaluate this new digital offer. The aim of the evaluation is to assess the impact, efficiency, effectiveness and appropriateness of the integrated digital smoking cessation pilot service, and whether it increases the number of successful quit attempts across London.

Primary research question:

1. Is the digital offer effective in helping people to stop smoking at 4 weeks?

Secondary questions:

2. How quickly did the digital app licences get used?
3. How many people downloaded a licence, per borough/local authority?
4. What are the characteristics (sociodemographic and smoking behaviours) of the smokers who took up the licences?
5. What aspects of the digital intervention predict quit success?

Method

Design and Outcomes

The research team was not involved in the design or delivery of the intervention. Data analysis is based on data collected by the service and commissioner; thus, the evaluation is a pragmatic service evaluation design, with the primary outcome being 4 week quit rates and secondary outcomes including:

a) the time taken for the Smokefree app licenses to be used.
b) the number of people who downloaded the license in total, and by borough
c) the distribution (numbers of the sample who are from different socio-demographic backgrounds (i.e. routine and manual workers; age, gender) and a description of the sample (% or average number depending on measure) of smoking behaviours (i.e. average cigarettes per day prior to their quit attempt).

The service evaluation was pre-registered on the OSF on 15 January 2025, https://osf.io/updjg. The pre-registered document includes a secondary question and outcome for follow-up at 12-week post-quit, not included in the service evaluation as data was not available. Due to initially low response rate at 4-week follow up, from the 29th of January 2025, participants setting a quit date were incentivised to respond at 4-weeks with a £5 voucher and the LTA made the decision not to collect data at 12-week post quit date. Nine percent (n=229) of the participant sample received an incentive to provide outcome data at 4-weeks post quit date through the Smokefree App.

LSBU Ethical approval ETH2425-0060, was granted 24 October 2024. Clients consented for their data to be used for evaluation and research purposes.

Population

Data was collected by the commissioned service (SmokeFree), delivering the intervention for LTA. Smokefree were commissioned to offer 2500 Pro user licenses for their digital intervention to smokers who were willing to make a quit attempt who resided within all 33 London boroughs (as determined by postcode of main residence).

Recruitment and Sample

Recruitment methods were dictated by the commissioned service in discussion with the Local Authority. Intervention delivery was between November 2024 and March 2025, and follow ups were conducted at 4 weeks post-quit (in line with stop smoking service practice).

There were two stages to recruitment with an initial "soft" launch on 18th November and a "full" launch on 1st January 2025. The soft launch gave London residents who downloaded the basic version of the app organically the opportunity to upgrade to the premium offer for free. The full launch involved targeted promotion to signpost London residents to download the SmokeFree app by using a direct link or QR code. Signposting was via LTA local authority partners supported by the LTA with the provision of a communications toolkit and via the SSL website through promotion of the digital offer within its "Five for 25: Five Steps to being Smokefree in 2025" new year stop smoking campaign.

Intervention

The SmokeFree App https://smokefreeapp.com/ is a digital platform that provides Pro users with access to a range of support including access to:

- Information and support materials (e.g. trackers of smoke free time and cravings, missions)

