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ORIGINAL ARTICLE

Maintaining abstinence from smoking after a period of enforced abstinence – systematic review, meta-analysis and analysis of behaviour change techniques with a focus on mental health

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Background. Smoking prevalence is doubled among people with mental health problems and reaches 80% in inpatient, substance misuse and prison settings, widening inequalities in morbidity and mortality. As more institutions become smoke-free but most smokers relapse immediately post-discharge, we aimed to review interventions to maintain abstinence post-discharge.

Methods. MEDLINE, EMBASE, PsycINFO, CINAHL and Web of Science were searched from inception to May 2016 and randomised controlled trials (RCTs) and cohort studies conducted with adult smokers in prison, inpatient mental health or substance use treatment included. Risk of bias (study quality) was rated using the Effective Public Health Practice Project Tool. Behaviour change techniques (BCTs) were coded from published papers and manuals using a published taxonomy. Mantel–Haenszel random effects meta-analyses of RCTs used biochemically verified point-prevalence smoking abstinence at (a) longest and (b) 6-month follow-up.

Results. Five RCTs ($n = 416$ intervention, $n = 415$ control) and five cohort studies ($n = 471$) included. Regarding study quality, four RCTs were rated strong, one moderate; one cohort study was rated strong, one moderate and three weak. Most common BCTs were pharmacotherapy ($n = 8$ nicotine replacement therapy, $n = 1$ clonidine), problem solving, social support, and elicitation of pros and cons (each $n = 6$); papers reported fewer techniques than manuals. Meta-analyses found effects in favour of intervention [(a) risk ratio (RR) = 2.06, 95% confidence interval (CI) 1.30–3.27; (b) RR = 1.86, 95% CI 1.04–3.31].

Conclusion. Medication and/or behavioural support can help maintain smoking abstinence beyond discharge from smoke-free institutions with high mental health comorbidity. However, the small evidence base tested few different interventions and reporting of behavioural interventions is often imprecise.

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Key words: Mental disorders, meta-analysis, smoke-free policy, smoking, smoking cessation.

Introduction

Smoking prevalence among people with mental health problems is about twice as high as in the population as a whole and increases with severity of illness, in some instances reaching up to 80% (Royal College of Physicians & Royal College of Psychiatrists, 2013; McManus *et al*. 2016). Smoking prevalence in those with mental health problems has not seen the same decline as in the general population (Cook *et al*. 2014; Szatkowski & McNeill, 2015). Smoking is the main contributor to a gap in life expectancy of 8–22 years between those with and without mental health problems (Brown *et al*. 2010; Chang *et al*. 2011; Wahlbeck *et al*. 2011; Lawrence *et al*. 2013; Tam *et al*. 2016). This affects a large number of people as it has been estimated that one-third of smokers have a mental health problem (Royal College of Physicians & Royal College of Psychiatrists, 2013). Prevalence of smoking and mental health problems is also higher among other disadvantaged groups, such as offenders and people with drug and alcohol dependence (Royal College of Physicians & Royal College of Psychiatrists, 2013) in prisons and substance use treatment settings, smoking prevalence in excess of 80% has been observed in some countries (Hickman *et al*. 2015). Evidence suggests that cessation benefits not only just physical, but also mental health (Taylor *et al*. 2014).

Recently, some efforts to address this inequality have been made, including the introduction of comprehensive smoke-free policies in secondary care settings

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and prisons (National Institute for Health and Care Excellence, 2013; Working Group for Improving the Physical Health of People with SMI, 2016), ideally involving both smoke-free policies in buildings and grounds and integrated treatment for temporary abstinence and quitting (Kleber *et al.* 2007; National Institute for Health and Care Excellence, 2013; Working Group for Improving the Physical Health of People with SMI, 2016). Staying in a smoke-free facility can provide a possibly rare period of abstinence from smoking and provides an opportunity to initiate long-term change to reduce morbidity and mortality. However, the risk of relapse after leaving is extremely high (Prochaska *et al.* 2006; Clarke *et al.* 2013) and there appears to be little routine support to maintain abstinence and little evidence on interventions that may reduce the risk of reverting to smoking. An existing review of interventions to maintain abstinence in hospitalised patients (Rigotti *et al.* 2012) specifically excluded patients from facilities that predominantly treat psychiatric conditions or substance abuse, meaning there is a particular lack of information on the extant evidence in these disadvantaged populations. One previous review summarised the impact of smoke-free psychiatric hospitalisation on patients' smoking (Stockings *et al.* 2014*a*). Institutions with incomplete smoke-free policies that were not necessarily providing any behavioural or pharmacological support to achieve abstinence were included in the review and the authors concluded that adherence to the smoke-free policy and receipt of treatment are likely to be important factors for patients' smoking.

We aimed to systematically review randomised controlled trials (RCTs) and cohort studies to identify pharmacological or behavioural interventions provided during the stay or post-discharge to maintain abstinence in smokers after a period of enforced abstinence in smoke-free facilities for mental health, substance misuse treatment centres or prisons. A secondary aim was to identify intervention components to guide development of future interventions.

Methods

The review is registered as PROSPERO 2016: CRD42016041840.

Inclusion criteria

The review included RCTs (including feasibility and pilot trials) and observational cohort studies with participants who were adult smokers (18 or older), abstinent because of a stay in a smoke-free prison, mental health or substance use treatment centre and followed up post-discharge. Institutions with partial smoke-free policies were included if participants had no access to smoking areas. In addition to a smoke-free setting, at least minimal support had to be offered. This could include any type of behavioural or pharmacological intervention aimed at maintaining abstinence from smoking following discharge, delivered during the stay and/or post-discharge. No limits were applied to control conditions where applicable.

