White Rose Research Online

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk
Universities of Leeds, Sheffield and York

Deposited via The University of York.

White Rose Research Online URL for this paper:
https://eprints.whiterose.ac.uk/id/eprint/230231/

Version: Published Version

Article:
Pope, Ian, Clark, Lucy V, Clark, Allan et al. (2025) Cessation of smoking in people attending UK emergency departments: the COSTED RCT with economic and process evaluation. Health Technology Asssessment. JHFR0841. ISSN: 2046-4924

https://doi.org/10.3310/JHFR0841

Reuse
This article is distributed under the terms of the Creative Commons Attribution (CC BY) licence. This licence allows you to distribute, remix, tweak, and build upon the work, even commercially, as long as you credit the authors for the original work. More information and the full terms of the licence here:
https://creativecommons.org/licenses/

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

UNIVERSITY OF LEEDS
University of Sheffield
UNIVERSITY of York

NIHR | National Institute for Health and Care Research

Health Technology Assessment

Check for updates

Synopsis

Cessation of smoking in people attending UK emergency departments: the COSTED RCT with economic and process evaluation

Ian Pope,[1*] Lucy V Clark,[2] Allan Clark,[2] Emma Ward,[3] Pippa Belderson,[3] Susan Stirling,[2] Steve Parrott,[4] Jinshuo Li,[4] Timothy Coats,[5] Linda Bauld,[6] Richard Holland,[7] Sarah Gentry,[3] Sanjay Agrawal,[8] Benjamin M Bloom,[9] Adrian Boyle,[10] Alasdair Gray,[11] M Geraint Morris[12] and Caitlin Notley[3]

[1]Norfolk and Norwich University Hospital, Norwich, UK
[2]Norwich Clinical Trials Unit, Norwich Medical School, University of East Anglia, Norwich, UK
[3]Norwich Medical School, University of East Anglia, Norwich, UK
[4]Department of Health Sciences, University of York, York, UK
[5]Department of Cardiovascular Sciences, University of Leicester, Leicester, UK
[6]Usher Institute and SPECTRUM Consortium, College of Medicine, University of Edinburgh, Edinburgh, UK
[7]University of Exeter Medical School, Exeter, UK
[8]University Hospitals of Leicester NHS Trust, Leicester, UK
[9]Royal London Hospital, Barts NHS Trust, London, UK
[10]Addenbrooke's Hospital, Cambridge University Hospitals Foundation Trust, Cambridge, UK
[11]Royal Infirmary Edinburgh, NHS Lothian, Edinburgh, UK
[12]Homerton University Hospital NHS Trust, London, UK

[*]Corresponding author i.pope@uea.ac.uk

Published July 2025
DOI: 10.3310/JHFR0841
Volume 29 • Issue 35

Abstract

Background: The emergency department represents a potentially valuable opportunity to support smoking cessation. Evidence is lacking around the use of e-cigarettes in opportunistic settings like the emergency department.
Objective: To undertake a randomised controlled trial in people who smoke attending United Kingdom emergency departments, testing a brief intervention which included provision of an e-cigarette versus signposting to smoking cessation services, assessing smoking abstinence.
Design: A two-arm pragmatic, multicentre, parallel-group, individually randomised, controlled superiority trial with an internal pilot, economic evaluation and mixed-methods process evaluation.
Setting: Six emergency departments across England and Scotland.
Participants: Adults who smoked daily, who were attending the emergency department for medical treatment or accompanying someone attending for medical treatment, were invited to participate. People were excluded if they had an expired carbon monoxide of < 8 parts per million, required immediate medical treatment, were in police custody, had a known allergy to nicotine, were daily e-cigarette users, were considered not to have capacity to consent or had already taken part in the trial.
Intervention: Brief stop smoking advice, e-cigarette starter kit and referral to stop smoking services.
Main outcome measures: The primary outcome was biochemically validated sustained abstinence at 6 months. Those lost to follow-up, or not providing biochemical verification, were considered not to be abstinent. Secondary outcomes were: self-reported 7-day smoking abstinence, number of quit attempts, number of cigarettes per day, nicotine dependence and incidence of self-reported dry cough or mouth or throat irritation.
Results: At 6 months, of 972 participants randomised, biochemically verified smoking abstinence was 7.2% in the intervention group and 4.1% in the control group (percentage difference = 3.3%) (95% confidence interval 0.3 to 6.3;

This synopsis should be referenced as follows:
Pope I, Clark LV, Clark A, Ward E, Belderson P, Stirling S, *et al*. Cessation of smoking in people attending UK emergency departments: the COSTED RCT with economic and process evaluation. *Health Technol Assess* 2025;**29**(35). https://doi.org/10.3310/JHFR0841

p = 0.032) [relative risk 1.76 (95% confidence interval 1.03 to 3.01)]. Self-reported 7-day abstinence at 6 months was 23.3% in the intervention group and 12.9% in the control group (percentage difference = 10.6%) (95% confidence interval 5.86 to 15.41; p < 0.001) [relative risk 1.80 (95% confidence interval 1.36 to 2.38)]. Daily e-cigarette use was 39.4% in the intervention group and 17.5% in the control group at 6 months. No serious adverse events related to taking part in the trial were reported. The economic evaluation found the intervention was likely to be cost-effective, judged by the National Institute for Health and Care Excellence threshold. The process evaluation found the intervention to be acceptable to both staff delivering it and participants receiving it. The brief nature of the intervention was highly adaptable to context, and interviews demonstrated how the intervention supported different pathways towards cessation.

Limitations: The inability to blind participants or researchers, the relatively low level of biochemical verification due to the nature of the population recruited and the fact that those in the control group did not receive usual care.

Conclusions: An opportunistic smoking cessation intervention comprising brief advice, an e-cigarette starter kit and referral to stop smoking services is effective for sustained smoking abstinence with few reported adverse events.

Future work: Future work will include testing other behaviour change interventions in the emergency department and adapting the Cessation of Smoking Trial in the emergency department intervention for other settings.

Funding: This synopsis presents independent research funded by the National Institute for Health and Care Research (NIHR) Health Technology Assessment programme as award number NIHR129438.

A plain language summary of this synopsis is available on the NIHR Journals Library Website https://doi.org/10.3310/JHFR0841.

Introduction

Some of the text in this synopsis is reproduced with permission from Notley *et al.*[1] This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) licence, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited. See: https://creativecommons.org/licenses/by/4.0/. The text below includes minor additions and formatting changes to the original text.

Rationale for research and background

Worldwide in 2019, 1.14 billion people smoked tobacco, accounting for 7.69 million deaths.[2] In the UK, 6.4 million people continue to smoke.[3] Smoking is a significant contributor of health inequality, with those classified as employed in 'routine and manual' occupations having a smoking rate of 22.8% compared to 8.3% for those in 'managerial and professional' occupations.[4] Treating tobacco addiction is a powerful tool to combat premature death and health inequalities and to reduce healthcare utilisation.[5,6]

Emergency departments (EDs) (also known as accident and emergency or casualty) treat large numbers of people who demonstrate behaviours that can harm their health both in the short and long term. Therefore, offering support and advice to people attending the ED may represent a significant opportunity to improve population health.

Every year, between a third and half of the population will attend an ED in most countries.[7–10] In England, there are 24.4 million ED attendances each year;[11] a large proportion of these patients are ambulatory, fully conscious and will be in the ED for several hours.[8,12–14]

Analysis of routinely collected data from Australia and the UK demonstrates that those who attend EDs are disproportionately likely to be from lower socioeconomic groups.[15,16] Surveys conducted in EDs in the US, Canada, New Zealand and Australia have all demonstrated a higher smoking prevalence among ED attendees when compared to the general population, with prevalence ranging from 20% to 41%.[17–22] The ED, therefore, offers a valuable opportunity to reach a large number of people and support them to quit smoking.

A systematic review of ED-based smoking cessation interventions, published in 2017, found that of 11 studies, the combined relative risk (RR) of abstinence for those who received a smoking cessation intervention in the ED was 1.40 [95% confidence interval (CI) 1.06 to 1.86] (p = 0.02).[23]

An economic evaluation of two multicomponent smoking cessation interventions found the cost of the intervention per patient ranged from $221 (£174.30) to $860 (£678.28), and the cost per quit ranged from $1669 (£1316.33) to $11,814 (£9317.62) (exchange rate of 1 USD = 0.79 GBP, as of 14 November 2024), which is comparable to other smoking cessation interventions.[24]

A Cochrane systematic review has shown e-cigarettes (ECs) to be the most effective smoking cessation intervention available in the UK[25] and around 60% more effective for smoking cessation than nicotine replacement therapy (NRT).[26] E-cigarettes are also the most widely used smoking cessation aid in the UK.[27]

Methods

Overview of the trial design

This was a two-arm pragmatic, multicentre, parallel-group, individually randomised, controlled superiority trial comparing an intervention of brief stop smoking advice, provision of an e-cigarette starter kit with advice on its use and referral to stop smoking services (SSSs), compared with signposting to SSSs, in an ED setting.

Objectives

The aim of Cessation of Smoking Trial in the Emergency Department (CoSTED) was to undertake a randomised controlled trial (RCT), with internal pilot, comparing a brief intervention (including provision of an e-cigarette) with signposting to SSSs, assessing long-term smoking abstinence in people attending an ED.

The objectives were:

1. To run an internal pilot study, with clear stop/go criteria, primarily to test recruitment systems.
2. To definitively test real-world effectiveness of an ED-based smoking cessation intervention in comparison with usual care (UC), by comparing smoking abstinence at 6-month follow-up between trial groups.
3. To undertake a cost-effectiveness analysis of the intervention in comparison with UC from a NHS and Personal Social Services (PSS) perspective.
4. To undertake an embedded mixed-methods process evaluation to assess delivery, implementation, fidelity and contamination.

Participants

Inclusion/exclusion criteria

Participants were eligible if they were aged 18 years or older, reported daily tobacco smoking and were attending the ED for medical treatment or accompanying someone attending for medical treatment.

People were excluded if they had an expired carbon monoxide (CO) of < 8 parts per million (ppm), required immediate medical treatment, were in police custody, had a known allergy to nicotine, were current dual users (defined as daily e-cigarette use), were considered not to have capacity to consent or had already taken part in the trial.

Should a participant have required immediate medical treatment on arrival at ED, they were still able to enter the trial if and when they no longer required immediate medical treatment.

Recruitment

Participants were recruited by members of the team while in the ED.

Settings and locations

Participants were recruited from six EDs (Norfolk and Norwich University Hospital, The Royal London Hospital, Leicester Royal Infirmary, Homerton University Hospital, The Royal Infirmary of Edinburgh and Addenbrooke's Hospital). Data were collected in person at recruitment and via text, phone or online/postal questionnaire at follow-up.

Trial procedures

The process by which participants were recruited is outlined below:

1. Potential participants were screened for their smoking status either by a member of the team asking them if they smoked while in the ED or a member of the team reviewing their medical notes for smoking status.
2. Potential participants who reported currently smoking were given a patient information sheet (PIS) while they were in the ED and given time to read it.
3. Potential participants were then asked if they were interested in taking part and if they had any questions. Those who were interested then underwent screening for inclusion and exclusion criteria, and if appropriate, they were then asked to give written consent.
4. Following consent, participants underwent CO breath testing to ensure an expired CO level of at least 8 ppm to denote current smoking.
5. Baseline data were collected, including smoking behaviour, a measure of tobacco dependence and health service usage data.
6. Participants were then randomised via a web-based service provided by the Norwich Clinical Trials Unit (NCTU) to either intervention or control.
7. After receiving the intervention or control condition, participants proceeded with their care in the ED as appropriate.

Accompanying people

In the event of a person accompanying an eligible patient also meeting inclusion criteria and requesting to participate, the following procedure was followed: (1) if the patient did not consent to participate but the person accompanying them did consent, the person accompanying the patient was randomised or (2) if both the patient and the person accompanying the patient consented to participate, the patient was randomised,

and the accompanying person was allocated to receive the same treatment as the patient they accompanied (intervention or control). In this instance, the accompanying person was not included as part of the trial population for the primary analysis.

The 'intention to treat (ITT) population' refers to patients who were randomised and accompanying people randomised without the patient they were accompanying. The 'ITT+ population' refers to both the above individuals plus the accompanying people who were allocated with the patient they were accompanying.

Intervention

Participants randomised to the intervention group received an opportunistic smoking cessation intervention undertaken face-to-face in the ED,[28] comprising three elements: (1) brief smoking cessation advice (up to 15 minutes), (2) the provision of an e-cigarette starter kit plus advice on its use (up to 15 minutes) and (3) referral to SSSs local to the recruitment site.

The advice was delivered individually (or with an accompanying person) by a dedicated, trained smoking cessation advisor based in the ED. Protocol-driven[28] theory-based[29] smoking cessation advice addressed key aspects of the importance of switching away from tobacco smoking, tailored to the participants' presenting condition (e.g. discussing improved wound healing for patients attending with a laceration). This part of the intervention was a single session undertaken within the ED while participants were waiting to be seen or after discharge, in a quiet area or separate room if available.

Participants were provided with written information covering trial-specific information, a device-specific leaflet with contact details of the manufacturer's stop smoking helpline and a 'staying switched' leaflet developed with the National Centre for Smoking Cessation and Training (NCSCT) that provided information on continued use of e-cigarettes for sustained smoking abstinence.[28]

The e-cigarette starter kit (the DotPro, manufactured by Liberty Flights, an independent e-cigarette manufacturer not funded by the tobacco industry) is a 'pod' device. It is a reusable device with disposable replacement 'pods'. The kit included 11 pods (3 tobacco flavoured, 4 berry flavoured and 4 menthol flavoured) of 20 mg/ml nicotine strength. This device was chosen based on in-depth patient and public consultation, considering ease of use, nicotine delivery, satisfaction, price and availability of consumables in the areas local to recruiting EDs.[30]

Participants were electronically referred to the local SSS which provided routinely available follow-up support. This typically consisted of a phone call offering support and, if taken up, advice on how to quit, and free provision of NRT.

The intervention was delivered by smoking cessation advisors trained specifically for the role. The advisors were either research nurses, research practitioners, ED nurses or healthcare assistants seconded to the trial. They undertook 2.5 days of standardised training and were provided with an intervention manual[28] and videos. Training included online modules from the NCSCT,[31] level 2 smoking cessation advisor training and bespoke training on the use of e-cigarettes. All those trained had the opportunity to undertake some role-play and/or shadow a trained advisor prior to delivering the intervention themselves. Full details of the intervention, including a Template for Intervention Description and Replication (TIDieR) checklist,[32] are available online.[28]

Further details of the intervention can be found in the Intervention handbook, the TIDieR checklist and the logic model which are available on the Open Science Framework.[28]

Control

Participants allocated to control were given details of local NHS SSSs via written material but were not referred directly.

Table 1 lists the research papers being synthesised.

Measures

The following were collected at baseline:

- Demographics: age, ethnicity, employment, whether living with a partner.
- Smoking history: Fagerström Test for Nicotine Dependence (FTND),[33] cigarettes per day, previous stop smoking product use and whether they live with other people who smoke.
- Carbon monoxide breath test.

The following were collected at 1 and 3 months:

- Smoking status.
- Hospitalisations since last follow-up.

The following were collected at 6 months:

- Smoking status.
- Smoking behaviour.

TABLE 1 Research papers being synthesised

Title	Journal and citation
Cessation of Smoking Trial in the Emergency Department (COSTED): protocol for a multicentre randomised controlled trial	*BMJ Open* Notley C, Clark L, Belderson P, *et al.* Cessation of Smoking Trial in the Emergency Department (COSTED): protocol for a multicentre randomised controlled trial. *BMJ Open* 2023;**13**:e064585. https://doi.org/10.1136/bmjopen-2022-064585
Cessation of Smoking Trial in the Emergency Department (COSTED): a multicentre randomised controlled trial	*EMJ* Pope I, Clark LV, Clark A, *et al.* Cessation of Smoking Trial in the Emergency Department (COSTED): a multicentre randomised controlled trial. *Em Med J* 2024;**41**:276–82
Cost–utility analysis of provision of e-cigarette starter kits for smoking cessation in emergency departments: An economic evaluation of a randomized controlled trial	Li J, Wu Q, Parrott S, Pope I, Clark LV,Clark A, et al. Cost–utility analysis of provision of e-cigarette starter kits for smoking cessation in emergency departments:An economic evaluation of a randomized controlled trial. 2025;120(2):368–79. https://doi.org/10.1111/add.16698
The Context of the Emergency Department as a Location for a Smoking Cessation Intervention—Process Evaluation Findings From the Cessation of Smoking Trial in the Emergency Department Trial	Notley C, Belderson P, Ward E, Clark LV, Clark A, Stirling S, *et al*. The Context of the Emergency Department as a Location for a Smoking Cessation Intervention-Process Evaluation Findings From the Cessation of Smoking Trial in the Emergency Department Trial. *Nicotine Tob Res* 2024:ntae223. https://doi.org/10.1093/ntr/ntae223

- Household smoking.
- Nicotine and e-cigarette use.
- Healthcare usage.
- EQ-5D-5L.
- Symptoms.
- Carbon monoxide breath test (if they reported quitting).
- Adverse events.