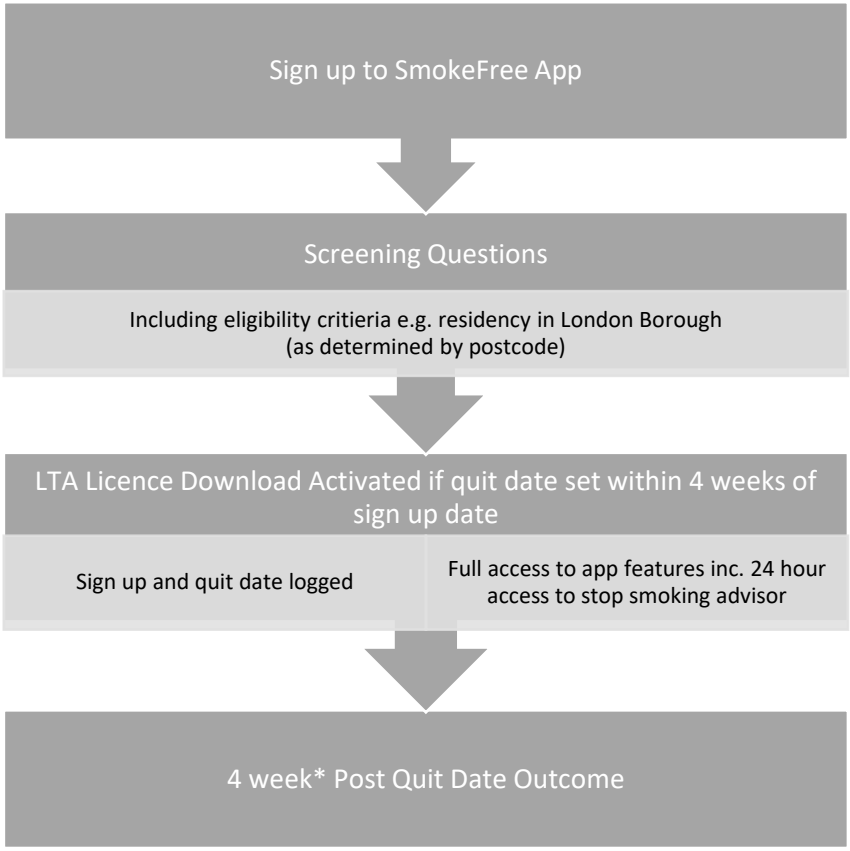
- National Centre for Smoking Cessation and Training (NCSCT) trained advisors, 24 hours a day, 7 days a week

- Advisor-led stop smoking clinics held in-app four times a day

- Pharmacotherapy (NRT and/or vapes)

The pilot evaluation included 2,500 users with a London postcode who set a quit date no more than two weeks prior to app activation (i.e. downloaded the app and signed in) and within 4 weeks of activation (see Figure 1 below for more detail).

Figure 1: Flow chart of SmokeFree App Intervention Offer



* 4-6 weeks in line with Russell Standard[16]

Data collection

Variables were those required by the Smokefree app and for the LAs standard national NHS Digital returns as well as additional variables around the specific intervention delivery.

Sociodemographic measures recorded at the time of intervention delivery included: Age (years); Postcode; Socioeconomic background (full time student; never worked or unemployed for over 1 year; retired, sick / unable to work; home carer; managerial or professional occupation; Intermediate occupation; routine and manual occupation; prisoner; other); Sexual orientation (heterosexual / straight, gay/lesbian; bisexual; other; not sure; Prefer not to say); Ethnicity (White – any other; White – British; White Irish; Asian – any other; Asian – Bangladeshi; Asian – Indian; Asian Pakistani; Black -African; Black any other; Black – Caribbean; Mixed – any other; Mixed – White and Asian; Mixed – White and Black African; Mixed – White and Black Caribbean; Other – Chinese; Any other ethnic group; not stated). Religion (Atheism; Buddhism; Christianity; Hinduism; Islam; Judaism; Sikhism; No religion; other religion; prefer not to say). Pregnancy status (not pregnant; pregnant; lives with pregnant woman; trying for a baby; not stated); Free Prescription status (yes; no; no response).

Smoking related measures included cigarettes per day (CPD) at the time of App sign up; time to first cigarette upon walking (within 5 minutes; between 6-30 minutes; 31-60 minutes; over 60 minutes); quit date; self-reported quit status at 4 week quit status outcome (quit; not quit; lost to follow up). Self-report quit status was prompted for and recorded within the app, where participants did not respond within the app Smoke Free advisors telephoned or texted

Intervention measures included the date of first log in to the app, number of times they logged into the app, number of times they used the 24hr advisor service, pharmacotherapy used via Swap to Stop Voucher obtained through the app (none, NRT only, Vape only, both NRT and Vape), number and type of NRT products allocated, method used to

access download of the app offer (organic download or via one of 3 QR codes used by the LA), and whether an incentive was received or not.

Data analysis

Data were primarily analysed descriptively, including the percentage of the sample who successfully quit (self-report) at 4 weeks, the average time taken for the Smokefree app licenses to be used, numbers (and %) of license downloads by London Borough and percentages or means (dependent on variable) of sociodemographic variables and intervention measures including app measures, and pharmacotherapy used (if any).

Lower-layer super output area (LSOA; an index of deprivation) was calculated based on participant postcode with LSOA index calculated and converted to quintiles by Smokefree prior to sharing the data with the research team.