Outcome measures

Primary outcome:

(i) Biochemically verified continuous smoking abstinence at longest follow-up (West *et al.* 2005).

Secondary outcomes:

(i) Biochemically verified continuous smoking abstinence at 6 months;
(ii) Biochemically verified point-prevalence (7-day) smoking abstinence at longest follow-up;
(iii) Biochemically verified point-prevalence smoking abstinence at 6 months;
(iv) Self-reported continuous abstinence at longest follow-up;
(v) Self-reported continuous smoking abstinence at 6 months;
(vi) Self-reported point-prevalence abstinence at longest follow-up;
(vii) Self-reported point-prevalence smoking abstinence at 6 months;
(viii) Other changes in smoking behaviour: (a) time to first cigarette post-discharge; (b) change in cigarette consumption at follow-up compared with the period prior to the enforced abstinence.

Search strategy and selection of studies

MEDLINE, EMBASE, PsycINFO, CINAHL and Web of Science were searched up to 25 May 2016. The search strategy included search terms relating to the population (smokers, mental health or substance use inpatients or prisoners), intervention (smoking cessation), outcome (relapse, maintenance) and study types (cohort studies, clinical trials). Searches were limited to studies in English and adults. A full search strategy is in the online supplement (A1). Endnote X7 was used to record publications at all stages of the selection process. One reviewer (ES) screened all titles and abstracts of studies. Full-text screening was undertaken by three authors; two reviewers (ES and LB) independently screened all papers and disagreements were settled by a third reviewer (AMcN); κ was calculated as a measure of agreement.

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Data extraction

Using a pre-defined table, relevant data were extracted from all included studies by one reviewer and checked by a second reviewer.

Assessment of risk of bias

Risk of bias (study quality) was assessed independently by two reviewers using the Effective Public Health Practice Project tool (EPHPP). The tool has been designed to assess different study designs including RCTs and cohort studies. It consists of six sections: (a) selection bias, (b) study design, (c) confounders, (d) blinding, (e) data collection method, (f) withdrawals and dropouts; each section is rated as strong, moderate or weak. A study is rated as overall of strong quality if no section has been rated weak, moderate if one section is rated weak, and weak if two or more sections have been rated weak (Armijo-Olivo *et al.* 2012). Differences in assessment were discussed to arrive at an agreed assessment.

Data synthesis

For trials, two pre-specified Mantel–Haenszel random effects meta-analyses were conducted using RevMan 5.3 (Higgins & Green, 2011). The strongest available outcomes were used. For both analyses, those lost to follow-up were treated as non-abstinent with the exception of nine deceased participants (West *et al.* 2005). Subgroup analyses by setting (prison, substance abuse, mental health) were planned. Observational studies were summarised in a narrative synthesis. Intervention components were coded using the behaviour change technique (BCT) taxonomy (Michie *et al.* 2015), which defines 93 BCTs organised into 16 clusters. Authors of eight studies were contacted for treatment manuals or treatment protocols as evidence indicates that descriptions in published papers are less comprehensive (Lorencatto *et al.* 2013); authors for the remaining two studies could not be contacted (Jonas & Eagle, 1991; Joseph, 1993). A manual used in one trial (Clarke *et al.* 2013), a manual used in two trials (Prochaska *et al.* 2014; Hickman *et al.* 2015) and detailed descriptions for another trial (Stockings *et al.* 2014*b*) and two cohort studies (Strong *et al.* 2012; Stuyt, 2015) were provided; interventions in the other four studies were coded based on descriptions in the published papers. It was explored whether any link between BCTs used and outcomes of interventions could be hypothesised.

Results

Description of studies

The search identified 8417 records; 10 studies with a total $N = 1302$ were included in the review (Fig. 1). Eight studies had been selected by both initial reviewers; κ was 0.71.

Five studies (Gariti *et al.* 2002; Clarke *et al.* 2013; Prochaska *et al.* 2014; Stockings *et al.* 2014*b*; Hickman *et al.* 2015) were trials (intervention $n = 416$, control $n = 415$), five (Jonas & Eagle, 1991; Joseph, 1993; Prochaska *et al.* 2006; Strong *et al.* 2012; Stuyt, 2015) were observational cohort studies ($n = 471$). One study was conducted in Australia (Stockings *et al.* 2014*b*), all others in the US. One trial was conducted in a prison (Clarke *et al.* 2013), one trial and one cohort study in substance use treatment settings (Joseph, 1993; Gariti *et al.* 2002), two trials and three cohort studies in mental health treatment settings (Jonas & Eagle, 1991; Prochaska *et al.* 2006; Strong *et al.* 2012; Prochaska *et al.* 2014; Hickman *et al.* 2015) and one trial and one cohort study in mixed substance use and mental health settings (Stockings *et al.* 2014*b*; Stuyt, 2015).

All institutions were described as having complete smoke-free policies and the average length of stay in the smoke-free environment differed considerably; it was 1.5 years in the prison setting (Clarke *et al.* 2013), while all other studies measured the stay in days and the next longest was 90 days (Stuyt, 2015). Follow-up periods ranged from 3 months (Clarke *et al.* 2013) to 18 months (Prochaska *et al.* 2014) (online Supplementary Table S1). All randomised trials (Gariti *et al.* 2002; Clarke *et al.* 2013; Prochaska *et al.* 2014; Stockings *et al.* 2014*b*; Hickman *et al.* 2015) and two of the observational cohort studies (Prochaska *et al.* 2006; Strong *et al.* 2012) used biochemically verified measures of 7-day point-prevalence smoking abstinence; the other three used self-reported abstinence (Jonas & Eagle, 1991; Joseph, 1993; Stuyt, 2015); only one trial reported continuous as well as point-prevalence abstinence (Stockings *et al.* 2014*b*).