Primary outcome

The primary effectiveness outcome is self-reported continuous smoking abstinence, biochemically validated by CO monitoring at 6 months with a cut-off of ≥ 8 ppm (i.e. a reading of ≤ 7 will denote abstinence), according to the Russell standard.[34] If CO readings cannot be gathered, the participant is assumed to be smoking.

Secondary outcomes

Secondary outcomes measured at 6 months from randomisation:

- Seven-day point prevalence abstinence [i.e. current smoking status, self-report of having smoked no cigarettes (not even a puff) in the past 7 days, biochemically validated by CO monitoring with a cut-off of ≥ 8 ppm].
- Number of quit attempts.
- Time to relapse (if applicable).
- Number of cigarettes per day.
- Nicotine dependence.[33]
- Number of times using an e-cigarette per day.
- Incidence of self-reported dry cough or mouth or throat irritation.[35]
- Motivation to stop smoking.[36]
- Self-reported use of healthcare services in the last 6 months.
- Self-reported use of smoking cessation services in last 6 months.
- Quality of life (using the EQ-5D-5L).[37]
- Self-reported smoking status and adverse events/reactions collected at 1 and 3 months.

Sample size

A sample size of 972 (486 per group) conferred 90% power to detect a difference between a control quit rate of 6.2% and intervention quit rate of 12.2% at the 5% level of significance (percentage difference = 6%). This was based on a US trial of an ED smoking cessation intervention using a brief intervention, referral to smoking cessation services and nicotine replacement.[38] A quit rate of 6.2% was used in the control group based on an average of three studies of unmotivated quitters who received either contact details for SSSs or no intervention.[36,39,40]

Randomisation

People who met inclusion criteria and gave consent were individually randomised (1 : 1) to intervention or control groups through a web-based service provided by the NCTU. This computer-generated randomisation employed varying block sizes of 2, 4 and 6 and was stratified by the six recruitment sites, which allowed for concealment of allocation.

Treatment blinding

Due to the participatory nature of the intervention, it was not feasible to blind participants or those delivering the intervention to group allocation.

Statistical methods

The primary outcome measure was compared between the two groups using a binary regression model with a log-link to estimate the RR and with an identity link to estimate the difference in risk; both models included fixed effects for randomisation group and site. In cases when the convergence failed for the identity link model, a Gaussian model with robust variance was used. The secondary outcome measures of self-reported point prevalence at 1, 3 and 6 months were compared using the same modelling strategy. The number of cigarettes smoked and the number of times using an e-cigarette per day at 6 months were compared between the two groups using quantile regression with fixed effects of group and site. The number of quit attempts between baseline and 6 months, and the frequency of e-cigarette use at 6 months, were compared between groups using Mann–Whitney tests. Significance level of 5% was set for all tests, and, where possible, 95% CIs are presented. There was an independent Data Monitoring Committee (DMC).

Participant withdrawal

Participants were able to withdraw from the study at any time. Participants who withdrew their consent for further data collection were not replaced. Data collected up to the point of the consent withdrawal were used.

Participants who were randomised in error and found ineligible by the site principal investigators (PIs), or during the first contact with the study team, were withdrawn.

Study approvals and trial conduct

The study was sponsored by the Norfolk and Norwich University Hospital. Ethical approval was obtained from the UK National Research Ethics Committee – Oxford B (reference 21/SC/0288).

A Trial Steering Committee (TSC) was convened at least every 12 months during the recruitment and follow-up phases of the trial with independent membership (listed below) and included two patient and public involvement (PPI) members. The chief investigators, the trial senior statistician and the sponsor representative were also invited to the TSC meetings as non-independent members, and the trial managers and researchers were invited to attend as observers. A Data Monitoring and Ethics Committee (DMEC) was also convened and met regularly during the trial. Independent committee members are listed below and included an independent statistician and specialists in the field. The trial senior statistician also attended the meetings, having prepared a report for the meeting. The chief investigators and the trial manager attended the open section of the meetings. All independent members of the TSC and DMC were approved by the NIHR.

A Trial Management Group consisting of members of the study team, including all of the site investigators, co-applicants and a sponsor representative, also met regularly. *Table 2* shows the members of the committees.

Economic evaluation methods

Costs

All monetary values are presented in 2021–2 Great British pounds. Trial treatments were the COSTED intervention and control. The printing costs of the information leaflet in the control group were £0.20 per card.

TABLE 2 Trial committee independent membership

Data monitoring and ethics committee	Dr Gary Abel (Chair) (statistician)
	Dr Kirsty Challen
	Professor Jamie Brown
Trial Steering Committee	Professor Steve Goodacre (Chair)
	Deb Smith
	Dr Sarah Jackson
	Carmen Glover
	Dr Francesca Pesola (statistician)
	Professor Paul McCrone

Intervention costs included costs of training staff, CO-monitors, e-cigarettes and intervention delivery.

Training included 7.5-hour NCSCT e-learning, 3-hour bespoke session for the intervention and 2-hour generic Smokefree Norfolk level 2 training, all delivered online. The hourly wages of staff delivering training and attendees, including salary oncosts, were multiplied by their respective time spent to estimate the opportunity cost of time.

Costs of CO-monitors over 6 months were estimated based on a discount rate of 3.5%[41] over 5 years operating life. Each site was equipped with one CO-monitor and £30 worth of mouthpieces.

The e-cigarette starter kit costed £23.15 per kit. The opportunity costs of staff time for brief advice were calculated by multiplying duration by band 4 hospital staff hourly wage, including salary oncosts. Participants were given a leaflet containing the information of the intervention (£0.39) and a tote bag (£1.47).

The use of a list of smoking cessation support and healthcare services were collected via self-reported case report form (CRF) at baseline and 6 months, and multiplied by a set of national average unit costs (*Table 3*).[42–51] Total costs included costs of treatments, smoking cessation support and healthcare services.

The quantities of NRT products participants bought over the 6-month trial period were collected and multiplied by the estimated prices of NRT products. Prices paid for e-cigarettes and accessories over the period were collected in monetary terms.

Only the number of individual and group sessions in SSS, and number of GP visits and hospital stays in the previous 3 months, was collected at baseline due to limited time in ED settings.

Outcomes

Following the NICE guidance recommendation,[41] a new mapping approach[52] was used to convert the complete profile of five domains of EQ-5D-5L[37] to utility value. Quality-adjusted life-years (QALYs) were derived from the utility values at baseline and 6 months, following the area under the curve approach.[53]

Smoking cessation outcomes included CO-validated sustained abstinence at 6 months, self-reported sustained abstinence at 6 months, and self-reported 7-day abstinence at 1, 3 and 6 months.

TABLE 3 Smoking cessation support and healthcare services collected and their respective unit costs (2021–2)

	Unit costs (2021–2)	Sources
Pharmacotherapies		
Nicotine patches	£11/pack	7, 8
Nicotine gums	£11/pack	
Nicotine tablets (microtab)	£16/pack	
Nicotine inhalators	£1/cartridge	7
Nicotine lozenges	£14/pack	
Nicotine nasal spray	£17/bottle	7, 8
Nicotine mouth spray	£13/bottle	
Varenicline (Champix)		
0.5 mg/1 mg 2-week treatment initiation pack	£29/pack	7
0.5 mg/1 mg 4-week treatment initiation pack	£55/pack	
0.5 mg tablet	£0.98/tablet	
1 mg tablet	£0.98/tablet	

continued

TABLE 3 Smoking cessation support and healthcare services collected and their respective unit costs (2021–22) (*continued*)

	Unit costs (2021–2)	Sources
Bupropion (Zyban)		
150 mg tablet	£0.70/tablet	7
	£41.76/pack	8
Smoking cessation advice		
Group session in SSSs	£1/session	6, 12
Individual session in SSS	£9/session	
Smoking cessation advice – general practitioner (GP)	£38/session	4, 5
Smoking cessation advice – practice nurse	£8/session	
Smoking cessation advice – pharmacist	£5/session	
NHS Smoking Helpline	£8/call	2, 3, 5
Healthcare services		
A&E attendance	£113/attendance	11
A&E admission	£303/admission	
Hospital outpatient	£165/appointment	
Hospital admission	£2621/episode	
Day case	£1038/case	
Ambulance convoy	£390/convoy	
Healthcare services – GP	£38/consultation	5
Healthcare services – practice nurse	£13/consultation	5, 10
Prescription	£19/prescription	9

Analyses

All analyses were carried out following the pre-registered analysis plan.[54] Except for participants' spending on smoking cessation aids, all analyses adopted an NHS and PSS perspective, as per NICE guidance.[41] Participants were analysed in their allocated groups, following intention-to-treat principle. Except for a secondary analysis performed on the ITT+ population, all other analyses were performed on the ITT population. The long-term model projection was performed in Microsoft Excel (Microsoft Corporation, Redmond, WA, US). Other analyses were performed in STATA MP 18.0 (StataCorp LP, College Station, TX, US).

Missing data

Missing values on all smoking cessation outcomes due to lost-to-follow-up were considered as not abstinent.[34] Missing data on other variables were handled following the methods proposed by Faria *et al.*[55] Missing values in baseline covariates were imputed using the mean value of the variable of the full sample, as these were assumed unrelated to the treatments. Missing values in follow-up variables were dealt with using multiple imputation by chained equation method, following Rubin's rule and assuming missing at random (MAR).[56] The imputation model included all variables necessary to the analysis or associated with missingness which were identified by univariate logistic regression or χ^2 test. The number of imputations was set as approximately the highest percentage figure of missing data.[57] The imputation was performed separately by groups and stratified by sites. Unless otherwise specified, all analyses were performed on the multiple imputed data set.

Primary analysis

Trial treatment costs per CO-validated 6-month sustained abstainer were presented for both groups, along with

incremental costs per one additional abstainer. An incremental cost–utility analysis (CUA) was conducted using total costs and QALYs over the 6-month period. Incremental costs and QALYs were estimated using generalised linear regression models, adjusting for demographic covariates, costs of smoking cessation and healthcare services before baseline and EQ-5D-5L utility at baseline, respectively, and ED site. Incremental costs were divided by incremental QALYs to generate an incremental cost-effectiveness ratio (ICER), which was compared with the maximum acceptable thresholds at £20,000 to £30,000 per QALY gain.[41]

Underlying uncertainty was assessed using a non-parametric bootstrap re-sampling technique (20). The bootstrap and multiple imputation generated 5000 pairs of estimates of incremental costs and effects to construct the 95% CIs for incremental costs and effects. A cost-effectiveness plane and cost-effectiveness acceptability curves (CEACs)[58] were plotted to visualise the uncertainty of cost-effectiveness.

Several sensitivity analyses were conducted. First, self-reported smoking cessation outcomes were used to examine the impact of missing CO readings and to estimate costs per quitter at different time points and provide wider comparability with existing literature.

To assess the impact of imputing missing data, a complete-case analysis (CCA) was conducted among the participants who had complete costs and QALYs at baseline and 6-month follow-up, and smoking status at 6 months, following the same method as the primary analysis. The pattern-mixture modelling approach was used to examine the MAR assumption.[55] Under the missing not at random (MNAR) assumption, it was assumed that those who had missing outcome measures at 6 months were either in higher need of healthcare services or experiencing worse health, or both at the same time. The adjusted incremental estimates were therefore re-estimated based on: (1) imputed costs were increased by 10%, 20% and 30%; (2) imputed utility at 6 months was reduced by 10%, 20% and 30%; (3) the combination of (1) and (2).

Secondary analyses

Adjusted difference in participants' spending on NRT and e-cigarette was estimated using generalised linear regression model, adjusting for demographic covariates, spending on e-cigarette at baseline and ED site. The uncertainty was presented using bootstrapped 95% CI. An incremental CUA was conducted following the same approach as the primary analysis, but on the ITT+ sample. A Markov model[59] was adapted to project lifetime impacts of the intervention compared to control. The model runs on 1-year cycle transitioning between smokers, ex-smokers and deaths, until a cohort of 1000 smokers reach 90 years or dead. The transition probabilities were estimated based on mortalities,[60] RRs of death,[60] natural quit rate and relapse rates.[24,25] Smoking-attributable costs (SACs) were estimated following smoking attributable proportion approach,[61] based on RRs of smoking-related diseases (SRDs),[62] hospital admission episodes of SRDs[63] and matching inpatient costs by Hospital Resources Grouper,[64] inflated to the analysis year.[44] Quality-adjusted life-years were estimated based on age, gender and smoking status.[65] A discount rate of 3.5% per annum was applied to all costs and QALYs.[41] A probabilistic sensitivity analysis (PSA) was conducted using Monte Carlo simulation.

Process evaluation

The objective of the mixed-methods process evaluation[66] was to assess implementation and explore participant views on the intervention compared to UC, contextual variation and potential contamination between the intervention and control groups. We also sought to assess fidelity of intervention delivery. Ultimately, as with all process evaluation studies, we aimed to triangulate data sources in order to get an indication from different perspectives of how the intervention might be working to achieve the primary and secondary effectiveness outcomes observed.

The process evaluation study utilised four key data sources:

Participant interviews

Detailed qualitative data were collected through semistructured interviews with a purposive sample of both intervention and control group participants (target total $n = 30$). These interviews were completed after 6 months of follow-up. Participants were given the option at baseline to consent to being contacted about the qualitative interviews.

A purposive sample were selected from those who had agreed to be contacted by a member of the research team for the interview. The sampling frame aimed to reflect the broader sample in terms of proportions of participants across trial sites, and demographic characteristics of age, gender and ethnicity. The sample included participants who had a range of outcomes, including smoking cessation, dual use of cigarettes and vapes, and continued tobacco smoking. Ten control participants were also interviewed, purposefully sampled for those who had sustained, quit or reduced smoking. Those approached for interview were contacted by e-mail or telephone by a researcher and given detailed information on what was involved. They

were provided with a PIS specifically for the qualitative interviews. After reading the PIS, participants were asked to confirm their consent either by completing and returning a paper consent form or completing an electronic informed consent form, accessed via a link in an e-mail or text. Interviews were undertaken remotely via telephone or video-conferencing (e.g. Microsoft Teams) and audio-recorded for transcription.

It was the aim that 30 face-to-face or telephone/video call interviews would be conducted, split equally across the trial arms and across the recruitment sites. Interviews were semistructured, following an open-ended topic guide (see the open science framework),[28] and lasted around 45 minutes. Interview guides, developed in consultation with PPI representatives, captured views and experiences of the intervention, if received, to understand barriers and facilitators and to assess patient perspectives. We also asked about continued use of an e-cigarette to understand experiences beyond the initial intervention that may impact on long-term smoking abstinence outcomes. Emerging themes from the qualitative interviews were discussed with PPI members.

Smoking cessation advisor interviews

At least one smoking cessation advisor from each of the ED sites delivering the intervention was invited to take part in a qualitative interview on completion of recruitment. Staff interviews assessed views and experiences of intervention delivery, giving an insider perspective on which parts of the intervention package are deemed to be most helpful, in which circumstances, with which participants. Barriers and facilitators to intervention delivery were explored from the staff perspective, to aid interpretation of trial findings and triangulate with participant qualitative data.