Quit rates were calculated on the full sample of those who self-reported having quit smoking at 4-6 weeks post quit date. Where follow-up quit status data was missing, we assumed missing = smoking, in accordance with the Russell Standard[16] in smoking cessation research. We will also conduct a complete case analysis, calculating quit rates only including those for whom follow up quit status is available.

Logistic regression was conducted to explore app engagement (number of logins to the app and use of advisor), use of pharmacotherapy as predictors of successful quits at 4 weeks, controlling for sociodemographic and dependence variables. The odds ratio and the 95% confidence interval for each predictor and the chi-square statistic and pseudo-R2 for the overall model are reported

Results

Baseline Participant Data

Sociodemographic profiles

See table 1 for detailed breakdown of participant sociodemographic data. The majority of participants (55%) were female, white British (52%) and identified as heterosexual/straight (73%). The average age was 37 years (SD= 12.68; range 11-86 years). Half were aged between 18-34 years old, with 21% aged 35-44 years and 20% aged 45-59 years. A minority of participants were aged under 18 (1%) or 60 years and over (7%). Thirty percent reported no religion, 26% preferred not to say their region and then the majority (26%) who reported a religion reported it to be Christianity.

Thirty-eight percent reported a managerial or professional occupation, followed by 23% indicating 'other' as their employment status. Routine and manual occupations only made up 8% of the sample, 3% reported they had never worked or were unemployed for over 1 year, and 8% sick or disabled and unable to work. Participants were from the full range of IDMQ (0-5), with the average of 2.39. Forty-two percent indicated they were eligible for free prescription status.

Only 1% of participants reported being pregnant, 1% reported they were trying for a baby and 0.4% were living with a pregnant woman.

Table 1: Participant Sociodemographic at the time of licence download, for the whole sample, and by 4-week quit status

	Total sample		4 -week Quits (n=1,063)		4-week Not Quit (n=1,437)	
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
Age (n = 2,453)	37.12(12.68)	11-86	38.32 (12.73)	17-82	36.22 (12.58)	11-86
IMDQ	2.39 (1.34)	0-5	2.38 (1.33)	0-5	2.40 (1.34)	0-5
	N	%	N	%	N	%
Age (categories; n=2,453)						
Under 18 years	14	0.6	5	0.5	9	0.6
18-34 years	1259	50.4	493	47.1	766	54.4
35-44 years	527	21.1	250	23.9	277	19.7
45-59 years	491	19.6	216	20.7	275	19.5
60 + years	162	6.5	82	7.8	80	5.7
Gender (n=2,496)						
Female	1368	54.8	584	55.0	784	54.7
Male	1061	42.5	446	42.0	615	42.9
Other	67	2.7	32	3.0	35	2.4
Sexual Orientation (n=2,488)						
Heterosexual / Straight	1813	72.5	775	73.0	1038	72.8
Gay / lesbian	128	5.1	53	5.0	75	5.3
Bisexual	105	4.2	52	4.9	53	3.7
Other	25	1.0	17	1.6	17	1.2
Not sure	28	1.1	11	1.0	17	1.2
Prefer not to say	389	15.6	154	14.5	235	16.5
Ethnicity (n=2,496)						
White – any other	386	15.4	164	15.5	222	15.5
White – British	1308	52.3	563	53.1	745	51.9
White – Irish	59	2.4	22	2.1	37	2.6
Asian – any other	50	2.0	13	1.2	37	2.6
Asian – Bangladeshi	29	1.2	11	1.0	18	1.3
Asian – Indian	98	3.9	39	3.7	59	4.1
Asian – Pakistan	30	1.2	10	0.9	20	2.4
Black – African	68	2.7	27	2.5	41	2.9
Black – any	10	0.4	3	0.3	7	0.5
Black – Caribbean	67	2.7	32	3.0	35	2.4
Mixed – any other	76	3.0	35	3.3	41	2.9
Mixed – White and Asian	49	2.0	21	2.0	28	1.9
Mixed – White and Black African	28	1.1	8	0.8	20	1.4
Mixed – White and Black Caribbean	69	2.8	31	2.9	38	2.6
Any other ethnic group	45	1.8	25	2.4	20	1.4
Other – Chinese	13	0.5	5	0.5	8	0.6
Not stated	111	4.4	51	4.8	60	4.2
Socioeconomic background (n=2,467)						
Never worked or unemployed for over 1 year	80	3.2	40	3.8	40	2.8
Routine and manual occupation	187	7.5	87	8.3	100	7.0
Intermediate occupation	115	4.6	53	5.1	62	4.4
Managerial or professional occupation	946	37.8	407	38.9	539	38.0
Full time student	209	8.4	66	6.3	143	10.1
Home carer	85	3.4	30	2.9	55	3.9
Retired	75	3.0	40	3.8	35	2.5
Prisoner	3	0.1	0	-	3	0.2
Sick or disabled and unable to work	197	7.9	83	7.9	114	8.0
Other	570	22.8	241	23.0	329	23.2
IMDQ (n=2,500)						
Quintile 0	179	7.2	70	6.6	109	7.6
Quintile 1	467	18.7	205	19.3	262	18.2
Quintile 2	783	31.3	348	32.7	435	30.3
Quintile 3	528	21.1	216	20.3	312	21.7
Quintile 4	349	14.0	137	12.9	212	14.8