Reporting of effects of smoking cessation treatment or continued abstinence from smoking on mental health or substance use varied considerably across studies (online Supplementary Table S2). One trial found rehospitalisation to be less common in the intervention group (Prochaska *et al.* 2014) and one cohort study found non-smokers to be less likely to relapse to other substances (Stuyt, 2015).

Intervention characteristics

Interventions used a number of theoretical approaches, and varied in intensity, content and mode of delivery (online Supplementary Table S1). In all but one trial (Gariti *et al.* 2002), inpatient interventions were delivered by researchers, not clinic staff, whereas cohort studies generally reported on interventions delivered by clinic staff (with the exception of Strong *et al.* 2012).

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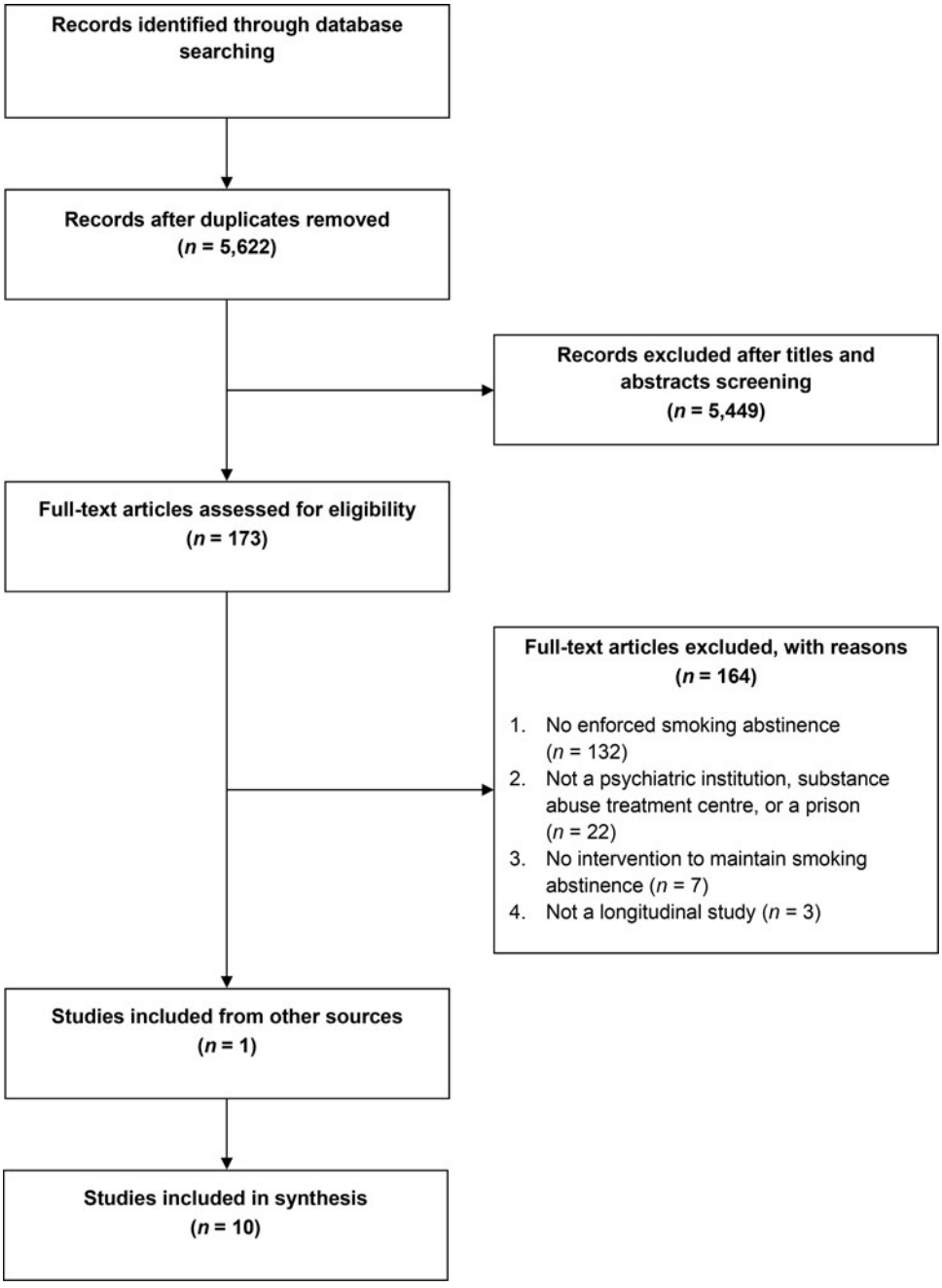

Fig. 1. Study selection.

Post-discharge interventions were included in the five trials (Gariti *et al.* 2002; Clarke *et al.* 2013; Prochaska *et al.* 2014; Stockings *et al.* 2014*b*; Hickman *et al.* 2015) and in one observational cohort study (Strong *et al.* 2012). Telephone calls were used in three studies (Strong *et al.* 2012; Clarke *et al.* 2013; Stockings *et al.* 2014*b*), ranging from one to eight calls between 1 day and 4 months post-discharge; two studies used a computer-generated intervention 3 and 6 months post-discharge (Prochaska *et al.* 2014; Hickman *et al.* 2015) and two provided an optional face-to-face appointment (Gariti *et al.* 2002; Stockings *et al.* 2014*b*) [one (Stockings *et al.* 2014*b*) in addition to telephone support].

The trials used different control interventions that included treatment as usual (Gariti *et al.* 2002; Prochaska *et al.* 2014; Stockings *et al.* 2014*b*), enhanced treatment as usual (Hickman *et al.* 2015) and a health-related intervention matched for frequency and duration but not addressing smoking cessation (Clarke *et al.* 2013).