Site observations

Observational data of the intervention delivery and ED setting were collected at each of the ED sites. Each observation visit was pre-arranged with the staff based at each site and occurred during daytime working hours. Consent for the participant intervention observations was obtained in the baseline consent. A researcher attended for a minimum of 3 hours and took notes about the context, the interactions and conversation between patients approached for the trial and staff involved. A structured observation record sheet was used for this purpose, prompting the researcher to observe the environment, interactions between key actors, the culture of the department, the flow of patients and any critical events that may impact on intervention delivery and implementation. The researcher also broadly documented details of the setting, including any smoking and vaping observed in and around the department and smoking–vaping policy signage. The observation form also included a site profile of each ED, including location, layout, size and patient journey procedures.

Descriptive statistics

Descriptive statistical data from the baseline and 6-month follow-up questionnaires were used to aid in the description of pathways towards smoking cessation (trajectories). Data were also used to compare differences between sites.

Discussion

The main results for the ITT population were published in Emergency Medicine Journal.[67] The results for the ITT+ have not been published elsewhere.

Recruitment

Recruitment was scheduled to take 12 months from October 2021 to September 2022; however, due to a delay in the set-up, the start of recruitment was delayed to January 2022. Recruitment then proceeded to be consistently above target (*Figure 1*). Recruitment closed ahead of schedule, taking 8 months rather than the predicted 12.

Participant flow

Figure 2 shows the Consolidated Standards for Reporting of Trials (CONSORT) flow diagram for the ITT population and *Figure 3* for the ITT+ population. *Table 4* presents the sample characteristics for the ITT population, and *Table 5* for the ITT+ population.

Between January and August 2022, we screened people in the ED, of whom 2888 reported current smoking. About 1443 agreed to take part and were assessed for eligibility with 484 subsequently randomised to intervention and 488 to control (see *Figure 2*). About 35 accompanying people were recruited with patients who were combined with the ITT population to form the ITT+ population (see *Figure 3*). Of those who declined to take part, 29% gave no reason. The most common reasons given were feeling too unwell (n = 296, 21.0%) and not wanting to quit smoking (n = 161, 11.4%). The most common reasons for being excluded were providing a CO reading of < 8 ppm (n = 308, 72.6%), currently using an e-cigarette daily (n = 52, 12.3%) and not smoking daily (n = 31, 7.3%).

Three participants were found later to be ineligible and were considered post-randomisation exclusions, two due

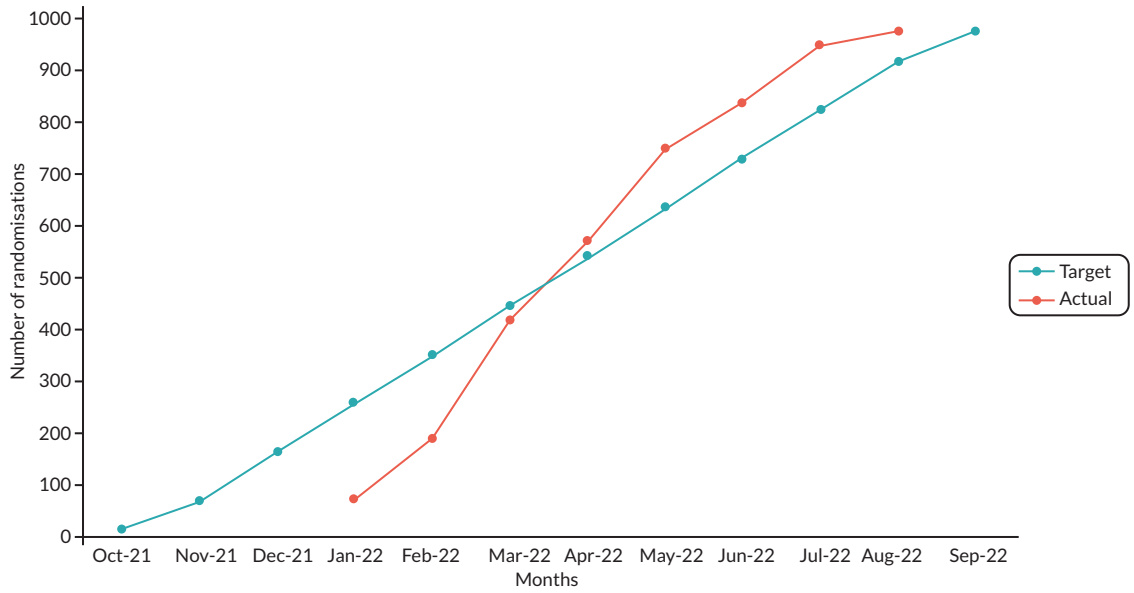

FIGURE 1 Randomisations by month.

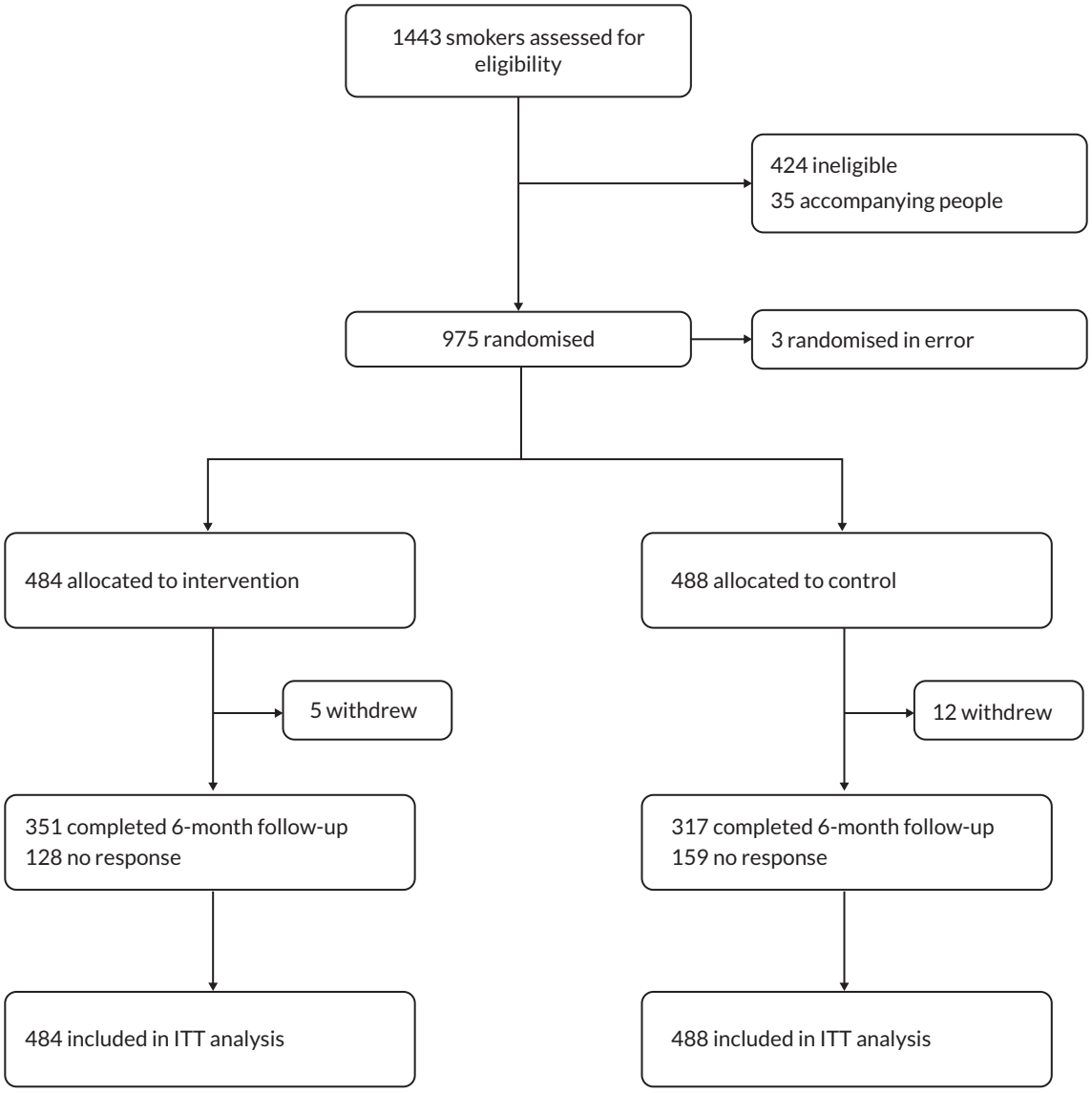

FIGURE 2 Trial profile for the ITT population.

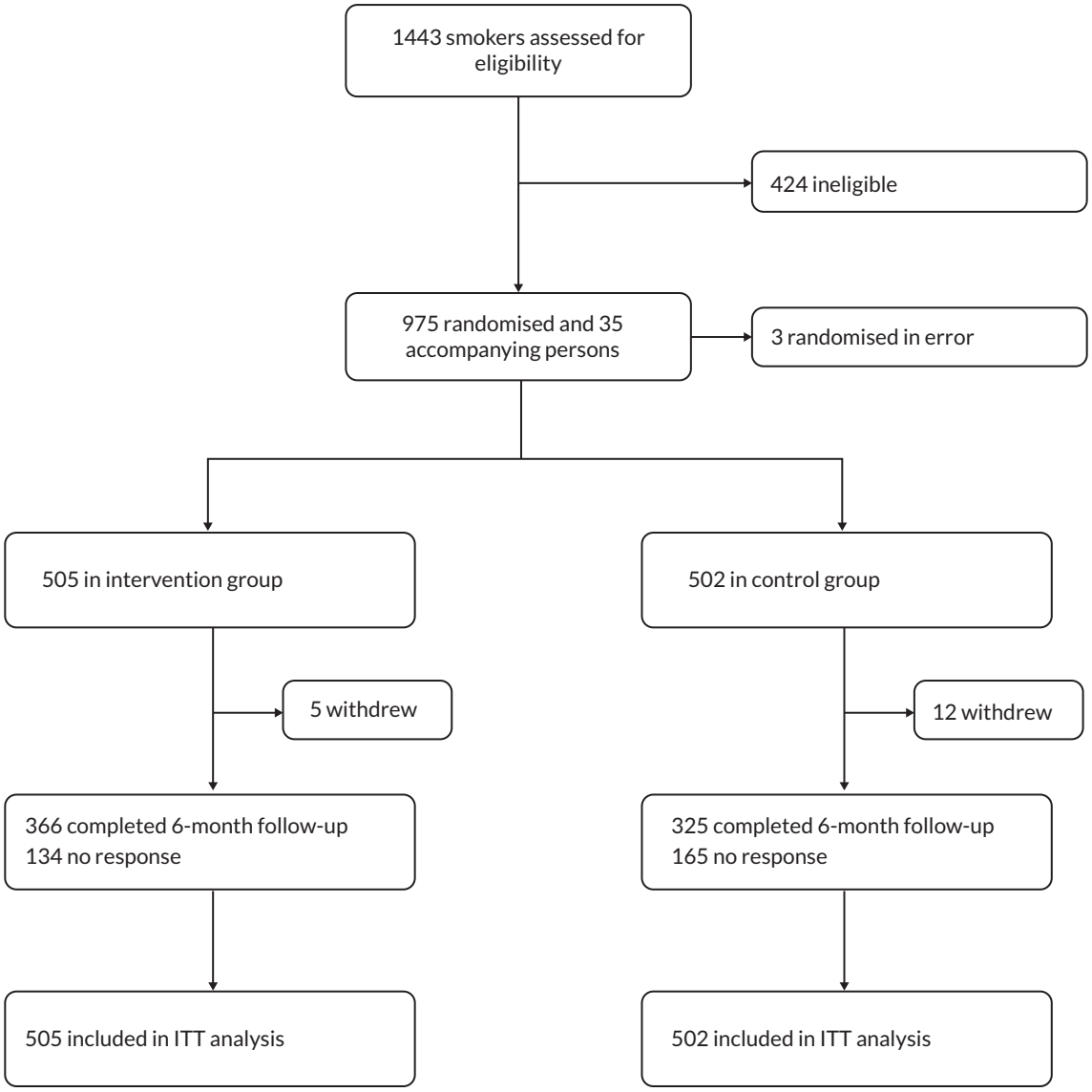

FIGURE 3 Trial profile for the ITT+ population.

to being randomised twice and one who subsequently reported daily use of an e-cigarette.

There were 5 (1.0%) withdrawals in the intervention group and 12 (2.5%) in the control group. Reasons for withdrawals were: no reason given (n = 7), wanting the intervention (n = 3), did not want to answer the questions (n = 6) and reporting a new allergy to nicotine (n = 1).

Baseline characteristics are reported in *Tables 4* and *5* and were broadly equivalent across groups. In the ITT population, the mean age was 40.52 in intervention group and 40.48 in the control group. The mean deprivation decile was 4.31 in the intervention group and 4.53 in the control group (1 = most deprived, 10 = least), indicating that participants were generally from more deprived neighbourhoods than average. Twenty-eight per cent of participants were unemployed or unable to work due to ill health. The proportion of participants that were White British was 72.9% in the intervention group and 71.7% in the control group. The median number of cigarettes smoked per day was 15 in both intervention and control groups, indicating participants were relatively heavy smokers. The mean score on the FTND was 5, indicating medium nicotine dependence.[33]

Effectiveness outcomes

Biochemically verified self-reported continuous abstinence at 6 months for the ITT population was 7.2% (35/484) in the intervention group and 4.1% (20/488) in the control group [relative risk (RR): 1.76 (95% CI 1.03 to 3.01), risk difference 3.3% (95% CI 0.3 to 6.3)] (*Tables 6* and *7*).

TABLE 4 Baseline characteristics of the ITT population

	Intervention (*n* = 484)	Control (*n* = 488)
Gender		
Male	302 (62.4%)	301 (61.7%)
Female	182 (37.6%)	187 (38.3%)
Mean age (years) (SD)	40.52 (13.58)	40.48 (13.72)
Ethnic origin		
White British	353 (72.9%)	350 (71.7%)
White – other	66 (13.6%)	56 (11.5%)
Black	29 (6.0%)	28 (5.7%)
South Asian	28 (5.8%)	36 (7.4%)
Other	7 (1.5%)	17 (3.5%)
Refused/missing	1 (0.2%)	1 (0.2%)
Mean deprivation decile (SD)	4.31 (2.57)	4.53 (2.61)
Employment status		
Employed	291 (60.1%)	305 (62.5%)
Unemployed	50 (10.3%)	46 (9.4%)
Unable to work due to sickness or disability	89 (18.4%)	87 (17.8%)
Carer, retired or student	52 (10.7%)	50 (10.3%)
Other	2 (0.4%)	0
Median number of cigarettes smoked per day (IQR)	15 (10–20)	15 (10–20)
Mean motivation to quit score (SD)	4.13 (1.58)	4.14 (1.62)
Mean age started smoking (SD)	16.13 (5.06) (*n* = 484)	15.51 (4.14) (*n* = 487)
Mean FTND score (SD)	4.94 (2.27)	4.84 (2.34)
Use of NRT in last 3 months	42 (8.7%)	46 (9.4%)
Use of e-cigarettes in the last 3 months		
Not used	353 (72.9%)	369 (75.6%)
Once a month of less	39 (8.1%)	55 (11.3%)
On 2–4 days a month	36 (7.4%)	20 (4.1%)
On 2–3 days a week	26 (5.4%)	23 (4.7%)
On 5–6 days a week	30 (6.2%)	21 (4.3%)
Daily	0	0
Lives with other smoker(s)	214 (44.2%)	185 (37.9%)
Recruitment by site		
Norfolk and Norwich University Hospital	199 (41.1%)	201 (41.2%)
Royal London Hospital	84 (17.4%)	84 (17.2%)
Homerton University Hospital	54 (11.2%)	53 (10.9%)
Leicester Royal Infirmary	74 (15.3%)	76 (15.6%)
Royal Infirmary of Edinburgh	50 (10.3%)	50 (10.3%)
Addenbrooke's Hospital	23 (4.8%)	24 (4.9%)

IQR, interquartile range; SD, standard deviation.