Quintile 5	194	7.8	87	8.2	107	7.4
Religion (n=2,485)						
Atheism	114	4.6	39	3.7	45	5.3
Buddhism	32	1.3	13	1.2	19	1.3
Christianity	638	25.5	265	25.0	373	26.2
Hinduism	55	2.2	18	1.7	37	2.6
Islam	148	5.9	61	5.7	87	6.1
Judaism	12	0.5	4	0.4	8	0.6
Sikhism	9	0.4	1	0.1	8	0.6
No religion	744	29.8	355	33.5	389	27.3
Other religion	86	3.4	37	3.5	49	3.4
Prefer not to say	647	25.9	268	25.3	379	26.6
Pregnancy Status (n=2,498)						
Not pregnant	2414	96.6	1024	96.5	1390	96.7
Pregnant	24	1.0	9	0.8	15	1.0
Lives with pregnant woman	10	0.4	7	0.7	3	0.2
Trying for a baby	32	1.3	13	1.2	19	1.3
Free Prescription Status						
Yes	1037	41.5	452	42.5	585	40.7
No	1437	57.5	606	57.0	831	57.8
No response	26	1.0	5	0.5	21	1.5

Smoking Behaviour

Table 2: Smoking behaviour data for the total sample (n=2,500) at the time of licence download, for the whole sample, and by 4-week quit status

	Total sample		**4 -week Quits (n=1,063)**		**4-week Not Quit (n=1,437)**	
	Mean (SD)	**Range**	**Mean (SD)**	**Range**	**Mean (SD)**	**Range**
Cigarettes Per Day	13.04 (13.67)	0-500	13.64 (6.12)	0-80	12.59 (16.22)	0-500
	N	**%**	**N**	**%**	**N**	**%**
Time to First Cigarette						
≤5 mins	765	30.6	321	30.2	444	30.9
6-30 mins	833	33.3	370	34.8	463	32.2
31-60 mins	392	15.7	161	15.1	231	16.1
60+ mins	510	20.4	211	19.8	299	20.8

HSI=heaviness of smoking index

The average number of cigarettes smoked per day was 13.04 with some participants reporting non-daily use (n=9; 0.4%) or smoking one cigarette per day (n=185, 7.4%) at baseline. Two thirds of participants smoked within 30 minutes of waking up, and a significant minority (20.4%) smoked over an hour after waking up.

Intervention Delivery

Licence downloads

The majority (87%, n=2162) of the licenses were used from organic downloads of the App. QR code access to the app and subsequent license access were under-utilised with only 13% (n=338) participants logging access via this means. Of those accessing via QR codes, the majority (93%, n=315) accessed via the QR code associated with Local Borough marketing, 14 (4%) accessed via the QR code on the Smokefree app landing page on the Stop Smoking London (SSL) website (Smokefree App for London - Stop Smoking London), and another 9 (3%) via the QR embedded into the SSL website campaign page for the Top 5 Tips to be smokefree in 2025.