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Risk of bias

Four of the trials achieved a global rating of strong (Clarke *et al.* 2011; Prochaska *et al.* 2014; Stockings *et al.* 2014*b*; Hickman *et al.* 2015); one was rated moderate due to a risk of selection bias (Gariti *et al.* 2002). One observational cohort study was rated strong (Prochaska *et al.* 2006) the others were moderate or weak (Table 1).

Effects of interventions

Biochemically verified smoking abstinence

Continuous abstinence was reported in only one study (Stockings *et al.* 2014*b*) at 6 months, two participants (1.9%) in the intervention group remained abstinent compared with none in the control group. Due to this lack of data, the primary outcome was not assessed in a meta-analysis.

The meta-analysis of 7-day point-prevalence abstinence at longest follow-up (3 to 18 months) included all five trials and found an overall effect in favour of intervention [risk ratio (RR) = 2.06, 95% confidence interval (CI) 1.30–3.27, Fig. 2*a*]. Overall, 12.7% of participants in the intervention groups achieved abstinence compared with 5.8% in the control groups.

The meta-analysis of 7-day point-prevalence abstinence at 6 months follow-up excluded the single trial conducted in a prison setting (longest follow-up was 3 months). The meta-analysis also found an effect in favour of intervention (RR = 1.86, 95% CI 1.04–3.31, Fig. 2*b*); 10.5% and 5.5% respectively achieved abstinence. No heterogeneity was indicated for either meta-analysis. No further subgroup analysis by setting was conducted because only one trial was set exclusively in substance use (Gariti *et al.* 2002) and one trial was set in both mental health and substance use settings (Stockings *et al.* 2014*b*).

Two observational cohort studies (Prochaska *et al.* 2006; Strong *et al.* 2012) aimed to use biochemically verified 7-day point-prevalence abstinence. However, in one all patients reported smoking at the 3-month follow-up (Prochaska *et al.* 2006), the other was a pilot study for intervention development and did not report results on verified abstinence (Strong *et al.* 2012).

Self-reported smoking abstinence

Four cohort studies reported self-reported abstinence without biochemical verification (Jonas & Eagle, 1991; Joseph, 1993; Strong *et al.* 2012; Stuyt, 2015). In one, four out of 39 psychiatric patients (10.3%) reported abstinence at 8 weeks post-discharge (Jonas & Eagle, 1991). In another study, 8.0% of patients admitted after the introduction of the smoke-free policy reported having quit smoking compared with 3.2% of patients admitted before introduction of the policy; however, length of follow-up differed, mean follow-up was 16 months for pre-policy and 11 months for post-policy patients (Joseph, 1993). In a pilot with 15 participants, six participants reported a quit attempt with a median number of 62 abstinent days (range 2–110 days) (Strong *et al.* 2012). A year after completing a 90-day substance misuse programme, an increase from 14% to 27% non-smokers among 140 patients was reported (Stuyt, 2015).

Other smoking outcomes – time to first cigarette

Time to first cigarette post-discharge was assessed in two trials and two cohort studies (Jonas & Eagle, 1991; Gariti *et al.* 2002; Prochaska *et al.* 2006; Clarke *et al.* 2013). One trial and one cohort study reported that 76% of participants returned to smoking on the day of discharge (Prochaska *et al.* 2006; Gariti *et al.* 2002) and in another cohort study 72% of participants resumed smoking 'immediately after discharge' (Jonas & Eagle, 1991). In the trial, 93% returned to smoking within a month with no group differences in the mean number of non-smoking days after discharge (Gariti *et al.* 2002). In one cohort study, median time to first cigarette was 5 minutes and all participants returned to smoking within 36 days (Prochaska *et al.* 2006), and in another, all participants who resumed smoking did so within 8 weeks post-discharge (Jonas & Eagle, 1991). The other trial displayed information graphically indicating that over 70% in the control group and about 50% in the intervention group returned to smoking within 1 day; this study reported an effect of treatment in a survival model of days to first smoking lapse (hazard ratio = 1.75, $p = 0.001$) (Clarke *et al.* 2013).

Other smoking outcomes – change in cigarette consumption

Change in cigarette consumption post-discharge compared with the period prior to the stay in a smoke-free environment was assessed in two trials and three cohort studies (Jonas & Eagle, 1991; Joseph, 1993; Gariti *et al.* 2002; Strong *et al.* 2012; Stockings *et al.* 2014*b*). One trial found a significant reduction for both groups for the 6 months following hospitalisation (24.6 reduced to 10.1 cigarettes per day for the intervention group and 23.8 to 9.4 cigarettes per day for the control group, $F(1) = 21.07$, $p < 0.001$), with no group differences; self-reported reduction was supported by biochemical test results (Gariti *et al.* 2002). The other trial found a significant effect of the intervention for 50% reduction in cigarettes per day, with 36.5% of intervention participants having reduced their cigarette consumption by six months *v.* 8.9% in the control group ($p < 0.0001$) (Stockings *et al.* 2014*b*).

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Table 1. Risk of bias (study quality) assessment (*Armijo-Olivo et al.* 2012)

	Selection bias	Design	Confounders	Blinding	Data collection	Withdrawals and drop-outs	Global rating
Randomised controlled trials							
Clarke *et al.* (2013)	2	1	1	2	1	2	Strong
Gariti *et al.* (2002)	3	1	1	2	1	1	Moderate
Hickman *et al.* (2015)	2	1	1	2	1	1	Strong
Prochaska *et al.* (2014)	2	1	1	2	1	1	Strong
Stockings *et al.* (2014*a*, *b*)	2	1	1	2	1	2	Strong
Cohort studies							
Jonas & Eagle (1991)	3	2	n/a	2	3	3	Weak
Joseph (1993)	3	2	3	2	3	n/a	Weak
Prochaska *et al.* (2006)	2	2	n/a	2	1	1	Strong
Strong *et al.* (2012)	3	3	n/a	2	1	n/a	Weak
Stuyt (2015)	1	2	n/a	2	3	1	Moderate

n/a, Assessment item not applicable for a particular study design.
Note: 1 = strong, 2 = moderate, 3 = weak.