TABLE 5 Baseline characteristics of the ITT+ population

	Intervention (*n* = 505)	Control (*n* = 502)
Gender		
Male	310 (61.4%)	305 (60.8%)
Female	195 (38.6%)	196 (39.0%)
Prefer to self-define	0	1 (0.2%)
Mean age (years) (SD)	40.42 (13.55)	40.44 (13.67)
Ethnic origin		
White British	367 (72.7%)	362 (72.1%)
White – other	69 (13.7%)	57 (11.4%)
Black	32 (6.3%)	28 (5.6%)
South Asian	28 (5.5%)	36 (7.2%)
Other	7 (1.4%)	18 (3.6%)
Refused/missing	2 (0.4%)	1 (0.2%)
Mean deprivation decile (SD)	4.30 (2.59) (*N* = 499)	4.52 (2.62) (*N* = 497)
Employment status		
Employed	303 (60.0%)	311 (62.0%)
Unemployed	53 (10.5%)	48 (9.6%)
Unable to work due to sickness or disability	94 (18.6%)	90 (17.9%)
Carer, retired or student	53 (10.5%)	53 (10.6%)
Other	2 (0.4%)	0
Median number of cigarettes smoked per day (IQR)	15 (10–20)	15 (10–20)
Mean motivation to quit score (SD)	4.13 (1.59)	4.15 (1.62)
Mean age started smoking (SD)	16.08 (5.03) (*N* = 505)	15.49 (4.10) (*N* = 501)
Mean FTND score (SD)	4.94 (2.28)	4.87 (2.35)
Use of NRT in last 3 months	43 (8.5%)	49 (9.8%)
Use of e-cigarettes in the last 3 months		
Not used	364 (72.1%)	376 (74.9%)
Once a month of less	42 (8.3%)	56 (11.2%)
On 2–4 days a month	39 (7.7%)	22 (4.4%)
On 2–3 days a week	28 (5.5%)	26 (5.2%)
On 5–6 days a week	32 (6.3%)	22 (4.4%)
Daily	0	0
Lives with other smoker(s)	229 (45.4%)	194 (38.7%)
Recruitment by site		
Norfolk and Norwich University Hospital	207 (41.0%)	206 (41.0%)
Royal London Hospital	89 (17.6%)	87 (17.3%)
Homerton University Hospital	54 (10.7%)	54 (10.8%)
Leicester Royal Infirmary	81 (16.0%)	81 (16.1%)
Royal Infirmary of Edinburgh	51 (10.1%)	51 (10.1%)
Addenbrooke's Hospital	23 (4.6%)	23 (4.6%)

In total, 351 (72.5%) participants in the intervention group and 317 (65.0%) in the control group reported their smoking status at 6 months (*Figure 1*). Of those who reported continuous abstinence, 35/122 (28.7%) in the intervention group and 20/64 (31.3%) in the control group, went on to have their abstinence biochemically verified. Sixty-eight participants in the intervention group and 32 in the control group declined to provide a CO reading or were non-contactable, and 19 in the intervention group and 12 in the control group had a CO reading ≥ 8 ppm.

Secondary outcomes

Self-reported 7-day abstinence at 1 month was 19.4% (94 of 484) in the intervention group and 10.0% (49 of 488) in the control group [RR 1.92 (95% CI 1.39 to 2.64); $p < 0.0001$]. At 3 months, it was 23.3% (113 of 484) in the intervention group and 11.9% (58 of 488) in the control group [RR 1.97 (95% CI 1.47 to 2.63); $p < 0.0001$], and at 6 months, it was 23.3% (113 of 484) in the intervention group and 12.9% (63 of 488) in the control group [RR 1.80 (95% CI 1.36 to 2.38); $p \leq 0.0001$] (*Tables 8* and *9* and *Figure 4*).

The number needed to treat to achieve biochemically validated smoking continuous abstinence at 6 months was 30 (95% CI 16 to 343), and for self-reported abstinence at 6 months, it was 9 (95% CI 6 to 11).

At 6 months, the median number of quit attempts was 2 in the intervention group (IQR = 1–4) and 1 in the control group (IQR = 0–3) ($p \leq 0.0001$).

Of those who responded, the number of participants using an e-cigarette daily at 6 months was 39.4% (125 out of 317) in the intervention group and 17.5% (53 out of 303) in the control group.

TABLE 6 Abstinence rates at different time points for the ITT population

	Intervention	Control	Absolute difference (95% CI)	*p*-value	Relative risk (95% CI)	*p*-value
Primary outcome: biochemically validated self-reported continuous smoking abstinence at 6 months	35 (7.2%)	20 (4.1%)	3.3 (0.3 to 6.3)	0.032	1.76 (1.03 to 3.01)	0.038
Self-reported 7-day abstinence at 1 month	94 (19.4%)	49 (10.0%)	9.0 (4.9 to 13.7)	< 0.0001	1.92 (1.39 to 2.64)	< 0.0001
Self-reported 7-day abstinence at 3 months	113 (23.3%)	58 (11.9%)	11.3 (6.6 to 16.1)	< 0.0001	1.97 (1.47 to 2.63)	< 0.0001
Self-reported 7-day abstinence at 6 months	113 (23.3%)	63 (12.9%)	10.6 (5.86 to 15.41)	< 0.0001	1.80 (1.36 to 2.38)	< 0.0001
Self-reported 7-day abstinence at 6 months, biochemically validated	36 (7.4%)	22 (4.5%)	3.3 (0.1 to 6.5)	0.038	1.65 (0.98 to 2.76)	0.057

TABLE 7 Abstinence rates at different time points for the ITT+ population

	Intervention	Control	Absolute difference (95% CI)	*p*-value	Relative risk (95% CI)	*p*-value
Primary outcome: biochemically validated self-reported continuous smoking abstinence at 6 months	38 (7.5%)	20 (4.0%)	3.7 (0.7 to 6.7)	0.015	1.89 (1.12 to 3.20)	0.018
Self-reported 7-day abstinence at 1 month	97 (19.2%)	51 (10.2%)	9.0 (4.7 to 13.3)	< 0.0001	1.88 (1.37 to 2.57)	< 0.0001
Self-reported 7-day abstinence at 3 months	116 (23.0%)	60 (11.6%)	10.9 (6.2 to 15.6)	< 0.0001	1.92 (1.44 to 2.56)	< 0.0001
Self-reported 7-day abstinence at 6 months	119 (23.6%)	66 (13.2%)	10.5 (5.82 to 15.26)	< 0.0001	1.78 (1.36 to 2.35)	< 0.0001
Self-reported 7-day abstinence at 6 months, biochemically validated	39 (7.7%)	22 (4.4%)	3.7 (0.6 to 6.8)	0.018	1.76 (1.06 to 2.92)	0.029

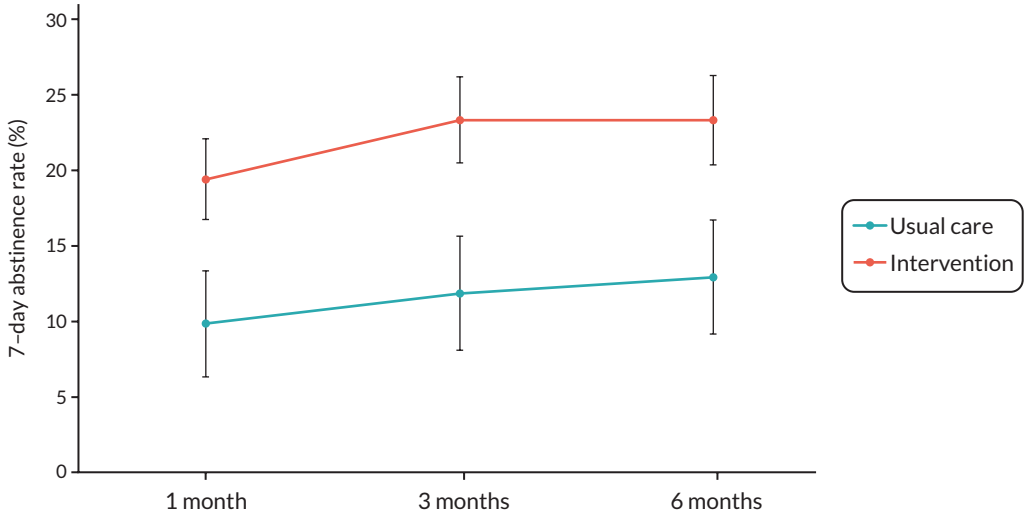

FIGURE 4 Self-reported abstinence rates at 1, 3 and 6 months for the ITT population.

TABLE 8 Secondary outcome measures for the ITT population

	Intervention	Control	Absolute difference (95% CI)	*p*-value
Number of cigarettes smoked at 6 months, median (IQR)	0 (0–10) *n* = 328	10 (0–15) *n* = 291	−8 (−10.39 to 5.61)	< 0.0001
Number of quit attempts, median (IQR)	2 (1–4) *n* = 190	1 (0–3) *n* = 234		< 0.0001
Number of times using an e-cigarette per day at 6 months, median (IQR)	5 (0–10) *n* = 185	0 (0–3) *n* = 246	5 (4.01 to 5.99)	< 0.0001
Frequency of e-cigarette use in past 6 months, n (%):				< 0.0001[a]
Not used	47 (14.8%)	165 (54.5%)		
Once a month of less	39 (12.3%)	24 (7.9%)		
On 2–4 days a month	32 (10.1%)	25 (8.3%)		
On 2–3 days a week	52 (16.4%)	23 (7.6%)		
On 5–6 days a week	22 (6.9%)	13 (4.3%)		
Daily	125 (39.4%)	53 (17.5%)		
Dry cough in last week, at 6 months, median (IQR) n (%)	1 (1 – 2) *N* = 310	1 (1 – 3) *N* = 292		0.344
1 (not at all)	174 (56.1%)	154(52.7%)		
2	60 (19.4%)	57 (19.5%)		
3	46(14.8%)	47 (16.1%)		
4	17 (5.5%)	22 (7.5%)		
5 (extremely)	13 (4.2%)	12 (4.1%)		
Throat/mouth irritation in last week, at 6 months, median (IQR) n (%)	1 (1 – 2) *N* = 310	1 (1 – 2) *N* = 293		0.117
1 (not at all)	206 (66.5%)	176(60.1%)		
2	46 (14.8%)	49 (16.7%)		

TABLE 8 Secondary outcome measures for the ITT population (*continued*)

	Intervention	Control	Absolute difference (95% CI)	*p*-value
3	31 (10.0%)	41 (14.0%)		
4	17 (5.5%)	19 (6.5%)		
5 (extremely)	10 (3.2%)	8 (2.7%)		
Motivation to quit median (IQR)	4 (3–5) (*N* = 177)	4 (2–5) (*N* = 227)		0.432
FTND: mean (SD)	3.70 (2.21) (*N* = 185)	4.17 (2.24) (*N* = 224)	−0.51 (−0.95 to −0.07)	0.022

a *p*-value is for use of e-cig (yes/no) at 6 months (data not shown).

TABLE 9 Secondary outcome measures for the ITT+ population

	Intervention	Control	Absolute difference (95% CI)	*p*-value
Number of cigarettes smoked at 6 months, median (IQR)	0 (0–10) *n* = 314	10 (0–15) *n* = 283	−8 (−10.41 to 5.59)	< 0.0001
Number of quit attempts, median (IQR)	2 (1–4) *n* = 183	1 (0–3) *n* = 229		< 0.0001
Number of times using an e-cigarette per day at 6 months, median (IQR)	5 (0–10) *n* = 176	0 (0–3) *n* = 239	5 (4.04 to 5.96)	< 0.0001
Frequency of e-cigarette use in past 6 months, n (%):				< 0.0001[a]
Not used	48 (14.5%)	168 (54.0%)		
Once a month of less	40 (12.1%)	25 (8.0%)		
On 2–4 days a month	34 (10.3%)	25 (8.0%)		
On 2–3 days a week	54 (16.3%)	23 (7.4%)		
On 5–6 days a week	24 (7.3%)	13 (4.2%)		
Daily	131 (39.6%)	57 (18.3%)		
Dry cough in last week, at 6 months, median (IQR) n (%)	1 (1 – 2) *N* = 324	1 (1 – 3) *N* = 300		0.453
1 (not at all)	182 (56.2%)	160 (52.7%)		
2	62 (19.1%)	59 (19.7%)		
3	47(14.5%)	47 (15.7%)		
4	20 (6.2%)	22 (7.3%)		
5 (extremely)	13 (4.0%)	12 (4.0%)		
Throat/mouth irritation in last week, at 6 months, median (IQR) n (%)	1 (1 – 2) *N* = 324	1 (1 – 2) *N* = 301		0.241
1 (not at all)	213 (65.7%)	184 (61.1%)		
2	50 (15.4%)	49 (16.3%)		
3	32 (9.7%)	41 (13.6%)		
4	19 (5.9%)	19 (6.3%)		

continued

TABLE 9 Secondary outcome measures for the ITT+ population (*continued*)

	Intervention	Control	Absolute difference (95% CI)	*p*-value
5 (extremely)	10 (3.1%)	8 (2.7%)		
Motivation to quit median (IQR)	4 (3–5) (*N* = 184)	4 (2–5) (*N* = 232)		0.419
FTND: mean (SD)	3.71 (2.21) (*N* = 192)	4.16 (2.24) (*N* = 229)	−0.48 (−0.91 to −0.05)	0.029

a *p*-value is for use of e-cig (yes/no) at 6 months (data not shown).

Safety outcomes

The number of participants reporting serious adverse events was 5.2% (25 of 484) in the intervention group and 5.1% (25 of 488) in the control group (*Tables 10* and *11*). None were related to the intervention.

TABLE 10 Adverse event by type in the ITT population

	Intervention	Control
	N = 484	*N* = 488
Serious adverse events (one or more) n (%)	25 (5.2%)	25 (5.1%)
Adverse events (one or more)		
Throat/mouth irritation (extreme) *n* (%)	10 (3.2%) (*n* = 310)	8 (2.7%) (*n* = 293)
Dry cough (extreme) *n* (%)	13 (4.2%) (*n* = 310)	12 (4.1%) (*n* = 292)

TABLE 11 Adverse event by type in the ITT+ population

	Intervention	Control
	N = 505	*N* = 502
Serious adverse events (one or more) n (%)	27 (5.4%)	26 (5.2%)
Adverse events (one or more)		
Throat/mouth irritation (extreme) *n* (%)	10 (3.1%) (*n* = 324)	8 (2.7%) (*n* = 301)
Dry cough (extreme) *n* (%)	13 (4.0%) (*n* = 324)	12 (4.0%) (*n* = 300)

Economic evaluation results

Treatment costs

The training costs for the CoSTED intervention were estimated at £6690, equalling £14 per participant. The mean duration of brief advice was 25.7 minutes (SD 7.3 minutes). The mean costs of intervention were £48 (SD £3) per participant.

All participants in the control group were given the referral card, making the mean control costs £0.20 (SD £0) per participant.

Missing data

Most missing values were due to lost-to-follow-up rather than individual items missing, leading to higher level of missing values in the control group than in the intervention group. After examining the missing data, the multiple imputation model included the baseline covariates (age, gender, FTND, if there are other smokers in the household, reason for ED attendance, and ED), outcome measures at baseline and 6 months [costs of smoking cessation advice, spending on e-cigarette, EQ-5D-5L utility and visual analogue scale (VAS)], costs of healthcare services at baseline, and outcome measures at 6 months (CO-validated abstinence, costs of NRT, varenicline and bupropion, costs of primary care services, costs of secondary care services, and spending on NRT). Outcome variables were imputed using predictive mean matching, with the 10 closest neighbouring values to draw from (19). The number of multiple imputations was set as 45.

Primary analysis

The mean control and intervention costs per CO-validated sustained abstainer were £5 [standard error (SE) £1] and £657 (SE £107), respectively. Including costs of smoking cessation over the 6 months, mean costs of achieving one case of CO-validated sustained abstinence were £597 (SE £164) in the control group and £876 (SE £151) in the intervention group. The incremental cost of intervention/

control and smoking cessation per additional abstainer was £1255 (95% CI £550 to £6090).

The mean total costs over the 6-month period in the control group were £1651 (SE £276) and in the intervention group were £1408 (SE £171) (*Table 12*). After adjustment, the mean total costs in the intervention group were higher than in the control group by £31 (95% CI −£341 to £283). The mean QALYs over the 6-month period were 0.290 (SE 0.007) in the control group and 0.303 (SE 0.006) in the intervention group. After adjustment, the mean QALYs in the intervention group were 0.004 (95% CI −0.004 to 0.014) higher than in the control group. The intervention was more costly and more effective than UC, where ICER was calculated at £7750 per QALY gained. The probability of cost-effectiveness between £20,000/QALY gain and £30,000/QALY gain was shown from 71.1% to 71.3% (*Figure 5*).

