Increasing smoking cessation care provision in hospitals: a meta-analysis of intervention effect

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Abstract

Introduction

Levels of hospital smoking cessation care are less than optimal. This study aimed to synthesize the evidence regarding the effectiveness of interventions in increasing smoking cessation care provision in hospitals.

Methods

A review identified relevant studies published between 1994 and 2006. A description of studies, including methodological quality, was undertaken. Intervention effectiveness in increasing smoking cessation care practices was examined for controlled studies using meta-analysis. Care practices examined were: assessment of smoking status; advice to quit; counselling or assistance to quit; advising, offering or providing nicotine replacement therapy (NRT); and follow up or referral.

Results

Eighteen of the 25 identified studies were US-based and in inpatient settings. Of the 10 controlled trials, four addressed cardiac patients, five measured one smoking cessation care practice, and nine implemented multi-strategic interventions (eg combining educational meetings with reminders and written resources). Studies generally described a poor methodological quality. Meta-analysis of controlled trials demonstrated a significant intervention effect on provision of assistance and counselling to quit (PRD 16.6, CI 4.9-28.3), but not for assessment of smoking status, advice to quit, or the provision or discussion of NRT. Statistical heterogeneity was indicated for all smoking cessation care practices. An insufficient number of studies did not allow meta-analysis of follow-up and/or referral to further assistance.

Discussion

Interventions can be effective in increasing the routine provision of hospital smoking cessation care. Future research should use more rigorous study designs, examine a broader range of smoking cessation care practices, and focus on hospital-wide intervention implementation.

Introduction

The hospital setting represents an excellent opportunity to impact on smoking prevalence at the population level, and internationally hospitals are advocated as an appropriate setting for the provision of smoking cessation care to patients (Commonwealth Department of Health and Aged Care, 2000; Surgeon General, 2004; World Health Organisation, 2003). Although smoking cessation care guidelines have existed since the mid 1990s, (Fiore et al., 2000; Fiore, Jaen, & Baker, 2008; Raw, McNeill, & West, 1998; West, McNeill, & Raw, 2000; Fiore, Bailey, & Cohen, 1996) the provision of smoking cessation care in hospitals remains low, or variable at best (Baratiny, Campbell, Sanson-Fisher, & Cockburn, 2003; France, Glasgow, & Marcus, 2001). It is advocated that research focus on the identification of strategies to increase the incorporation of smoking cessation care into routine hospital practice (France et al., 2001; Miller & Wood, 2003; Nagle, Schofield, & Redman, 1999).

General reviews of clinical practice change suggest some potentially effective intervention strategies to achieve care compliance including educational outreach, reminders, interactive educational meetings and multi-faceted interventions (Bero, Grilli, & Grimshaw, 1998; Dijkstra et al., 2006; Grimshaw et al., 2001; Grol, Baker, & Moss, 2002; Solberg et al., 2000). Other strategies, such as audit and feedback and local opinion leaders have been found to have a variable effect. Reviewers have also concluded that all such strategies are capable of producing an effect (Grimshaw et al., 2006).

Although many general reviews of clinical practice change include studies undertaken in hospitals, only one identified review considered studies undertaken in hospitals alone. Dijkstra et al reviewed the effect of a range of intervention strategies on hospital-based clinical practice (Dijkstra et al., 2006). They found an intervention effect across all studies, across all single intervention studies and across all multi-strategic intervention studies. They demonstrated an intervention effect for the use of reminders and for feedback, and also found the effect of educational material, reminders, and feedback remained significant in multi-strategic interventions after adjustment for other intervention components (Dijkstra et al., 2006). Only 13 of the 53 studies included in this review examined preventive care or screening and only two of these specifically examined smoking cessation care provision.

Another particularly relevant review examined 10 studies that investigated the effect of a health professional training intervention on the provision of smoking cessation care. Lancaster et al found health professionals trained in smoking cessation care provision were approximately 1.5 to 2.5 times more likely to provide smoking cessation counselling than untrained health professionals (Lancaster, Silagy, & Fowler, 2000). An intervention effect was also demonstrated for setting a quit date, provision of a follow-up appointment, provision of written resources, and the offer of NRT. Lancaster et al also found the use of prompts increased the frequency of health professional intervention. This review was limited to the primary care setting, and predominantly examined care provided by medical officers. Other review evidence has failed to find an effect for training alone (Hopkins et al., 2001) but have also concluded that reminders used in conjunction with health professional training (Hopkins et al., 2001), and reminders used alone (Hopkins et al., 2001; Fiore et al., 1996; Fiore et al., 2000) are effective in increasing smoking cessation care provision.