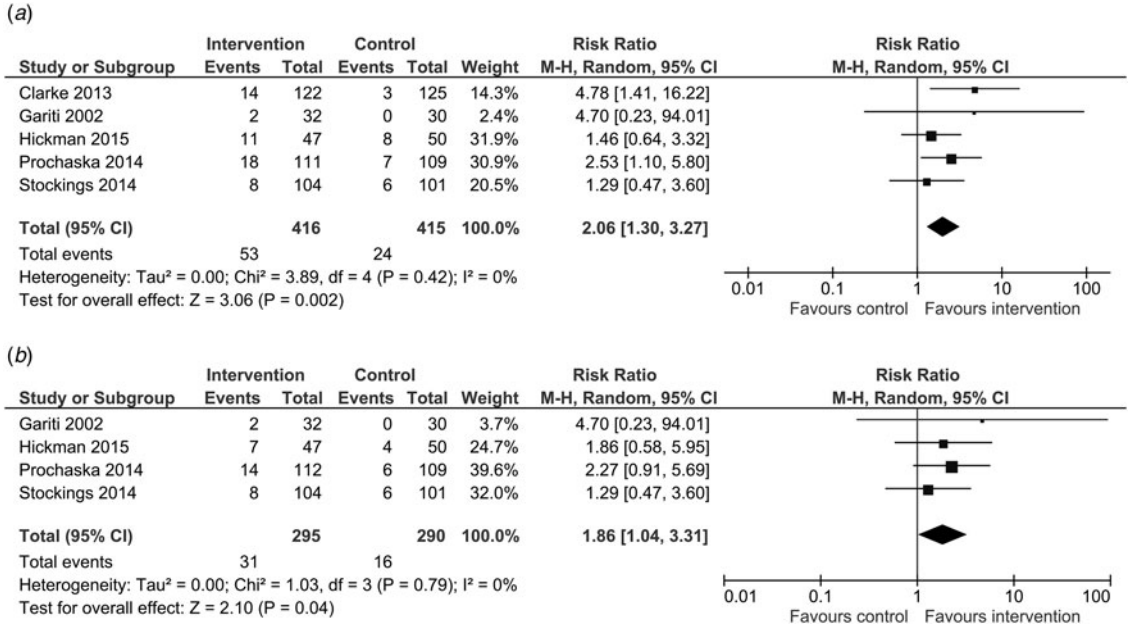

Fig. 2. (*a*) Comparison of biochemically verified point-prevalence abstinence at longest follow-up in randomised trials. Note: Length of follow-up: Clarke 3 months, Gariti 6 months, Hickman 12 months, Prochaska 18 months, Stockings 6 months. (*b*) Comparison of biochemically verified point-prevalence abstinence at 6 month follow-up in randomised trials. M-H, Mantel-Haenszel.

One cohort study reported a self-reported average decrease of seven cigarettes per day (95% CI −13.80 to 0.51) with a group mean of 13 cigarettes at 6-month follow-up (S.D. = 8.35, IQR: 8.2 to 16.1) (Strong *et al.* 2012). Another cohort study did not find any difference between self-reported number of cigarettes smoked per day at admission and six to 18 months post-discharge [21.6 (S.D. = 13.6) *v.* 21.3 (S.D. = 15.4) (Jonas & Eagle, 1991)]. The third cohort study stated that around 20% of patients reported smoking less (without quantification) and no difference between patients treated before and after the introduction of a smoke-free policy (Joseph, 1993).

Behaviour change techniques

The number of BCTs that could be coded varied considerably between studies and was higher when

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manuals were available. It ranged from a single technique in published reports of two cohort studies (Jonas & Eagle, 1991; Prochaska *et al.* 2006) to 34 BCTs (Clarke *et al.* 2013) and 36 BCTs (Prochaska *et al.* 2014; Hickman *et al.* 2015) in trial manuals (online Supplementary Table S1).

All studies delivered at least one BCT from the 'Regulation' cluster. This cluster includes pharmacological support, reducing negative emotions, conserving mental resources and paradoxical instructions (the latter was not delivered in any study). No study included BCTs coded to be part of the 'Scheduled consequences' cluster, which includes ten BCTs focused on specific reward or punishment schedules (other incentives or rewards are included in a different cluster). Two trials covered all remaining 15 clusters (Prochaska *et al.* 2014; Hickman *et al.* 2015); the trial (Clarke *et al.* 2013) with the next highest number of BCTs covered 14 clusters, additionally omitting 'Comparison of behaviour'.

The most commonly used technique was pharmacological support ($n = 9$). Pharmacological support in the form of nicotine replacement therapy (NRT) was used in four of the five trials (Gariti *et al.* 2002; Prochaska *et al.* 2014; Stockings *et al.* 2014*b*; Hickman *et al.* 2015), mostly in the form of patches, and this was available both during and after the stay in the smoke-free institution. In four of the five observational cohort studies (Jonas & Eagle, 1991; Prochaska *et al.* 2006; Strong *et al.* 2012; Stuyt, 2015), NRT was available only during inpatient treatment. One study mentioned availability of clonidine patches as part of treatment as usual (Joseph, 1993). The next most commonly used BCTs (all $n = 6$, online Supplementary Table S2) were problem solving ('Goals and planning' cluster), unspecified social support ('Social support' cluster) and pros and cons ('Comparison of outcomes' cluster).