Sensitivity analyses

Using self-reported outcomes, the mean costs of control and intervention were £2 (SE £0) and £189 (SE £15) per 6-month abstainer, respectively. *Figure 6* illustrates the 7-day quit rate at 1, 3 and 6 months and the respective control/intervention costs per quit.

In total, 285 participants in the control group and 296 participants in the intervention group were included in the CCA. The complete cases appeared slightly older and consisted of higher proportion of females. Adjusted incremental costs were −£43 (95% CI −559 to £278), and adjusted mean QALYs were 0.002 (95% CI −0.010 to 0.013). The probability of cost-effectiveness at £20,000/QALY–£30,000/QALY was 71.3% to 71.1%.

The MNAR scenarios (1) and (2) resulted in adjusted incremental costs decreased with the increase of imputed costs, and adjusted incremental QALYs increased with the decrease of imputed utilities. Scenario (3) reported

TABLE 12 Results of primary analysis, CCA and analysis of broader sample

	Control (*n* = 488)	Intervention (*n* = 484)
Mean (SE)		
Baseline		
Costs of smoking cessation and healthcare services	£710 (96)	£631 (110)
Costs of UC/intervention	£0 (0)	£48 (0)
CO-verified 6-month abstinence	4.1% (0.9%)	7.2% (1.2%)
Costs of UC/intervention per quitter	**£5 (1)**	**£657 (107)**
Over 6 months' period		
Costs of smoking cessation	£24 (4)	£16 (4)
Costs of primary care services	£133 (12)	£127 (12)
Costs of secondary care services	£1494 (274)	£1218 (169)
Total costs	**£1651 (276)**	**£1408 (171)**
EQ-5D-5L utility		
Baseline	0.527 (0.015)	0.550 (0.015)
6 months	0.634 (0.017)	0.660 (0.016)
QALYs	**0.290 (0.007)**	**0.303 (0.006)**
Mean (95% CI)		
Adjusted incremental costs	£31 (−£341 to £283)	
Adjusted incremental QALYs	0.004 (−0.004 to 0.014)	
ICER	£7750 per QALY gained (uncertainty, see *Figure 5*)	

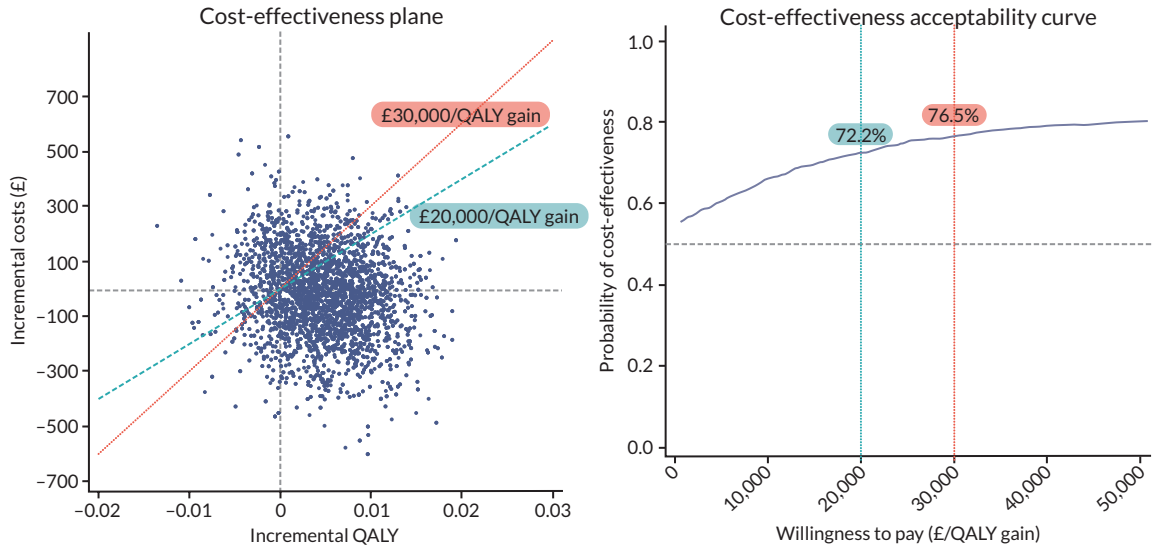

FIGURE 5 Cost-effectiveness plane (left) and CEACs (right) of primary analysis.

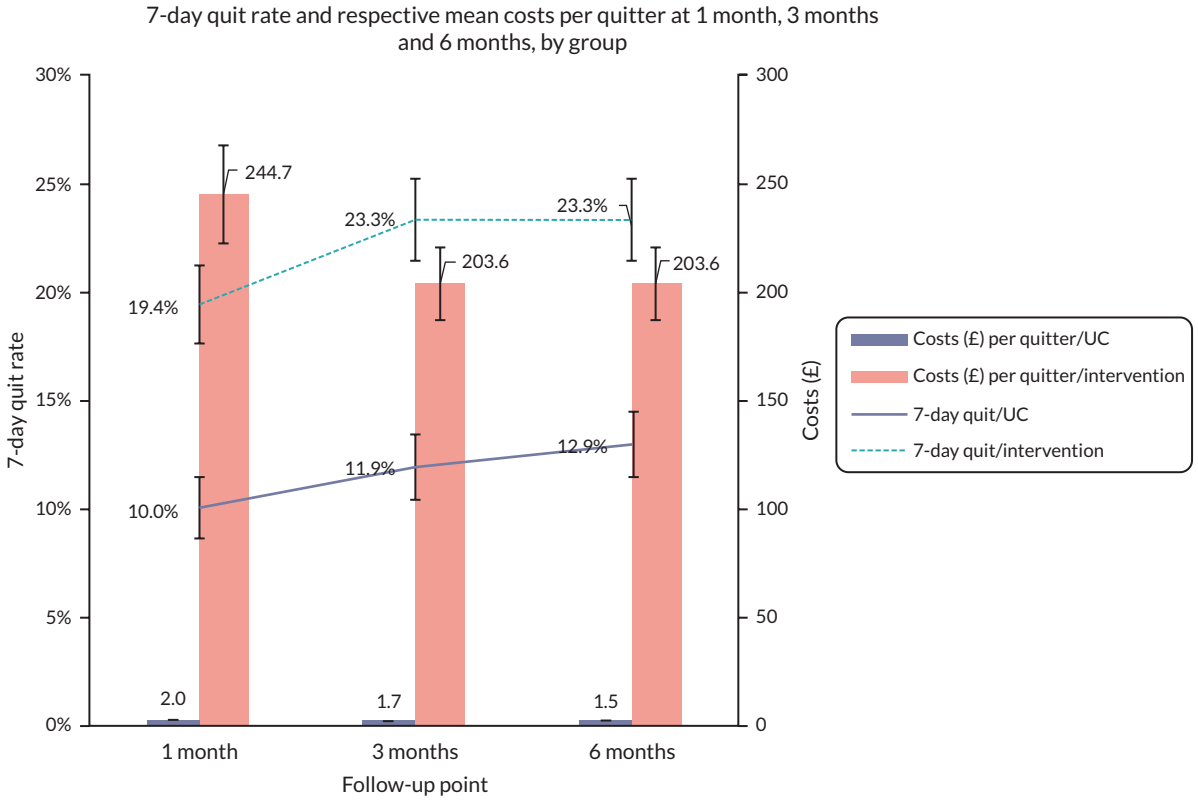

FIGURE 6 Seven-day quit at 1, 3 and 6 months and their respective UC/intervention costs per quit.

highest ICER at £5217/QALY gain when both changed by 10% and lowest ICER at £1765/QALY gain when both changed by 30%.

Secondary analyses

After adjustment, the mean spending on smoking cessation aids in the intervention group was £45 (95% CI £32 to £63) higher than in the control group.

The ITT+ sample led to slightly lower costs and higher QALYs, as accompanying persons were not seeking medical treatment. Adjusted incremental costs were £28 (95% CI −£322 to £319), and adjusted incremental QALYs were 0.003 (95% CI −0.005 to 0.013), with ICER calculated at £9333 per QALY (probability of cost-effectiveness at £20,000–£30,000: 61.0–64.8%).

The estimated mean lifetime SACs and QALY gains of control and intervention were similar (*Table 13*). Compared to control, the intervention was £32 more costly per person but 0.029 QALYs more effective. The lifetime ICER was estimated at £1131 per QALY gained, with probability of cost-effectiveness between £20,000 and £30,000 plateauing at 54% (*Figures 7* and *8*). This was largely due to projected quit rates after 10 years being very similar between groups (13.3% in control vs. 14.2% in intervention).

Process evaluation results

The process evaluation findings related to context are published.[68] Further findings on mechanisms of change and cessation pathways are in preparation. Findings are reported in summary form here.

TABLE 13 Results of model-based incremental cost-effectiveness analysis

	Control mean (SE)	Intervention mean (SE)	Incremental outcomes mean (95% CI)
Quit defined as CO-verified abstinence at 6 months			
Costs	£2368 (£3)	£2400 (£3)	£32 (−£163 to £231)
QALYs	25.507 (0.037)	25.535 (0.037)	0.029 (−0.489 to 0.847)
ICER	£1131 per QALY gained (uncertainty, see *Figure 7*)		
Quit defined as self-reported abstinence at 6 months			
Cost	£2348 (£3)	£2361 (£3)	£13 (−£186 to £207)
QALYs	25.552 (0.037)	25.626 (0.037)	0.074 (−0.746 to 0.898)
ICER	£174 per QALY gained (uncertainty, see *Figure 8*)		

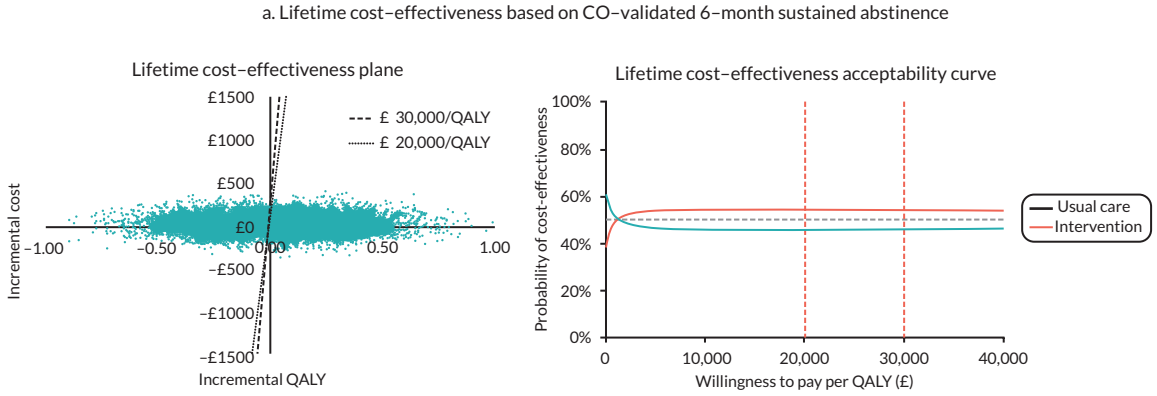

FIGURE 7 Lifetime cost-effectiveness plane and CEACs estimated by model projection (6-month CO-validated sustained abstinence).

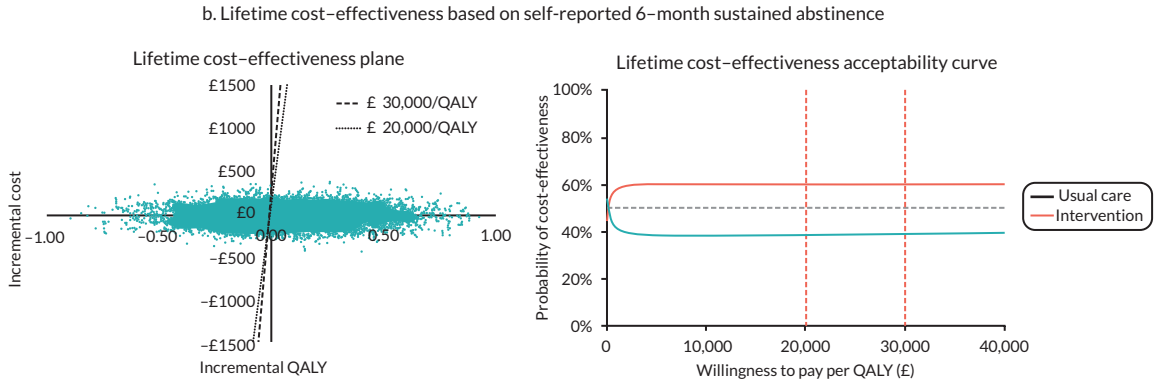

FIGURE 8 Lifetime cost-effectiveness plane and CEACs estimated by model projection (6-month self-reported abstinence).

Qualitative interviews captured the views of a wide range of ED-based staff involved in delivering the intervention (n = 11) across all sites. Our purposive sampling of trial participants meant that we spoke to a wide range of people representing diverse characteristics (*Table 14*).

Qualitative data revealed contextual influences that both positively and negatively influenced how staff delivered and how participants received the intervention. For example, participants talked about the setting being the 'right time, right place' for them to consider smoking cessation.

TABLE 14 Participant interview sample

	Trial participants (interview subsample n = 34)
Site	
Site 1	12
Site 2	6
Site 3	6
Site 4	3
Site 5	5
Site 6	2
Sample group	
Intervention – quit	7
Intervention – harm reduction (reduced smoking and/or uptake of vaping)	12
Intervention – no/limited change	5
Usual care	10
Gender	
Male	20
Female	14
Age (years)	
Mean (range)	44 (20–70)
20–29	6
30–39	8
40–49	5
50–59	10
60 +	5
Ethnicity	
Asian Bangladeshi	2
Asian other	1
Black British	1
Black Caribbean	2
White British	23
White Eastern European	2
White Irish	2
White other	1

For the majority of participants interviewed, having the intervention delivered by a medical professional, in a medical setting, gave it credibility, and legitimised vaping.

The context of the ED with lengthy average waiting times seemed to facilitate acceptability. From the perspectives of participants, waiting around acted as a positive incentive to take part in a study and to allow the time to receive the intervention, since they were resigned to 'passing the time':

At some sites, smoking was banned on the premises, but vaping was permitted. Particularly in contexts with 'vape-friendly' site policies, the environment was felt to further legitimise and support vaping as part of a smoking quit attempt.

Advisors had to be flexible and adaptable to deliver the intervention alongside clinical care. However, despite challenges, advisors generally found patients accepting of interruptions and adaptations. Flexibility was also shown in use of locations, including the waiting room, trolley space, consulting rooms and outside (where a participant wanted to try the vape).

Observations gave confidence that advisors had a good level of understanding of smoking cessation, the health benefits of switching to vaping and detailed technical knowledge about the specific device provided. This demonstrable knowledge ensured that key intervention components were delivered, and fidelity to the manual was high overall. However, some deviations to intervention delivery were noted, primarily influenced by the context. For example, sometimes intervention delivery was cut short due to interruptions for care.

Advisors had a variety of professional backgrounds, for example, research nurse, ED nurse, healthcare assistant and peer support worker. Each bought a unique skill set and experience to the role but received the standardised COSTED training package. There were no discernible across-site differences in smoking cessation outcomes.

Interview and observation data were analysed to explore mechanisms of impact. Thematic analysis focused on participant responses to and interactions with the intervention, informed by the COM-B theoretical framework of behavioural change.[29] The key findings are outlined below:

- **Enhancing capability:** Providing encouragement and information on switching to vaping, from a credible source within a healthcare setting, perceived as enhancing 'psychological capability' (furthering knowledge and enabling decision-making). 'Physical capability' was improved by guidance on effective use of an e-cigarette and provision of a device with good functionality and appeal. Boredom and lack of alternative distractions while waiting in the ED were described by participants as providing a facilitative context for engagement.
- **Enhancing opportunity:** Interview data revealed that the trial was successful in opportunistically engaging hard-to-reach or low-motivated smokers, who may not have actively sought support or purchased a vape.
- **Enhancing motivation:** A motivational impetus was described in relation to (a) receipt of the intervention at a time of heightened health awareness due to the presenting condition fostering a frame of mind to contemplate change; (b) the perception of the intervention as an opportunity for a non-committal switch attempt; and (c) positive, supportive and non-judgmental interactions with advisors delivering the intervention.