Although the reviews described above provide some guidance on potential strategies to enhance smoking cessation care provision in hospitals, none have specifically reviewed the effect of an intervention on this form of care. Such a review would provide hospital administrators direct evidence regarding the feasibility of re-orienting hospitals to improve smoking cessation care delivery, and provide an indication of appropriate intervention approaches to effect such change. As such, this paper reviews studies published between 1994 and 2006 that describe interventions to increase the routine provision of smoking cessation care by health care professionals in hospitals. The review aimed to: first, provide an overview of studies that quantitatively assessed the impact of an intervention on the routine provision of smoking cessation care, and second, to examine the effectiveness of controlled intervention studies in increasing the routine provision of smoking cessation in hospitals using a meta-analytic approach.

Methods

Identification of studies

Guidelines outlining best practice smoking cessation care were published in the mid 1990s (Fiore et al., 1996; West et al., 2000). Further, the one previous review that examined clinical practice change specific to the hospital setting only included studies up to 1998 (Dijkstra et al., 2006). As such, studies published in peer–reviewed journals between January 1994 and June 2007 were selected as the focus of the study. An electronic search of the Medline, Embase, Cinahl and Psychinfo databases was undertaken. Broad search terms, previously used in other reviews (Lancaster et al., 2000; Rice, 2006; Rigotti et al., 2000; Wolfenden, Campbell, Walsh, & Wiggers, 2003) were used to increase the sensitivity of the search (Higgins & Green, 2005), and were 'hospital' (or 'physician' or 'nurse' or 'managed care') and 'smoking cessation' (or 'nicotine replacement therapy' or 'smoking counselling/counseling'). Citations were excluded if: there was not an abstract, or the abstract indicated the study was unlikely to be relevant; and the citation did not include the terms 'hospital', 'inpatient' or 'outpatient' as subject headings. The full text of the remaining citations was examined with reference to the inclusion criteria outlined below. The reference lists of included studies were checked for further relevant studies.

An article was eligible for inclusion if it:

- Was in English;
- Was in a hospital setting (either inpatient or outpatient) excluding primary care. If the setting was unclear and the author was unable to clarify the setting, the study was excluded;
- Described smoking cessation care provided by medical officers, nurses or other allied health staff who were not part of an additional research team;
- Was an intervention trial (including controlled trials, time series or non-controlled before and after studies) and reported smoking cessation care at follow-up against a baseline or comparison group. Uncontrolled trials were included because a description and assessment of the methodological quality of the overall field of studies that aimed to increase routine hospital smoking provision was the first study objective;

- Described at least one intervention strategy undertaken to increase smoking cessation care. Studies including a very minimal description of strategies, for example ‘staff were introduced to the program materials’, were excluded;
- Quantitatively measured at least one of the following practices: assessment of smoking status; advice to quit; counselling or assistance to quit; advising, offering or providing nicotine replacement therapy (NRT); and follow up or referral to a quit service;
- Described the proportion of patients receiving care, the proportion of health professionals providing care, or both.

Description of studies

Data from each study were extracted by one person (MF) and checked for correctness by a second author (RS). Methodological quality was assessed by the protocol outlined below. Differences were resolved by consensus.

Intervention strategies utilised

Intervention strategy classification was based on definitions outlined by the Cochrane Effective Practice and Organisation of Care Group and is presented in Table 1 (Grimshaw et al., 2001). The number of studies reporting use of each intervention strategy type, and the number of intervention strategies used by each study were summarised for all studies and for controlled trials separately. Studies were considered to have used a multi-strategic approach if they reported implementing more than one intervention strategy type. For controlled trials, the control group condition was also described.

Methodological quality

All studies were appraised against eight criteria: selection bias, allocation bias, confounders, blinding, data collection methods, withdrawals, appropriateness of analysis, and intervention integrity and timing (see Table 2). Studies were classified as methodologically strong, moderate or weak for each of the first six criteria using a tool developed for studies in public health (Effective Public Health Practice

Project, 2003). If the study was a randomised controlled trial, it was also appraised regarding random allocation, including if the method of random allocation was stated, and if so, whether the method of allocation was appropriate and concealed. One of the authors (MF) appraised all studies and two other authors (LC and CP) independently appraised half the articles each. One of the authors (MF) examined appropriateness of analysis in conjunction with a statistician.

Intervention effect on smoking cessation care provision

For each study, the prevalence of the smoking cessation care practices reported (baseline and post-test for uncontrolled studies, and follow-up levels of care for control and intervention groups for controlled trials) was described. The smoking care practices described were: assessment of smoking status; advice to quit; counselling or assistance to quit; advising, offering or providing nicotine replacement therapy (NRT); and follow up or referral. Across studies, the frequency of report of each smoking cessation care practice was also described.