Generally, studies delivered fewer BCTs post-discharge than during the stay, with the exception of one trial (Stockings *et al.* 2014*b*), which delivered a more comprehensive intervention after patients had left the hospital.

In addition to the BCTs described in the interventions, a smoke-free environment in itself delivers a number of BCTs for smoking cessation such as restructuring the physical environment (BCT 12.1), restructuring the social environment (12.2), avoidance/reducing exposure to cues for the behaviour (12.3) and removing access to the reward (7.4) (Michie *et al.* 2015).

Due to the small number of studies, variable study designs and inconsistent outcome measures, associations between specific BCTs and outcomes could not be assessed statistically. The two trials reporting an overall positive effect (Clarke *et al.* 2013; Prochaska *et al.* 2014) differed in setting, length of stay, mode and intensity of intervention and length of follow-up, but both used over 30 BCTs during the stay. Interestingly, one did not include pharmacotherapy (Clarke *et al.* 2013), while the second did during the stay and post-discharge (Prochaska *et al.* 2014). However, another trial using the same techniques as Prochaska *et al.* 2014 in a smaller sample from a similar population detected no effect (Hickman *et al.* 2015).

Discussion

A systematic search found only ten small studies researching maintenance of abstinence from smoking after a period of enforced abstinence in populations with high mental health comorbidity. Outside of trial intervention groups, no or minimal support for maintaining abstinence was delivered. Relapse to smoking occurred very quickly following discharge, and the four studies that reported it found that at least 70% of participants relapsed to smoking on the day of discharge. There was some evidence that providing behavioural or pharmacological interventions was effective for improving abstinence.

Evidence on how best to maintain or increase abstinence in this setting remains limited with few trials or high-quality observational studies. The trials mostly had a low risk of bias, while the cohort studies by design were more likely to be affected by bias. In terms of outcome measures, although most used biochemical validation, few attempted to measure continuous abstinence, the strongest outcome (West *et al.* 2005). However, in this population and setting, a floor effect for continuous abstinence at follow-up would be likely. A single study evaluated an intervention in a prison setting. There was little variety in location; all but one study had been conducted in the USA. The interventions under study varied, but many evidence-based interventions have not been evaluated. For example, there is good evidence that contingency management is effective for increasing abstinence from smoking, although there is limited evidence in smokers with mental health problems (Hunt *et al.* 2013; Cahill *et al.* 2015). Pharmacotherapies were also limited and no study tested varenicline (Cahill *et al.* 2016) cytisine (Cahill *et al.* 2016) or bupropion (Tsoi *et al.* 2013; van der Meer *et al.* 2013; Hughes *et al.* 2014), which have all shown effectiveness.

Limitations of the review include that policies such as smoke-free institutions may be implemented without an evaluation of the effects in the peer-reviewed literature. However, we searched Web of Science, one source of grey literature. Another limitation is due to the complexity and reliability of coding BCTs (Abraham *et al.* 2015), more experienced coders may have coded some aspects differently. However, the

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included analysis of BCTs for the first time provides evidence on components assessed in studies to date.

In contrast to the one previous review of the impact of smoke-free psychiatric hospitalisation on smoking (Stockings *et al.* 2014*a*), the present review includes only longitudinal studies and includes non-psychiatric institutions with high prevalence of mental health problems. Additionally, in our review, smokers were exposed to complete smoke-free policies and received some intervention to support abstinence. The previous review findings suggested these are crucial for a stay in a smoke-free institution to have an effect on smoking (Stockings *et al.* 2014*a*).

As in previous reports (Lorencatto *et al.* 2013), we found some large differences between descriptions of behavioural interventions in some published reports and manuals. Most strikingly, coding from the manual instead of the publication increased the number of BCTs from four (Prochaska *et al.* 2014; Hickman *et al.* 2015) to over 30 each in two cases. Due to the small number of studies and their variable study designs and outcome measures, it remains difficult to draw any clear conclusions about associations between specific techniques and effects of the intervention.

The present evidence suggests that a larger number of BCTs from a wide range of clusters is more likely to result in an effective intervention. It is worth noting that even where the same BCTs are included, delivery will differ (Lorencatto *et al.* 2014; Lorencatto *et al.* 2016; Tate *et al.* 2016), e.g. in frequency, quality and fidelity which can impact effects, akin to medication effectiveness depending on the amount and duration of, and adherence to, treatment.

The present review focused on mental health; it is likely that interventions in other setting such as general hospitals would be transferrable to some extent. However, an existing Cochrane review covered these institutions (Rigotti *et al.* 2012), while excluding institutions that primarily treat mental health problems or substance abuse. That review found evidence that interventions of the highest intensity, consisting of counselling that began in the hospital and continued for more than 1 month post-discharge, increased smoking cessation post-discharge; no benefit could be detected from the large number of studies with less intense interventions. The review also found that addition of NRT conferred a benefit, while there was not enough evidence for clear conclusions on varenicline or bupropion when added to counselling (Rigotti *et al.* 2012). For the present review, not enough studies were available to distinguish the impact of interventions delivered during the stay and post-discharge.

Reviews evaluating the evidence for preventing relapse for smokers in the general population who have successfully quit for a short time found some evidence for the use of NRT, bupropion or varenicline (Agboola *et al.* 2010) but insufficient evidence to recommend the use of any specific behavioural intervention (Agboola *et al.* 2010; Hajek *et al.* 2013), indicating the general scarcity of evidence on maintaining abstinence in any population of smokers.