Barriers to impact

Some participants' quit attempts faltered because of limited product availability. Others reported trying the vape but finding it ineffective. Referral to local SSSs, an intervention component, was rarely taken up, indicating an important role for alternative approaches to ongoing support.

A secondary mixed-methods analysis was undertaken to explore participant smoking pathways between intervention delivery and 6-month follow-up. The aim was to understand what happened to participants between intervention delivery and follow-up. The sample included 366 participants who received the intervention and provided 6-month follow-up data, including 24 participants who additionally participated in a qualitative interview. Results showed that some quitters switched almost immediately after initiating EC use, whereas others relapsed before quitting or gradually cut down, experiencing a period of 'dual use'. Qualitative data suggested that those participants who managed to maintain a quit, compared to those that were still smoking at follow-up, perceived themselves to have strong intrinsic motivation, had more satisfaction with the EC, were able to use other quitting strategies and were in an environment that was more conducive to quitting. Dual use was associated with a reduction of smoking, and although all those still smoking discussed stress and opportunity to smoke as being key drivers for their continued smoking, those who had reduced had found more satisfaction with vaping. Around a fifth of participants who quit or reduced had used an EC

less than a month or not at all during the study period. Qualitative data suggested that the quit or reduction was instead in part due to change in circumstance reducing opportunities or desire to smoke, but also the brief advice given at the hospital as part of the intervention had brought awareness to their smoking, had built quitting confidence and, in some cases, prompted seeking additional stop smoking support/treatment.

Principal findings

The overall findings of the study were that:

- It is feasible to recruit people to a stop smoking trial in EDs.
- The people recruited are from more deprived neighbourhoods than the average in the population, and many are from underserved groups.
- The COSTED intervention is effective in achieving increased smoking abstinence compared to UC at 6 months.
- Participants were positive about receiving a stop smoking intervention in the ED.
- There was no difference in outcomes across sites, suggesting that the intervention can be flexibly employed and adaptable to different ED contexts.
- There were different 'pathways' to cessation, with some people instantly switching and others more gradually switching away from tobacco.
- The intervention is cost-effective when compared to the NICE threshold.

Trial strengths

The strengths of this trial are:

- It is the first UK ED smoking cessation trial ever conducted and the first trial worldwide to incorporate e-cigarettes into an ED-based smoking cessation intervention.
- It was a large, robustly conducted RCT.
- The inclusion criteria were very broad, meaning the results have good generalisability.
- The primary outcome was a rigorous, internationally accepted outcome measure.
- The intervention is simple and easy to administer, meaning it could easily be rolled out.
- The in-depth process evaluation provides extensive insight into the mechanisms of action of the intervention.
- The economic evaluation provided detailed information about cost-effectiveness over the short and long term.

Challenges faced and trial limitations

Challenges faced and limitations of the trial were:

- Some sites faced more difficulties with recruitment than others, and therefore there is not balanced recruitment between the sites.
- Control participants received a dose of the intervention (above UC) by undergoing CO testing, being asked questions about their smoking behaviour, being given contact details for local SSSs and potentially receiving some advice about quitting; this may have reduced the effect size of the intervention in comparison to control.
- Due to the characteristics of the population recruited, achieving follow-up (both self-reported and CO readings) was very challenging, despite extensive efforts. This resulted in differences in follow-up between intervention and control and relatively low levels of biochemical verification when compared to the sample size calculation.
- The assumption that those who did not reply or provide a CO reading were still smoking, while well accepted in smoking cessation trials, may be conservative.
- There were very low levels of engagement with SSSs (one of the intervention components), which may have reduced the potential intervention effectiveness.
- Abstinence at 6 months does not necessarily equate to long-term abstinence.
- Twelve months is a more widely used end point; however, this was not possible due to timing constraints.
- Carbon monoxide testing, while commonly used, has some limitations, including that those who have not smoked for ~2 days would have very low CO level and therefore may be misclassified as abstinent when in fact they had smoked recently.

While the biochemically confirmed quit rates in the intervention and control groups were not as large as the power calculation had been based on, the self-reported continuous abstinence rates were much larger.

Contribution to existing knowledge

- This trial has, for the first time, provided evidence of effectiveness of an ED-based smoking cessation intervention in the UK setting.
- For the first time, the provision of e-cigarettes in the ED setting was shown to be acceptable to participants and effective in achieving smoking abstinence at 6 months.

- The outcomes contribute to the existing evidence base of ED based smoking cessation intervention effectiveness.

Take-home messages

- It is feasible and acceptable to deliver a stop smoking intervention to people in the ED and those who are recruited are from more deprived neighbourhoods and from underserved groups.
- An ED-based smoking cessation intervention incorporating brief advice, provision of an e-cigarette starter kit and referral to SSSs is effective in achieving smoking abstinence.
- The intervention is cost-effective in the shorter term in comparison to the NICE threshold.

Reflections on the project

Our original project proposal did not include recruitment of accompanying people attending the ED with patients. As suggested by peer reviewers, we adapted the protocol to include accompanying people, who were offered the intervention alongside their randomised patient, (but excluded from the analysis), or were able to be recruited in their own right and randomised, if the patient they were accompanying did not consent to be involved in the study. This design has complicated the analysis as requires a separate analysis for the 'ITT+' population, with few additional people (n = 35). At the time of recruitment, many EDs still had restrictions in place, preventing accompanying people from entering the ED, which limited this pool of potential recruits substantially. The additional procedures and analysis required to include the accompanying people was perhaps an unnecessary complication.

We drew on additional resources (e.g. medical student interns) to assist with 1-, 3- and 6-month follow-ups. This was more onerous and time-consuming than anticipated, which was potentially due to the 'hard-to-contact' nature of the population. In hindsight, the trial would have benefited from additional trial administrator support.

Obtaining CO readings at 6-month follow-up for bio-chemical validation of the primary outcome was the most challenging aspect of the trial. Advanced planning to collect CO readings remotely or in person in the community would have benefited us, and additional planning/resource/capacity to collect CO readings is essential for future trials adopting a similar follow-up procedure. Although research nurses at site had agreed to collect CO readings, they were unwilling or unable to collect readings outside of the ED for a number of reasons, and many participants were unwilling or unable to attend the ED for follow-up appointments. Planning to link with community-based research support teams would have been beneficial, as although we did receive some support from the CRNs, this was limited as it had not been planned from the start.

There were relatively high levels of ongoing use of e-cigarettes in the intervention group – this we see as a positive due to reducing the risk of relapse to smoking. However, there are differences in opinion regarding the ongoing use of nicotine in the context of uncertainty regarding the long-term impacts of e-cigarette use. We did not collect data regarding future wishes for e-cigarette cessation.

Engagement with partners and stakeholders

We had very good engagement with partners and stakeholders. Chief investigators made in-person site visits, and the trial manager was in regular communication with sites. We worked hard to build rapport and a virtual team. We engaged with the local SSSs in each site to link to the trial. Smokefree Norfolk collaborated with us to develop and provide the bespoke intervention training.

Chief investigator Caitlin Notley is a member of the Norfolk Tobacco Control Alliance, with good links to the local authority (commissioners of the SSS) and the third sector. Chief investigator Ian Pope retained his clinical ED role, positively facilitating engagement at sites.

We engaged throughout with patients and the public, through media press releases promoting the study, social media reporting on trial progress, dissemination at academic and service provider conferences and research forums. Our dissemination event was attended by trial site teams and PIs, PPI members, public health commissioners, representatives from Office for Health Improvement and Disparities (OHID) and National Health Service England (NHSE) and service providers.

Individual training and capacity-strengthening activities

All members of the research team attended dissemination activities, including conferences and the dissemination event. The researchers on the study built capacity and went on to collaborate with colleagues through these events on further funding applications. Dr Pippa Belderson was recruited as a Senior Research Associate to work on this trial and has since gone on to further funded projects in the field of smoking cessation.

We trained medical student interns to assist with follow-up data collection, giving them vital research experience. We also mentored an associate PI through the NIHR Associate PI Scheme.

Institutional capacity strengthening

This trial is the first-ever international trial of a smoking cessation intervention incorporating the offer of an e-cigarette starter kit within the ED setting. This has been a major contribution to the smoking cessation work of the UEA Addiction Research Group, which hosts other large NIHR-funded trials, and contributes to a portfolio of work in this field from intervention development through to implementation. The UEA Addiction Research Group has grown to become a nationally recognised centre of excellence in this field.

Strong links have been developed with the NCTU, who have developed capacity in supporting public health–focused trials.

Patient and public involvement

We sought input and involvement from patient and public involvement (PPI) representatives at key points in the project to ensure the work was a collaboration with patients and members of the public. A total of seven PPI contributors have been involved in the study, with four additional trial participants acting in a PPI capacity via involvement in our dissemination activities. All had experience of smoking and/or vaping and included current smokers and ex-smokers. One had additional experience working in a vape shop. Our PPI participants represented a range of backgrounds and ages and included men and women.

The PPI input, which informed and shaped intervention design and PPI participation in dissemination activities, is summarised below.

Trial and intervention design

- Early scoping for feasibility

Early-stage PPI consultation was conducted with patients in EDs who were positive about the trial, felt it had potential to reach people who smoked who were not actively considering quitting. They also felt that, where appropriately tailored, the intervention could offer an innovative form of smoking cessation support.

- Representation and input at trial meetings

One member of the public was involved as a named member of the TSC, and a further two PPI representatives were part of the Trial Management Group and Expert Advisory Group.

- Informing choice of e-cigarette for use in intervention

Three PPI members contributed to the intervention development as part of a panel to assess selection of vape devices, and were asked to rate each for satisfaction factors and usability. Each then took part in two one-to-one consultations with a member of the research team, which were conducted to contextualise scores and explore views on the appropriateness of devices for the intervention. Overall, the panel felt that refillable devices were complex to set up, and these were excluded along with some closed-pod devices which received mixed feedback on satisfaction. The ease by which consumable could be purchased, including in brick-and-mortar shops, was highlighted as more important than the price. The closed-pod device which was selected for inclusion was rated highly for satisfaction and usability, and had mid-price range consumables which were widely available both in brick-and-mortar shops and online. Feedback from these interviews also helped inform development of the intervention format and content, for example, offering encouragement to try out different devices and flavours, and signposting to vape shops for specialist advice.

- Design of trial materials

Patient and public involvement representatives were consulted about study materials, including participant information sheets, the manualised script for advisors delivering the intervention and interview topic guides. For example, wording such as of 'opportunistic' trial recruitment or 'throw of the dice' to describe randomisation was removed following PPI feedback about potential misinterpretation of these phrases.

Dissemination

- Academic publications

A paper specifically reporting on our PPI process for selection of an appropriate e-cigarette to include in the trial has been *published*.[69] This paper includes direct quotes from members of the PPI panel and was produced

in consultation with them. We will also be sharing our draft process evaluation papers with our PPI panel and will invite them to provide feedback before submission.

- Conferences

The findings from our PPI consultation to select the intervention device have generated substantial informal interest and have been formally presented at The Society for the Study of Addiction (SSA) conference 2021 and the International Conference on the E-Cigarette (Paris 2022).

- Dissemination video

Four trial participants who had taken part in a process evaluation interview were approached about using their experiences and words, featuring audio-clips from interviews, for a dissemination video. A storyboard and 'script' drawn directly from interview data were shared in advance and consent obtained. This film has been shown at the European Society for Research on Nicotine and Tobacco annual conference (September 23) and will be shown at further conferences and events, as well as disseminated via social media (URL: www.youtube.com/watch?v=GvVdz1Ek-Os).

- Dissemination event

We have worked closely with a member of the public who participated in the trial, supporting her to prepare to speak about her experience in the COSTED trial at our dissemination event (October 2023). This event was held to share findings and learning to academics, policy-makers, commissioners and service leads. Her powerful story of switching from smoking to vaping due to taking part in the trial was highly impactful to the audience, bringing to life the real experiences behind the trial outcome data.

Equality, diversity and inclusion

It has been a central concern to ensure our approach throughout the research process has been fully inclusive, offering equality of access to the study for participants, as well as people with diverse characteristics. This has also been reflected in our trial team (co-applicants and researchers).

Language and terminology

Specifically, we have been mindful to use non-discriminatory language. We worked with PPI volunteers to check the inclusivity of trial materials and to ensure that our use of language was acceptable and inclusive.

Consideration of the disease burden, epidemiology, presentation and outcomes the population groups and any differences in the application of existing preventative, screening or diagnostic strategies and treatments

A key principle of our approach to recruitment was being as inclusive as possible, enabling all people attending the ED who smoked tobacco to take part, regardless of presenting condition, motivation to quit smoking or characteristics of the person. This not only ensured good generalisability of the findings of this trial but also gives us confidence that we have reached those populations who are often excluded from either participation in research or access to community-based referral services. The baseline characteristics of our recruited population demonstrate that we were able to recruit people from diverse ethnic groups, from lower-than-average socioeconomic status and with a high number (22) of those presenting with a mental health condition.

In terms of outcomes, we undertook sensitivity analyses exploring outcomes across different groups within our trial population (SES, ethnicity). We found no significant difference in the primary outcome of smoking cessation linked to these characteristics.

We explored the role of baseline characteristics in determining 7-day abstinence. Receiving the intervention was the most powerful predictor of abstinence, and this positive effect was enhanced by older age and having previously used e-cigarettes to help quit smoking.[70]

Generalisability and transferability of evidence

Given our recruited population represents diverse population groups, the generalisability and transferability of our findings is high. Our process evaluation findings demonstrate high acceptability and feasibility of intervention delivery, from both staff and participant perspectives, suggesting that the intervention delivered as part of this trial has high transferability to other EDs and could be widely implementable in practice.

Participant representation

On screening, our trial inclusion criteria were deliberately broad to enable participation by the vast majority of people attending the ED who smoked tobacco. The only exclusions were based on clinical urgency of the presenting condition or current dual use (daily) of an e-cigarette. This enabled us to optimise participation by all groups representing the local populations in each trial site. We purposefully chose EDs across England and Scotland to enable diverse participation by those from a range of ethnic groups and including populations of low SES.

Our trial procedures were purposefully 'light touch' so as to be non-onerous and to enable participation by people with, for example, low levels of literacy. As long as participants had sufficient capacity to give informed consent for participation in the trial, we went to great efforts to include them. Our follow-up approach was remote, via text message and e-mail where possible, promoting wide reach and inclusion. For those that did not have access to a mobile phone or e-mail, we offered paper copies of follow-up materials.

Enrol and retain diverse participants

There were no differences in retention to the study according to baseline demographics. As the trial mainly collected follow-up data remotely, through text message reply, by phone or through clicking on an e-mail link, the procedures could potentially exclude those without access to a telephone or a computer. In this case, we offered paper copies of follow-up questionnaires with stamped addressed envelopes for ease of return and to avoid cost to participants.

Participant data

We undertook a sensitivity analysis to explore any potential impact of participant characteristics on outcomes. We did not find any significant differences in smoking cessation outcomes according to diversity characteristics, demonstrating that the target of the research, smoking cessation, was inclusive across groups; however, the trial was not powered to explore such differences.

Reflections on your research team and wider involvement

Our research team has included a diverse mix of people from different backgrounds, at all levels of career development. Our co-applicants include senior academic, clinical and methodological expertise, and our operational team, supported by the NCTU, has included PhD students, medical students, early career researchers and junior and senior administrators. Our senior leadership team includes both women and men. The team did not include anyone with a disclosed disability or other protected characteristic. Our recruitment processes were entirely open to making necessary adjustments, but we did not have applications for any roles on the trial from those with disclosed disabilities.

We provided development opportunities for all team members and used funding to support development of our early career researchers particularly. This included support to travel to conferences and dissemination activities.

Our PPI members were involved throughout the study, as described in the PPI section. Particularly, we included the real voices of participants in a public-facing dissemination video and involved one trial participant in a PPI capacity to contribute, in person, to our dissemination event. This direct input was invaluable to establishing the importance and impact of the findings, not only aggregated, but on an individual level. Our PPI volunteer, Shonaid, was a valued and important part of the public dissemination event. Personally, she fed back that she had never travelled to London and felt honoured to be able to 'give something back' and possibly have a role in helping others to make the transition away from tobacco smoking. The benefit to her personally of contributing was reciprocated by the benefits that she afforded the research dissemination efforts.