The digital offer was launched on the 18th November 2024, the first license was activated on 18th November 2024. Three hundred and ninety-two (16%) of licenses were activated between this initial launch date and 31st December 2025, with an average license activation of 9 per day. Between 1st January 2025 and 2nd April 2025 (the date of the last commissioned license activation), the remaining 2,108 licenses were activated, averaging at 23 license activations per day.

Participants from all 33 London Boroughs used a SmokeFree App licence. Licence downloads by Borough varied, participants residing in Croydon used the most licences (n=273, 11%), and those residing in the City of London the least (n=13, 0.5%). See Table 3 for details.

Table 3: Licence downloads (n / %) by London Borough

Local Authority	N	%
Croydon	273	11.0
Southwark	163	6.5
Greenwich	157	6.3
Lewisham	144	5.8
Bromley	142	5.7
Havering	138	5.5
Hackney	108	4.3
Tower Hamlets	99	4.0
Barnet	96	3.8
Wandsworth	90	3.6
Islington	72	2.9
Haringey	69	2.8
Ealing	66	2.6
Brent	65	2.6
Camden	65	2.6
Bexley	64	2.6
Merton	63	2.5
Barking and Dagenham	62	2.5
Hillingdon	60	2.4
Enfield	57	2.3
Waltham Forest	50	2.0
Hammersmith and Fulham	48	1.9
Redbridge	47	1.9
Hounslow	44	1.8
Sutton	41	1.6
Newham	39	1.6
Westminster	36	1.4
Harrow	32	1.3
Kensington and Chelsea	30	1.2
Lambeth	26	1.0
Richmond	24	1.0
Kingston upon Thames	17	0.7
City of London	13	0.5

Intervention engagement & App Usage

The number of times the Smokefree app was used (total sessions) ranged considerably across participants, from only using it once, to someone using it 856 times. The average use was 24 times. The majority (62%) of participants who downloaded the licence utilised access to the stop smoking advisors. Of those 1,540 that accessed the advisors (expert usage, ever used), usage again varied considerably from 1 to 284 times, and an average use of 5 times. Of the those (n=1, 540) that accessed the advisors, 49% quit smoking at 4 weeks. See Table 4.

Table 4: Intervention Engagement data for total sample (n=2,500) and by quit status

	Total Sample (n=2500)		**4 week Quits** (n=1,063)		**4 week Not Quit** (n=1,437)	
	Mean (SD)	**Range**	**Mean (SD)**	**Range**	**Mean (SD)**	**Range**
Total Sessions	24.44 (49.41)	1-856	43.43 (63.98)	1-856	10.39 (27.53)	1-546
Expert Usage (number of times)	5.41 (12.25)	0-284	9.13 (16.99)	0-284	2.66 (5.47)	0-82
	N	**%**	**N**	**%**	**N**	**%**
Expert Usage (ever used)	1540	61.7	749	70.5	791	55.0

Pharmacotherapy Use

The majority (68.4%) of participants elected *not* to use any form of pharmacotherapy in their quit attempt alongside the use of the Smokefree app. Of those that did use pharmacotherapy (n=789; 32%), the majority (15%) elected to use a vape only (see Table 5 for further details). Twenty-four percent of participants (n=594) who used the Smokefree license utilised a Swap to Stop Voucher via the app. Of those that used NRT, patches were the most popular product used by 391 participants, with the average use of 5.03 packs (7 patches per pack). The average amount of NRT used in those who were quit at 4 weeks was at least twice that for those who were not (except for Nasal spray for which there only two participants).

Table 5: Pharmacotherapy use for total sample and by quit status

		Total Sample (n=2500)		**4 week Quits** (n=1,063)		**4 week Not Quit** (n=1,437)	
		N	**%**	**N**	**%**	**N**	**%**
Pharmacotherapy							
Vape only		372	14.9	222	20.9	150	10.4
NRT only		195	7.8	123	11.6	72	5.0
NRT & Vape		222	8.9	165	15.5	57	4.0
None		1711	68.4	553	52.0	1158	80.6
Swap to Stop		594	23.8	387	36.4	208	14.4
	N	**Mean (SD)**	**Range**	**Mean (SD)**	**Range**	**Mean (SD)**	**Range**
NRT use							
Patches	391	5.03 (3.84)	2-14	6.16 (4.07)	2-14	2.39 (1.26)	2-12
Gum	55	2.38 (2.21)	1-12	2.87 (2.47)	1-12	1.18 (0.39)	1-2
Lozenges	39	1.90 (1.80)	1-8	2.31 (2.09)	1-8	1.08 (0.28)	1-2
Mouthspray	36	1.94 (2.11)	1-10	2.21 (2.33)	1-10	1.00 (0.00)	-
Inhalator (20[a])	63	1.29 (0.77)	1-5	1.45 (0.93)	1-5	1.00 (0.00)	-
Inhalator (36[a])	21	2.62 (1.63)	1-6	2.89 (1.61)	1-6	1.00 (0.00)	-
Nasal spray	2	1.00 (0.00)	-	1.00	-	1.00	-