Future research should evaluate interventions in more diverse countries, policy settings and institutions that enforce abstinence as e.g. evidence for prisons is particularly lacking. Research on the effectiveness of interventions such as contingency management and pharmacotherapies other than NRT would be beneficial. Improved reporting is recommended; more comprehensive descriptions of interventions, potentially using frameworks such as the BCT taxonomy (Michie *et al.* 2015) would facilitate replication of studies and analysis of effectiveness of different intervention components. In addition, it would be beneficial to report clearly and comprehensively any effects of cessation treatment or cessation on mental health and substance use.

Conclusion

In populations with high rates of smoking and mental health comorbidity there is rapid and almost complete relapse to smoking after a period of enforced abstinence. Institutions implementing smoke-free policies need to also implement interventions to support sustained abstinence to help reduce inequalities in morbidity and mortality due to smoking. Interventions consisting of nicotine replacement and/or behavioural support can increase abstinence beyond discharge. However, the existing evidence base is small, tested only a narrow range of interventions and is limited by imprecise reporting of behavioural interventions. Pharmacological interventions other than NRT and additional behavioural interventions should be assessed and reported.

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/S0033291717002021

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Declaration of Interest

None.

References

Abraham C, Wood CE, Johnston M, Francis J, Hardeman W, Richardson M, Michie S (2015). Reliability of identification of behavior change techniques in intervention descriptions. *Annals of Behavioral Medicine* **49**, 885–900.

Agboola S, McNeill A, Coleman T, Leonardi Bee J (2010). A systematic review of the effectiveness of smoking relapse prevention interventions for abstinent smokers. *Addiction* **105**, 1362–1380.

Armijo-Olivo S, Stiles CR, Hagen NA, Biondo PD, Cummings GG (2012). Assessment of study quality for systematic reviews: a comparison of the Cochrane Collaboration risk of bias tool and the effective public health practice project quality assessment tool: methodological research. *Journal of Evaluation in Clinical Practice* **18**, 12–18.

Brown S, Kim M, Mitchell C, Inskip H (2010). Twenty-five year mortality of a community cohort with schizophrenia. *British Journal of Psychiatry* **196**, 116–121.

Cahill K, Hartmann-Boyce J, Perera R (2015). Incentives for smoking cessation. *The Cochrane Database of Systematic Reviews* **5**, CD004307.

Cahill K, Lindson-Hawley N, Thomas KH, Fanshawe TR, Lancaster T (2016). Nicotine receptor partial agonists for smoking cessation. *The Cochrane Database of Systematic Reviews* **5**, CD006103.

Chang CK, Hayes RD, Perera G, Broadbent MT, Fernandes AC, Lee WE, Hotopf M, Stewart R (2011). Life expectancy at birth for people with serious mental illness and other major disorders from a secondary mental health care case register in London. *PLoS ONE* **6**, e19590.

Clarke JG, Martin RA, Stein L, Lopes CE, Mello J, Friedmann P, Bock B (2011). Working inside for smoking elimination Project W.I.S.E.) study design and rationale to prevent return to smoking after release from a smoke free prison. *BMC Public Health* **11**, 767.

Clarke JG, Stein LA, Martin RA, Martin SA, Parker D, Lopes CE, McGovern AR, Simon R, Roberts M, Friedman P, Bock B (2013). Forced smoking abstinence: not enough for smoking cessation. *JAMA Internal Medicine* **173**, 789–794.

Cook BL, Wayne GF, Kafali EN, Liu Z, Shu C, Flores M (2014). Trends in smoking among adults with mental illness and association between mental health treatment and smoking cessation. *JAMA* **311**, 172–182.

Gariti P, Alterman A, Mulvaney F, Mechanic K, Dhopesh V, Yu E, Chychula N, Sacks D (2002). Nicotine intervention during detoxification and treatment for other substance use. *American Journal of Drug and Alcohol Abuse* **28**, 671–679.

Hajek P, Stead LF, West R, Jarvis M, Hartmann-Boyce J, Lancaster T (2013). Relapse prevention interventions for smoking cessation. *The Cochrane Database of Systematic Reviews* **5**, CD003999.

Hickman III NJ, Delucchi KL, Prochaska JJ (2015). Treating tobacco dependence at the intersection of diversity, poverty, and mental illness: a randomized feasibility and replication trial. *Nicotine & Tobacco Research* **17**, 1012–1021.

Higgins JPT, Green S (eds) (2011). *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.1.0. The Cochrane Collaboration. Available from www.handbook.cochrane.org.

Hughes JR, Stead LF, Hartmann-Boyce J, Cahill K, Lancaster T (2014). Antidepressants for smoking cessation. *The Cochrane Database of Systematic Reviews* **1**, CD000031.

Hunt GE, Siegfried N, Morley K, Sitharthan T, Cleary M (2013). Psychosocial interventions for people with both severe mental illness and substance misuse. *The Cochrane Database of Systematic Reviews*, **10**, CD001088.

Jonas JM, Eagle J (1991). Smoking patterns among patients discharged from a smoke-free inpatient unit. *Hospital & Community Psychiatry* **42**, 636–637.

Joseph AM (1993). Nicotine treatment at the drug dependency program of the Minneapolis VA medical center: a researcher's perspective. *Journal of Substance Abuse Treatment* **10**, 147–152.

Kleber HD, Weiss RD, Anton Jr RF, George TP, Greenfield SF, Kosten TR, O'Brien CP, Rounsaville BJ, Strain EC, Ziedonis DM, Hennessy G, Connery HS, McIntyre JS, Charles SC, Anzia DJ, Cook IA, Finnerty MT, Johnson BR, Nininger JE, Summergrad P, Woods SM, Yager J, Pyles R, Cross CD, Peele R, Shemo JP, Lurie L, Walker RD, Barnovitz MA, Gray SH, Saxena S, Tonnu T, Kunkle R, Albert AB, Fochtmann LJ, Hart C, Regier D, Work Group on Substance Use, D, American Psychiatric, A & Steering Committee on Practice, G (2007). Treatment of patients with substance use disorders, Second Edition. American Psychiatric Association. *American Journal of Psychiatry* **164**, 5–123.