Impact and learning

What difference has been made already?

As a result of the trial, we believe 53 people in the intervention group quit smoking who otherwise would not have done so; this will lead to an improvement in their health and life expectancy.

Implementing the trial has also increased awareness of smoking cessation in the recruiting EDs, with the result that ED staff are more likely to speak to patients about their smoking.

The results of the trial have already been presented to a wide variety of audiences, including emergency medicine clinicians at the Royal College of Emergency Medicine Annual Scientific Conference, tobacco researchers at the Society for Research on Nicotine and Tobacco Europe conference and policy-makers at the NHS England Tobacco Dependence Delivery Group.

Eleven organisations (acute trusts and Integrated Care Boards) have contacted us interested in implementing smoking cessation interventions in their EDs.

What longer-term impact might there be?

If rolled out, the COSTED intervention has the potential to reduce population smoking prevalence and therefore reduce future morbidity and mortality, improve economic output (given the negative impact of smoking on productivity) and reduce health inequalities.

Lessons learnt for future research

- It is feasible to recruit large numbers of people to research studies EDs if there are dedicated staff to do so.
- Those recruited from EDs will generally be representative of the wider population.
- Follow-up using text message is feasible and acceptable.
- Careful consideration should be made to the benefit, including biochemical validation as an inclusion criterion for ED-based smoking cessation trials. In COSTED, this resulted in many potential participants who reported smoking daily being excluded from taking part due to low CO levels.[71] This is hypothesised to have occurred because of long waits to be seen in the ED, therefore participants having been abstinent for several hours.
- Achieving biochemical verification of smoking status after they have left the ED is challenging in this population because of the transient nature and wide geographical spread.

Related work

- A publication discussing the limitation of using CO verification as an inclusion criterion has been published.
- A study of the number of people attending an individual ED who were currently smoking to determine prevalence is now planned.
- The COSTED results will be included in a new Cochrane systematic review of ED-based smoking cessation trials.

Collaborations/further funding/future work

- Prof Caitlin Notley and Dr Ian Pope are planning to undertake a study investigating the long-term health impacts of e-cigarette use.
- Dr Ian Pope has successfully gained funding from the ATTAIN network to undertake a literature review and PPI work for a NIHR HTA application on a physical activity intervention in EDs.

Implications for decision-makers

The COSTED trial has demonstrated the acceptability, feasibility and effectiveness of ED-based smoking cessation interventions when there is dedicated staffing to deliver it. Decision-makers should therefore consider incorporating them as part of the wider approach to tackling tobacco smoking. Emergency department interventions may be particularly effective for reaching underserved groups and those from more deprived neighbourhoods, and therefore offer an opportunity to combat health inequalities.

Research recommendations

1. Long-term health impacts of sustained nicotine vaping in the absence of tobacco smoking.
2. Assessment of suitability of other clinical settings as locations for opportunistic smoking cessation intervention, for example, pre-operative, primary care, respiratory and oncology clinics, equivalent emergency triage for specific groups such as the early pregnancy assessment unit or mental health assessment units.
3. Feasibility and effectiveness of delivering other behaviour change interventions in the ED environment, for example, an intervention to increase physical activity.

Conclusion

An ED-based smoking cessation intervention comprising brief advice, an e-cigarette starter kit and referral to SSSs is effective for achieving increased smoking abstinence 6 months later.

Recruiting people in the ED is feasible, and via this route, people from neighbourhoods with higher levels of socioeconomic deprivation and those from underserved groups can be recruited.

The ED context was shown to impact intervention delivery and receipt of smoking cessation interventions 'in the moment'. Although this specific, local ED context may be a barrier to intervention implementation, flexibility and adaptiveness of staff, and acceptability by participants, proved to be critically facilitative factors. The time, place and 'moment' were powerfully experienced by participants who were amenable to the long-term behaviour change of smoking cessation. This suggests that the ED is an opportune location to support smoking cessation to improve long-term health.

This synopsis should be referenced as follows:
Pope I, Clark LV, Clark A, Ward E, Belderson P, Stirling S, *et al*. Cessation of smoking in people attending UK emergency departments: the COSTED RCT with economic and process evaluation. *Health Technol Assess* 2025;**29**(35). https://doi.org/10.3310/JHFR0841

The COSTED intervention is likely to be cost-effective compared to control. Further exploration into its cost, including exploring the financial impact of different staffing models, is now recommended.

Additional information

CRediT contribution statement

Ian Pope (https://orcid.org/0000-0002-5623-4178): Conceptualisation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Visualisation, Writing – original draft, Writing – reviewing and editing.

Lucy V Clark (https://orcid.org/0000-0001-7162-0512): Conceptualisation, Formal analysis, Investigation, Methodology, Project administration, Resources, Writing – reviewing and editing.

Allan Clark (https://orcid.org/0000-0003-2965-8941): Conceptualisation, Formal analysis, Methodology, Validation, Writing – reviewing and editing.

Emma Ward (https://orcid.org/0000-0002-7579-3215): Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Writing – reviewing and editing.

Pippa Belderson (https://orcid.org/0000-0003-2065-6878): Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Writing – reviewing and editing.

Susan Stirling (https://orcid.org/0000-0001-6663-7846): Data curation, Formal analysis, Methodology, Validation, Writing – reviewing and editing.

Steve Parrott (https://orcid.org/0000-0002-0165-1150): Conceptualisation, Formal analysis, Methodology, Validation, Writing – reviewing and editing.

Jinshuo Li (https://orcid.org/0000-0003-1496-7450): Data curation, Formal analysis, Methodology, Validation, Writing – original draft, Writing – reviewing and editing.

Timothy Coats (https://orcid.org/0000-0003-2736-2784): Conceptualisation, Methodology, Writing – reviewing and editing.

Linda Bauld (https://orcid.org/0000-0001-7411-4260): Conceptualisation, Methodology, Writing – reviewing and editing.

Richard Holland (https://orcid.org/0000-0002-4663-6923): Conceptualisation, Methodology, Writing – reviewing and editing.

Sarah Gentry (https://orcid.org/0000-0002-0805-0200): Conceptualisation, Methodology, Writing – reviewing and editing.

Sanjay Agrawal (https://orcid.org/0000-0001-7873-0300): Conceptualisation, Methodology, Project administration, Writing – reviewing and editing.

Benjamin M Bloom (https://orcid.org/0000-0002-3016-4925): Conceptualisation, Methodology, Project administration, Writing – reviewing and editing.

Adrian Boyle (https://orcid.org/0000-0002-9009-5423): Conceptualisation, Methodology, Project administration, Writing – reviewing and editing.

Alasdair Gray (https://orcid.org/0000-0003-1460-8327): Conceptualisation, Methodology, Project administration, Writing – reviewing and editing.

M Geraint Morris (https://orcid.org/0000-0001-8019-1510): Conceptualisation, Methodology, Project administration, Writing – reviewing and editing.

Caitlin Notley (https://orcid.org/0000-0003-0876-3304): Conceptualisation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Visualisation, Writing – original draft, Writing – reviewing and editing.

Acknowledgements

We thank the study sponsor, Norfolk and Norwich University Hospital NHS Foundation Trust. The study was led by researchers at the University of East Anglia and managed by the NCTU (specifically Mei-See Man, Matthew Hammond, Tom Conway, Ollie Ellacott, Antony Colles, Erica Berardi and Zuzanna Halicka). Our thanks go to the research teams at the organisations involved in recruitment and in supporting delivery of the trial and the sites' local SSSs. We would also like to thank PPI contributors who were critical in defining the choice of e-cigarette starter kit and shaping the intervention. We acknowledge the contribution of the smoking cessation advisors who underwent training to deliver the intervention. We thank Smokefree Norfolk for supporting the study by training the advisors. Thanks also to our independent TSC and DMC members (Prof. Steve Goodacre, Dr Gary Abel, Dr Sarah Jackson, Carmen Glover, Dr Francesca Pesola, Deb Smith, Dr Kirsty Challen, Prof. Jamie Brown, Prof. Paul McCrone). We thank all the participants for taking part. The e-cigarettes and pods were DotPro, produced by Liberty Flight, and were purchased at wholesale price. Liberty flight had

no role in the study design, data collection, data analysis, data interpretation or writing of this report.

Data-sharing statement

The protocol, consent form, statistical analysis plan, medical ethics committee approvals, training materials and other relevant study materials are available online at https://osf.io/8hbne/. Deidentified participant data will be made publicly available within 3 months at the above address. Other data are available upon request from the corresponding author.

Ethics statement

The study was approved by the UK National Research Ethics Committee – Oxford B (reference 21/SC/0288) at meeting held on 14 September 2021.

Information governance statement

Norfolk and Norwich University Hospital is committed to handling all personal information in line with the UK Data Protection Act (2018) and the General Data Protection Regulation (EU GDPR) 2016/679. Under the Data Protection legislation, Norfolk and Norwich University Hospital is the Data Controller, and you can find out more about how we handle personal data, including how to exercise your individual rights and the contact details for our Data Protection Officer, here: www.nnuh.nhs.uk/departments/information-governance/

Disclosure of interests

Full disclosure of interests: Completed ICMJE forms for all authors, including all related interests, are available in the toolkit on the NIHR Journals Library report publication page at https://doi.org/10.3310/JHFR0841.

Primary conflicts of interest: The authors have no conflicts of interest to declare.

Linda Bauld: PHR – Research Funding Board June 2015 to June 2021.

Alasdair Gray – HTA Prioritisation Committee B (In hospital) March 2020 to March 2024.

Department of Health and Social Care disclaimer

This publication presents independent research commissioned by the National Institute for Health and Care Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, MRC, NIHR Coordinating Centre, the Health Technology Assessment programme or the Department of Health and Social Care.

This synopsis was published based on current knowledge at the time and date of publication. NIHR is committed to being inclusive and will continually monitor best practice and guidance in relation to terminology and language to ensure that we remain relevant to our stakeholders.

Trial registration

This trial is registered as NCT04854616.

Funding

This synopsis presents independent research funded by the National Institute for Health and Care Research (NIHR) Health Technology Assessment programme as award number NIHR129438.

Award publications

This synopsis provided an overview of the research award *Cessation of Smoking Trial in the Emergency Department (COSTED)*. Other articles published as part of this thread are:

Notley C, Clark L, Belderson P, Ward E, Clark AB, Parrott S, *et al*. Cessation of smoking trial in the emergency department (COSTED): protocol for a multicentre randomised controlled trial. *BMJ Open* 2023;**13**:e064585. https://doi.org/10.1136/bmjopen-2022-064585

Pope I, Clark LV, Clark A, Ward E, Belderson P, Stirling S, *et al*. Cessation of Smoking Trial in the Emergency Department (COSTED): a multicentre randomised controlled trial. *Emerg Med J* 2024;**41**:276–82. https://doi.org/10.1136/emermed-2023-213824

Li J, Wu Q, Parrott S, Pope I, Clark LV, Clark A, *et al*. Cost-utility analysis of provision of e-cigarette starter kits for smoking cessation in emergency departments: An economic evaluation of a randomized controlled trial. *Addiction* 2025;**120**(2):368–79. https://doi.org/10.1111/add.16698

Notley C, Belderson P, Ward E, Clark LV, Clark A, Stirling S, *et al*. The Context of the Emergency Department as a Location for a Smoking Cessation Intervention—Process Evaluation Findings From the Cessation of Smoking Trial in the Emergency Department Trial, *Nicotine Tob Res* 2025:**27**(5):909–16. https://doi.org/10.1093/ntr/ntae223

For more information about this research, please view the award page (https://fundingawards.nihr.ac.uk/award/NIHR129438).

Additional outputs

Publications

Pettit N, Pope I, Neuner B, Lash R, Bernstein SL. A Selective review of smoking cessation interventions in the

emergency department. *Em Cancer Care* 2022;**1**:5. https://doi.org/10.1186/s44201-022-00006-5

Pope I, Suresh C, Ward E, Belderson P, Notley C. Biochemical Verification of Tobacco-Use as an Inclusion Criterion in Smoking Cessation Trials – Lessons From the Cessation of Smoking Trial in the Emergency Department. *Tob Use Insight* 2023;**16**:1179173X231193898. https://doi.org/10.1177/1179173X231193898

Belderson P, Ward E, Pope I, Notley C. Selecting an e cigarette for use in smoking cessation interventions and healthcare services: findings from patient and public consultation for the COSTED trial. *BMJ Open* 2024;**14**:e078677. https://doi.org/10.1136/bmjopen-2023-078677

Pope I, Rashid S, Iqbal H, Belderson P, Ward E, Clark L, *et al*. Engagement With Stop Smoking Services After Referral or Signposting: A Mixed-Methods Study. *Nicotine Tob Res* 2024;**27**(2):360–3. https://doi.org/10.1093/ntr/ntae159

Ward E, Belderson P, Clark A, Stirling S, Clark L, Pope I, Notley C. How do people quit smoking using e-cigarettes? A mixed-methods exploration of participant smoking pathways following receiving an opportunistic e-cigarette-based smoking cessation intervention. *Addiction* 2024;**119**:2185–96. https://doi.org/10.1111/add.16633

Conference presentations

Society for Research on Nicotine and Tobacco (15.9.21) – oral presentation of trial protocol.

Society for study of Addiction annual conference (5/11/21) Oral presentation: Satisfaction, Usability, Affordability and Availability: The PPI Process of Selecting an E-Cigarette for Inclusion in the Cessation of Smoking Trial in the Emergency Department (COSTED).

Society for study of addiction online interview (28/6/21): Vaping, smoking cessation and emergency departments: the SSA talks to Caitlin Notley.

Royal College of Emergency Medicine Annual Scientific Conference (5/5/22) invited talk on the Trial methods.

Lisbon Addictions Conference (24/11/22) Cessation of Smoking Trial in the Emergency Department – interim results.

International Scientific Conference on e-cigarettes (6/12/22) Use of pod device e-cigarettes in the Cessation of Smoking Trial in the Emergency Department.

British Thoracic Society Winter Meeting (25/11/22) E-cigarettes as an opportunistic smoking cessation intervention in emergency departments: an RCT.

Norwich Science Festival (15/2/23) E-cigarettes in the Emergency Department – a secret weapon in the battle against smoking?

Society for Research on Nicotine and Tobacco (1/3/23) COSTED trial methods and interim results.

Society for Research on Nicotine and Tobacco- Europe (12/9/23) COSTED Symposium incorporating the trial results, process evaluation findings and pathways.

Smoking Cessation and Health (14/9/23) Trial results.

Royal College of Emergency Medicine Annual Scientific Conference (26/10/23).

Other dissemination activities

Submission to the Consultation of the Independent Tobacco Review.

NHS England Prevention Team meeting (14/9/23) Trial results.

NHS England Tobacco Dependence Delivery Group (18/9/23) Trial results.

'Participant voices' video of participants sharing their experiences of taking part in the trial.

About this synopsis

The contractual start date for this research was in April 2021. This article began editorial review in October 2023 and was accepted for publication in October 2024. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The Health Technology Assessment editors and publisher have tried to ensure the accuracy of the authors' article and would like to thank the reviewers for their constructive comments on the draft document. However, they do not accept liability for damages or losses arising from material published in this article.

Copyright

Copyright © 2025 Pope *et al*. This work was produced by Pope *et al*. under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This is an Open Access publication distributed under the terms of the Creative Commons Attribution CC BY 4.0 licence, which permits unrestricted use, distribution, reproduction and adaptation in

any medium and for any purpose provided that it is properly attributed. See: https://creativecommons.org/licenses/by/4.0/. For attribution the title, original author(s), the publication source – NIHR Journals Library, and the DOI of the publication must be cited.

Published by the NIHR Journals Library (www.journalslibrary.nihr.ac.uk), produced by Newgen Digitalworks Pvt Ltd, Chennai, India (www.newgen.co).