N = number; NRT = nicotine replacement therapy; SD = standard deviation; [a] = cartridge pack

Quit Rates

At four-week post quit date, 317 (12.7%) self-reported smoking status via the Smokefree App, from those that didn't respond via the App, a further 1,224 (49%) reported 4-week smoking status following a follow up phone call or text from the advisor. Nine hundred and fifty-nine (38.4%) were therefore lost to follow up (LTFU).

At 4 weeks post quit date, 42.5% of participants (n=1,063) reported quitting, 19.1% (n=478) reported they had relapsed to smoking, and 38.4% were LTFU. Four-week quit rates using intention to treat principles (i.e. those lost to follow-up treated as relapsed to smoking) were therefore 42.5%. Complete case analysis (n=1,541) of 4 week quits based on only the sample that could be followed up suggests a quit rate of 69%.

Predictors of Quit Success

Logistic regression was conducted to explore app engagement as predictors of successful quits, controlling for sociodemographic variables (age, gender, ethnicity, socio-economic background, IMDQ) in the first block, followed by smoking dependence variables (CPD, time to first cigarette) in the second block. The app engagement predictor variables (number of app sessions, expert usage (ever use) and pharmacotherapy used) were entered in the final block (using the enter method in SPSS). After probable outliers were removed (i.e. 2.58 standard deviations away form the mean for CPD, age and total sessions), 2,264 cases (91% of the number of participants) were included in the logistic regression model. The overall model was significantly better that the constant only model $X^2(22)=757.088$, $p<0.001$. The model as a whole explained between 28 and 32% ($R^2=0.284$ Cox & Snell); $R^2=0.382$ Nagelkerke) of the variance in quit status at 4 weeks and correctly classified 59.1% of cases.

The results of the individual predictors are presented in Table 6 below. The odds of quitting at 4 weeks were 1.4 times higher for participants who reported smoking their first cigarettes of the day after 60 minutes of waking compared to those who smoked it within 5 minutes, and slightly higher (1.05) with increased app use (i.e. total sessions). The odds of quitting at 4 weeks also increased by 2.87 to 5.29 times for those who used any pharmacotherapy via the Smokefree app compared to none, with use of both vape and NRT with the highest increase in odds. None of the sociodemographic variables were significant predictors of quit success at 4 weeks.

Challenges and limitations

While the study had a large sample size of 2,500 participants, small cell sizes (numbers) and number of cells (categories) for some sociodemographic variables meant that it was not possible to include these in the logistic regression analysis (e.g. sexual orientation, religion, and pregnancy status). Similarly, it was not possible to examine recruitment pathway to the app as QR code use was so low.

App feature data availability and quality limited exploration of what features of the digital intervention influence quit success. To examine individual engagement components, more granular level data was required than was currently available. For example, instead of total sessions, the number of sessions by type of session. While data for the number of times a specialist advisor was accessed was available this number was already incorporated within the total number of sessions, so it was not possible to include both variables as predictors. A categorical variable of ever expert use (yes/no) was created for inclusion in the analysis to enable some examination of this but, this is a less sensitive measure than the number of times they sought support. Level of engagement with other app features may be predictors of quit success (e.g. time of use/access to the app (particularly to specialist advisors) during or outside of traditional hours. At time of the evaluation the data available was incomplete and unreliable due to a technical issue with its retrieval in the SmokeFree App database and so could not be examined.