Lawrence D, Hancock KJ, Kisely S (2013). The gap in life expectancy from preventable physical illness in psychiatric patients in Western Australia: retrospective analysis of population based registers. *BMJ* 346, f2539.

Lorencatto F, West R, Bruguera C, Brose LS, Michie S (2016). Assessing the quality of goal setting in behavioural support for smoking cessation and its association with outcomes. *Annals of Behavioral Medicine* **50**, 310–318.

Lorencatto F, West R, Bruguera C, Michie S (2014). A method for assessing fidelity of delivery of telephone behavioral support for smoking cessation. *Journal of Consulting and Clinical Psychology* **82**, 482–491.

Lorencatto F, West R, Stavri Z, Michie S (2013). How well is intervention content described in published reports of smoking cessation interventions? *Nicotine & Tobacco Research* **15**, 1273–1282.

McManus S, Bebbington P, Jenkins R, Brugha T (eds) (2016). *Mental Health and Wellbeing in England: Adult Psychiatric Morbidity Survey 2014*. NHS Digital: Leeds.

Michie S, Wood CE, Johnston M, Abraham C, Francis JJ, Hardeman W (2015). Behaviour change techniques: the development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). *Health Technology Assessment* **19**, 1–188.

National Institute for Health and Care Excellence (2013). *Smoking Cessation in Secondary Care: Acute, Maternity and Mental Health Services*. NICE: London.

Prochaska JJ, Fletcher L, Hall SE, Hall SM (2006). Return to smoking following a smoke-free psychiatric hospitalization. *American Journal on Addictions* **15**, 15–22.

Prochaska JJ, Hall SE, Delucchi K, Hall SM (2014). Efficacy of initiating tobacco dependence treatment in inpatient psychiatry: a randomized controlled trial. *American Journal of Public Health* **104**, 1557–1565.

Rigotti NA, Clair C, Munafo MR, Stead LF (2012). Interventions for smoking cessation in hospitalised patients. *The Cochrane Database of Systematic Reviews* **5**, CD001837.

Royal College of Physicians & Royal College of Psychiatrists (2013). *Smoking and Mental Health*. RCP: London.

Stockings EA, Bowman JA, Prochaska JJ, Baker AL, Clancy R, Knight J, Wye PM, Terry M, Wiggers JH (2014a). The impact of a smoke-free psychiatric hospitalization on patient smoking outcomes: a systematic review. *The Australian and New Zealand Journal of Psychiatry* **48**, 617–633.

Stockings EA, Bowman JA, Wiggers J, Baker AL, Terry M, Clancy R, Wye PM, Knight J, Moore LH (2011). A randomised controlled trial linking mental health inpatients to community smoking cessation supports: a study protocol. *BMC Public Health* **11**, 570.

Stockings EAL, Bowman JA, Baker AL, Terry M, Clancy R, Wye PM, Knight J, Moore LH, Adams MF, Colyvas K, Wiggers JH (2014b). Impact of a postdischarge smoking cessation intervention for smokers admitted to an inpatient psychiatric facility: a randomized controlled trial. *Nicotine & Tobacco Research* **16**, 1417–1428.

Strong DR, Uebelacker L, Schonbrun YC, Durst A, Saritelli J, Fokas K, Abrantes A, Brown RA, Miller I, Apodaca TR (2012). Development of a brief motivational intervention to facilitate engagement of smoking cessation treatment among inpatient depressed smokers. *Journal of Smoking Cessation* **7**, 4–11.

Stuyt EB (2015). Enforced abstinence from tobacco during in-patient dual-diagnosis treatment improves substance abuse treatment outcomes in smokers. *The American Journal on Addictions* **24**, 252–257.

Szatkowski L, McNeill A (2015). Diverging trends in smoking behaviors according to mental health status. *Nicotine & Tobacco Research* **17**, 356–360.

Tam J, Warner KE, Meza R (2016). Smoking and the reduced life expectancy of individuals with serious mental illness. *American Journal of Preventive Medicine* **51**, 958–966.

Tate DF, Lytle LA, Sherwood NE, Haire-Joshu D, Matheson D, Moore SM, Loria CM, Pratt C, Ward DS, Belle SH, Michie S (2016). Deconstructing interventions: approaches to studying behavior change techniques across obesity interventions. *Translational Behavioral Medicine* **6**, 236–243.

Taylor G, McNeill A, Girling A, Farley A, Lindson-Hawley N, Aveyard P (2014). Change in mental health after smoking cessation: systematic review and meta-analysis. *BMJ* **348**, g1151.

Tsoi DT, Porwal M, Webster AC (2013). Interventions for smoking cessation and reduction in individuals with schizophrenia. *The Cochrane Database of Systematic Reviews* **2**, CD007253.

van der Meer RM, Willemsen MC, Smit F, Cuijpers P (2013). Smoking cessation interventions for smokers with current or past depression. *The Cochrane Database of Systematic Reviews* **8**, CD006102.

Wahlbeck K, Westman J, Nordentoft M, Gissler M, Laursen TM (2011). Outcomes of nordic mental health systems: life expectancy of patients with mental disorders. *British Journal of Psychiatry* **199**, 453–458.

West R, Hajek P, Stead L, Stapleton J (2005). Outcome criteria in smoking cessation trials: proposal for a common standard. *Addiction* **100**, 299–303.

Working Group for Improving the Physical Health of People with SMI (2016). *Improving the Physical Health of Adults with Severe Mental Illness: Essential Actions*. Royal College of Psychiatrists: London.