List of abbreviations

A&E	accident and emergency
CCA	complete-case analysis
CEAC	cost-effectiveness acceptability curve
CI	confidence interval
CUA	cost–utility analysis
COSTED	Cessation of Smoking Trial in the Emergency Department
CRF	case report form
DMC	Data Monitoring Committee
DMEC	Data Monitoring and Ethics Committee
ED	emergency department
FTND	Fagerström Test for Nicotine Dependence
GP	general practitioner
ICER	incremental cost-effectiveness ratio
IQR	interquartile range
ITT	Intention to treat
MAR	missing at random
MNAR	missing not at random
NCSCT	National Centre for Smoking Cessation and Training
NCTU	Norwich Clinical Trials Unit
NHSE	National Health Service England
NICE	National Institute for Health and Care Excellence
NRT	nicotine replacement therapy
OHID	Office for Health Improvement and Disparities
PPI	patient and public involvement
PI	principal investigator
PIS	participant information sheet
PSA	probabilistic sensitivity analysis
PSS	Person Social Services
QALY	quality-adjusted life-year
RCT	randomised controlled trial
RR	relative risk
SAC	smoking-attributable cost
SES	Socioeconomic status
SSS	Stop Smoking Service
TIDiER	Template for Intervention Description and Replication
TSC	Trial Steering Committee
UC	usual care
UEA	University of East Anglia
VAS	visual analogue scale

References

1. Notley C, Clark L, Belderson P, Ward E, Clark AB, Parrott S, *et al*. Cessation of smoking trial in the emergency department (COSTED): protocol for a multicentre randomised controlled trial. *BMJ Open* 2023;**13**:e064585. https://doi.org/10.1136/bmjopen-2022-064585
2. Reitsma MB, Kendrick PJ, Ababneh E, Abbafati C, Abbasi-Kangevari M, Abdoli A, *et al*. Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. *Lancet* 2021;**397**:2337–60.
3. Office for National Statistics. *Adult Smoking Habits in the UK*. 2022. URL: www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/adultsmokinghabitsingreatbritain/2022#e-cigarette-use-and-vaping-prevalence-in-great-britain (accessed 1 November 2024)
4. Office for National Statistics. *Adult Smoking Habits in the UK*. URL: www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/adultsmokinghabitsingreatbritain/2022 (accessed 26 February 2025).

5. Action on smoking and health. *Health Inequalities and Smoking [Internet]*. 2019. URL: https://ash.org.uk/uploads/ASH-Briefing_Health-Inequalities.pdf (accessed 1 November 2024)
6. Mullen KA, Manuel DG, Hawken SJ, Pipe AL, Coyle D, Hobler LA, *et al*. Effectiveness of a hospital-initiated smoking cessation programme: 2-year health and healthcare outcomes. *Tob Control* 2017;**26**:293–9.
7. Statista. *Emergency Department Visits Per 1,000 People in Canada*. URL: www.statista.com/statistics/1194655/emergency-service-activity-in-canada-by-province-territory/ (accessed 26 February 2025).
8. Cairns C, Kang K. *National Hospital Ambulatory Medical Care Survey: 2019 Emergency Department Summary Tables*. National Center for Health Statistics (U.S.); 2022. URL: https://stacks.cdc.gov/view/cdc/115748 (accessed 1 November 2024)
9. Hull SA, Homer K, Boomla K, Robson J, Ashworth M. Population and patient factors affecting emergency department attendance in London: retrospective cohort analysis of linked primary and secondary care records. *Br J Gen Pract* 2018;**68**:e157–67.
10. Baier N, Geissler A, Bech M, Bernstein D, Cowling TE, Jackson T, *et al*. Emergency and urgent care systems in Australia, Denmark, England, France, Germany and the Netherlands – Analyzing organization, payment and reforms. *Health Policy* 2019;**123**:1–10.
11. *Hospital Accident & Emergency Activity 2021–22*. NHS Digital. URL: https://digital.nhs.uk/data-and-information/publications/statistical/hospital-accident--emergency-activity/2021-22 (accessed 26 February 2025).
12. Lowthian JA, Curtis AJ, Cameron PA, Stoelwinder JU, Cooke MW, McNeil JJ. Systematic review of trends in emergency department attendances: an Australian perspective. *Em Med J* 2011;**28**:373–7.
13. *What's Going on with A&E Waiting Times?* The King's Fund. URL: www.kingsfund.org.uk/projects/urgent-emergency-care/urgent-and-emergency-care-mythbusters (accessed 26 February 2025).
14. Paling S, Lambert J, Clouting J, González-Esquerré J, Auterson T. Waiting times in emergency departments: exploring the factors associated with longer patient waits for emergency care in England using routinely collected daily data. *Emerg Med J* 2020;**37**:781–6.
15. NHS Digital. *Hospital Accident and Emergency Activity 2018-19*. URL: https://files.digital.nhs.uk/F5/ACF07A/AE1819_Annual_Summary.pdf (accessed 26 February 2025).
16. Unwin M, Crisp E, Stankovich J, McCann D, Kinsman L. Socioeconomic disadvantage as a driver of non-urgent emergency department presentations: a retrospective data analysis. *PLOS ONE* 2020;**15**:e0231429.
17. Lowenstein S, Tomlinson D, Koziol-McLain J, Prochazka A. Smoking habits of emergency department patients: an opportunity for disease prevention. *Academic Em Med* 1995;**2**:165–71.
18. Richman PB, Dinowitz S, Nashed A, Eskin B, Cody R. Prevalence of smokers and nicotine-addicted patients in a suburban emergency department. *Academic Em Med* 1999;**6**:807–10.
19. Tolmie AD, Erker R, Oyedokun T, Sullivan E, Graham T, Stempien J. Prevalence of cigarette smoking among adult emergency department patients in Canada. *West J Emerg Med* 2020;**21**:190–7.
20. Boudreaux ED, Baumann BM, Friedman K, Ziedonis DM. Smoking stage of change and interest in an emergency department–based intervention. *Acad Emerg Med* 2005;**12**:211–8.
21. Lynch A, Quigley P. ExHALED Study: prevalence of smoking and harm levels in an emergency department cohort. *Em Med Australasia* 2010;**22**:287–95.
22. Weiland T, Jelinek GA, Taylor SE, Taylor DM. Tobacco smoking by adult emergency department patients in Australia: a point-prevalence study. *Public Health Res Pract* 2016;**26**:2631634.
23. Lemhoefer C, Rabe GL, Wellmann J, Bernstein SL, Cheung KW, McCarthy WJ, *et al*. Emergency department–initiated tobacco control: update of a systematic review and meta-analysis of randomized controlled trials. *Prev Chronic Dis* 201;**14**. URL: www.cdc.gov/pcd/issues/2017/16_0434.htm (accessed 26 February 2025).
24. Miller TR, Johnson MB, Dziura JD, Weiss J, Carpenter KM, Grau LE, *et al*. Cost-effectiveness of smoking cessation approaches in emergency departments. *Am J Prev Med* 2023;**65**:39–44.
25. Lindson N, Theodoulou A, Ordóñez-Mena JM, Fanshawe TR, Sutton AJ, Livingstone-Banks J, *et al*. Pharmacological and electronic cigarette interventions for smoking cessation in adults: component network meta-analyses. *Cochrane Database Systematic Rev* 2023;**9**:CD015226.
26. Hartmann-Boyce J, Lindson N, Butler AR, McRobbie H, Bullen C, Begh R, *et al*. Electronic cigarettes for smoking cessation. *Cochrane Database Systematic Rev* 2022;**4**:CD010216.
27. *E Cigarettes Latest Trends – Graphs – Smoking in England*. URL: https://smokinginengland.info/graphs/e-cigarettes-latest-trends (accessed 26 February 2025).
28. Notley C, Pope I, Clark L, Ward E, Belderson P. *The COSTED Trial: Cessation of Smoking Trial in the*

Emergency Department. 2022. URL: https://osf.io/8hbne/ (accessed 26 February 2025).

29. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci* 2011;**6**:42.
30. *COSTED PPI e-cig Selection Poster.pdf*. 2023. URL: https://osf.io/https://osf.io/xpv6s (accessed 26 February 2025).
31. *NCSCT E-Learning*. URL: https://elearning.ncsct.co.uk/ (accessed 26 February 2025).
32. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, *et al*. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *Br Med J* 2014;**348**:g1687.
33. Heatherton TF, Kozlowski LT, Frecker RC, Fagerström KO. The Fagerström test for nicotine dependence: a revision of the Fagerström tolerance questionnaire. *Br J Addict* 1991;**86**:1119–27.
34. West R. Assessing smoking cessation performance in NHS Stop Smoking Services: The Russell Standard (clinical). 2005. URL: www.ncsct.co.uk/library/view/pdf/assessing-smoking-cessation-performance-in-nhs-stop-smoking-services-the-russell-standard-clinical.pdf (accessed 26 February 2025).
35. Hajek P, Phillips-Waller A, Przulj D, Pesola F, Myers Smith K, Bisal N, *et al*. A randomized trial of e-cigarettes versus nicotine-replacement therapy. *N Engl J Med* 2019;**380**:629–37.
36. Pieterse ME, Seydel ER, DeVries H, Mudde AN, Kok GJ. Effectiveness of a minimal contact smoking cessation program for Dutch general practitioners: a randomized controlled trial. *Prev Med* 2001;**32**:182–90.
37. *EQ-5D-5L – EQ-5D*. URL: https://euroqol.org/information-and-support/euroqol-instruments/eq-5d-5l/ (accessed 26 February 2025).
38. Bernstein SL, D'Onofrio G, Rosner J, O'Malley S, Makuch R, Busch S, *et al*. Successful tobacco dependence treatment in low-income emergency department patients: a randomized trial. *Ann Emerg Med* 2015;**66**:140–7.
39. Hennrikus D, Joseph AM, Lando HA, Duval S, Ukestad L, Kodl M, Hirsch AT. Effectiveness of a smoking cessation program for peripheral artery disease patients: a randomized controlled trial. *J Am Coll Cardiol* 2010;**56**:2105–12.
40. McFall M, Saxon AJ, Malte CA, Chow B, Bailey S, Baker DG, *et al*.; CSP 519 Study Team. Integrating tobacco cessation into mental health care for posttraumatic stress disorder: a randomized controlled trial. *JAMA* 2010;**304**:2485–93.
41. NICE health technology evaluations: the manual. URL: www.nice.org.uk/process/pmg36/chapter/introduction-to-health-technology-evaluation
42. Wu Q, Parrott S, Godfrey C, Gilbert H, Nazareth I, Leurent B, *et al*. Cost-effectiveness of computer-tailored smoking cessation advice in primary care: a randomized trial (ESCAPE). *Nicotine Tob Res* 2014;**16**:270–8.
43. *Unit Costs of Health and Social Care 2016 | PSSRU*. URL: www.pssru.ac.uk/project-pages/unit-costs/unit-costs-2016/ (accessed 26 February 2025).
44. *Unit Costs of Health and Social Care 2020 | PSSRU*. URL: www.pssru.ac.uk/project-pages/unit-costs/unit-costs-2020/ (accessed 26 February 2025).
45. *Unit Costs of Health and Social Care 2021 | PSSRU [Internet]*. URL: www.pssru.ac.uk/project-pages/unit-costs/unit-costs-of-health-and-social-care-2021/ (accessed 26 February 2025).
46. *Via Community Ltd Hiring Smoking Cessation Advisor Job in Harrow, England | Glassdoor*. URL: www.glassdoor.co.uk/job-listing/smoking-cessation-advisor-via-JV_IC3527316_KO0,25_KE26,29.htm?jl=1009306543392 (accessed 26 February 2025).
47. *Prescription Cost Analysis – England – 2021/22 | NHSBSA*. URL: www.nhsbsa.nhs.uk/statistical-collections/prescription-cost-analysis-england/prescription-cost-analysis-england-202122 (accessed 26 February 2025).
48. *BNF Content Published by NICE*. 2024. URL: https://bnf.nice.org.uk/ (accessed 26 February 2025).
49. *Unit Costs of Health and Social Care 2015 | PSSRU*. URL: www.pssru.ac.uk/project-pages/unit-costs/unit-costs-2015/ (accessed 26 February 2025).
50. NHS England. *National Cost Collection for the NHS*. URL: www.england.nhs.uk/costing-in-the-nhs/national-cost-collection/ (accessed 26 February 2025).
51. National Institute for Health and Care Excellence. *Tobacco: Preventing Uptake, Promoting Quitting and Treating Dependence*. 2022. URL: www.nice.org.uk/guidance/ng209 (accessed 1 November 2024)
52. Hernández Alava M, Pudney S, Wailoo A. Estimating the relationship between EQ-5D-5L and EQ-5D-3L: results from a UK population study. *PharmacoEcon* 2023;**41**:199–207.
53. Richardson G, Manca A. Calculation of quality adjusted life years in the published literature: a review of methodology and transparency. *Health Econ* 2004;**13**:1203–10.

54. *COSTED Health Economics Analysis Plan V1.0.docx*. 2022. URL: https://osf.io/https://osf.io/gevch (accessed 26 February 2025).

55. Faria R, Gomes M, Epstein D, White IR. A guide to handling missing data in cost-effectiveness analysis conducted within randomised controlled trials. *PharmacoEcon* 2014;**32**:1157–70.

56. Rubin DB. Statistical matching using file concatenation with adjusted weights and multiple imputations. *J Business Eco Statistics* 1986;**4**:87–94.

57. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med* 2011;**30**:377–99.

58. NHS Business Services Authority. *PD1 Reports*. 2023. URL: www.nhsbsa.nhs.uk/prescription-data/dispensing-data/pd1-reports (accessed 1 November 2024)

59. Wu Q, Gilbody S, Li J, Wang HI, Parrott S. Long-term cost-effectiveness of smoking cessation interventions in people with mental disorders: a dynamic decision analytical model. *Value Health* 2021;**24**:1263–72.

60. *Deaths registered in England and Wales – Office for National Statistics*. URL: www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregistrationsummarytables/2021 (accessed 26 February 2025).

61. *Economics of Tobacco Toolkit: Assessment of the Economic Costs of Smoking*. URL: www.who.int/publications-detail-redirect/economics-of-tobacco-toolkit-assessment-of-the-economic-costs-of-smoking (accessed 26 February 2025).

62. *Hiding in Plain Sight: Treating Tobacco Dependency in the NHS – RCP London*. URL: https://shop.rcp.ac.uk/products/hiding-in-plain-sight-treating-tobacco-dependency-in-the-nhs?variant=12392294547534 (accessed 26 February 2025).

63. *Hospital Episode Statistics (HES)*. NHS England Digital. URL: https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/hospital-episode-statistics (accessed 26 February 2025).

64. *NHS Reference Costs 2015 to 2016. GOV.UK*. URL: www.gov.uk/government/publications/nhs-reference-costs-2015-to-2016 (accessed 26 February 2025).

65. Vogl M, Wenig CM, Leidl R, Pokhrel S. Smoking and health-related quality of life in English general population: implications for economic evaluations. *BMC Public Health* 2012;**12**:203.

66. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, *et al*. Process evaluation of complex interventions: medical research council guidance. *Br Med J* 2015;**350**:h1258.

67. Pope I, Clark LV, Clark A. Cessation of smoking trial in the emergency department (COSTED): a multicentre randomised controlled trial. *Emerg Med J* 2024;**41**:276–82.

68. Notley C, Belderson P, Ward E, Clark LV, Clark A, Stirling S, *et al*. The context of the emergency department as a location for a smoking cessation intervention—process evaluation findings from the cessation of smoking trial in the emergency department trial. *Nicotine Tob Res* 2024:ntae23. https://doi.org/10.1093/ntr/ntae223.

69. Belderson P, Ward E, Pope I, Notley C. Selecting an e-cigarette for use in smoking cessation interventions and healthcare services: findings from patient and public consultation for the COSTED trial. *BMJ Open* 2024;**14**:e078677. https://doi.org/10.1136/bmjopen-2023-078677.

70. Pope I, Clark A, Clark L, Ward E, Stirling S, Belderson P, Notley C. Predictors of successful tobacco cessation after receiving an e-cigarette based smoking cessation intervention. *Tob Use Insight* 2024;**17**. https://doi.org/10.1177/1179173X241283470.

71. Pope I, Suresh C, Ward E, Belderson P, Notley C. Biochemical verification of tobacco-use as an inclusion criterion in smoking cessation trials- lessons from the cessation of smoking trial in the emergency department. *Tob Use Insight* 2023;**16**. https://doi.org/10.1177/1179173X231193898.