Pharmacotherapy use recorded in the digital app was for that obtained via the app only. There was no record of pharmacotherapy use by those who obtained these smoking cessation aids another way (e.g. Swap to Stop voucher obtained directly from local stop smoking services, over-the-counter purchases, prescribed by GP) so the findings are

limited to the comparison of NRT and vapes obtained via the app versus none obtained via the app. The 'none' group may therefore include participants who used NRT and vapes obtained from outside of the app.

A £5 incentive for follow-up was implemented part way through evaluation timeframe and could have influenced quit success directly, particularly as the primary outcome of 4 week quit status was measured via self-report only.

Table 6: Logistic regression model exploring what factors predict the odds of quit success at 4 weeks post quit date.

Predictor	**B (SE)**	***p***	**OR**	**95% CI**	
				Lower	**Upper**
Constant	-2.066 (0.264)	<0.001	0.127		
Age	0.005 (0.005)	0.303	1.005	0.996	1.014
Gender					
Male V female	0.002 (0.107)	0.982	1.002	0.813	1.236
Other v female	0.468 (0.343)	0.172	1.597	0.816	3.124
Ethnicity					
Asian v white	-0.43 (0.189)	0.82	0.958	0.662	1.386
Black v white	-0.096 (0.217)	0.657	0.908	0.594	1.389
Mixed v white	0.216 (0.175)	0.217	1.242	0.881	1.751
Other v white	.311 (0.336)	0.354	1.365	0.707	2.637
Socioeconomic background					
Intermediate v Managerial	0.135 (0.244)	0.580	1.144	0.710	1.845
Routine & Manual v Managerial	0.045 (0.203)	0.825	1.046	0.702	1.557
Unemployed v Managerial	0.451 (0.279)	0.106	1.571	0.909	2.715
Unable to work v Managerial	-0.318 (0.211)	0.132	0.727	0.481	1.101
Other v Managerial	-0.123 (0.119)	0.299	0.884	0.700	1.116
IMDQ	-0.031 (0.039)	0.428	0.970	0.899	1.046
CPD	0.004 (0.007)	0.581	1.004	0.990	1.018
Time to first cigarette					
6-30min v <5min	0.168 (0.131)	0.198	1.183	0.916	1529
31-60 min v <5min	0.102 (0.170)	0.549	1.107	0.794	1.543
60+ min v <5min	**0.367 (0.162)**	**0.023**	**1.444**	**1.051**	**1.984**
Number of app sessions	**0.052 (0.003)**	**<0.001**	**1.054**	**1.047**	**1.060**
Expert Usage (ever use)	0.166 (0.130)	0.200	1.181	0.916	1.523
Pharmacotherapy used					
Vape only v None	**1.354 (0.154)**	**<0.001**	**3.874**	**2.866**	**5.236**
NRT only v None	**1.055 (0.203)**	**<0.001**	**2.872**	**1.928**	**4.279**
NRT + Vape v none	**1.661 (0.130)**	**<0.001**	**5.293**	**3.566**	**7.858**

IMDQ = index of multiple deprivation quintile; CPD = cigarettes per day; B=change in the value of the outcome variable associated with a one-unit change in the predictor; SE = standard error; p = significance value; OR = odds ratio; CI=confidence intervals

Conclusions

All 2,500 app licenses were used within a 6-month period, with activations per day higher following borough wide recruitment strategies compared to organic downloads. All London Boroughs saw utilisation of the licences, but there was considerable variation in number of downloads between them.

App use was by users from a range of genders, ethnicities, sexual orientation, and sociodemographic backgrounds, including those from lower IDMQs. Approximately half were aged 18-34 years, and most app users would be considered as dependent smokers.

Four week quit rates were 43% for those using the Smokefree App. App features were difficult to assess, but greater total app usage over the quit attempt increased the chances of quit status at 4 weeks. While most app users did not elect to use pharmacotherapy (at least not via the app) the odds of success increased by nearly three for those on vapes and by over five for those using both NRT and vapes. Quit success was also influenced by indices related to dependence (i.e. not smoking within 60 mins of waking, compared to smoking within 5 mins). Sociodemographic factors did not affect quit success for those using the app.

Overall, the findings of the evaluation suggest that the Smokefree app provided a viable addition to existing service provision. Acceptance of the digital support offer was indicated via the quick uptake of licences and by a broad range of dependent smokers including those from ethnic minorities and lower IDMQs.

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