Meta-analysis of intervention effect

A random effects meta-analysis (DerSimonian-Laird) was undertaken for controlled trials only to determine an estimate of intervention effect for each smoking cessation care practice. Follow-up control data was compared to follow-up intervention data. A weighted pooled risk difference (PRD) was calculated to estimate the intervention effect size. A PRD with a lower confidence interval not less than zero was regarded as demonstrating a significant intervention effect. Cochrane's Q was calculated to indicate statistical heterogeneity and the level of heterogeneity was quantified by a measure of inconsistency (I^2) (Higgins et al., 2005). Smoking cessation care practices with inconsistency of more than 50% were considered to include substantial heterogeneity. All statistical analyses were undertaken using STATA (StataCorp, 2005) and Statsdirect (StatsDirect Ltd, 2005).

In each study, each smoking cessation care practice reported could potentially be measured by a single care item, or by a number of different care items each treated separately (for example, assistance or counselling could be measured on 'advising risks of smoking' and 'advising how to quit'). Similarly,

each care practice outcome could be measured by a single measurement tool or by more than one tool (for example, audit and observation). When a smoking cessation care practice was measured by a number of different care items, or by more than one data collection tool the smoking cessation care items were ranked and the median effect size was included in the meta-analysis (if there was an even number of items, the median was calculated as the lowest of the two middle outcomes). If there were insufficient data to undertake a meta-analytic approach to describe the intervention effect on a smoking cessation care practice, that care practice was reported descriptively.

Results

Studies identified in literature review

In total 770 citations were extracted from the search whose title or abstract indicated the possibility of meeting the inclusion criteria. One hundred and eighty four articles were excluded because the citation did not meet the abstract related inclusion criteria. One hundred and thirty six articles were subsequently excluded as they did not describe an intervention study. Of the remaining 450 articles, 415 were excluded as they: were not in English (4 articles); were not in an eligible hospital setting (110 articles); did not describe smoking cessation care routinely provided by hospital health professionals (37 articles); did not describe the proportion of patients receiving or the health professionals providing smoking cessation care (191 articles); did not report smoking cessation care for the control or pre-test component (60 articles); or did not describe intervention strategies adequately (13 articles). A further seven articles were excluded as they: were a comment on a study already extracted (4 articles); were dissertations (2 articles); or an historical article reprinted outside the year limitation (1 article). The setting could not be clarified for one article and it was excluded. As such, twenty seven articles met the inclusion criteria. Three articles described the same intervention study (Cooke, Mattick, & Walsh, 2001b; Cooke, Mattick, & Walsh, 2001a; Campbell, Walsh, Sanson-Fisher, Burrows, & Stojanozski, 2006) which resulted in 25 studies being included in the review (Zhang et al., 2005; Wolfenden et al., 2005b; Williams, Schmaltz, Morton, Koss, & Loeb, 2005; Walsh, Redman, Byrne, Melmeth, & Brinsmead, 2000; Stoeckle-Roberts et al., 2006; Schnoll et al., 2003; Rigotti et al., 1997; Puska, Barrueco, Roussos, Hider, & Hogue, 2005; Pandey & Cursio, 2006;

Naudziunas, Jankauskiene, Kalinauskiene, & Pilvinis, 2005; Mehta et al., 2002; Mehta et al., 2004; McDaniel, Kristeller, & Hudson, 1999; Marciniak et al., 1998; LaBresh, Ellrodt, Gliklich, Liljestrand, & Peto, 2004; Hajek, Taylor, & Mills, 2002; Cooke et al., 2001b; Cooke et al., 2001a; Chang, Zimmerman, & Beck, 1995; Campbell et al., 2006; California Acute Stroke Pilot Registry Investigators, 2005; Butler et al., 2006; Bratzler et al., 2001; Bolman, de Vries, & van Breukelen, 2002; Barr Taylor, Houston Miller, Cameron, Wien Fagans, & Das, 2005; Allen, Pederson, & Leonard, 1998; Ahluwalia, Gibson, Kenney, Wallace, & Resnicow, 1999).

Description of studies

General summary

A description of each study can be viewed online in a supplementary table. Studies were actually undertaken (rather than published) during 1989 to 2004 (two studies did not report the year of study). The majority of studies (18 of 25) took place in the United States and were in inpatient settings. Patient diagnoses included cardiac or cardio-vascular, antenatal, cancer, emergency, pre-surgical, respiratory, and a range of other patient diagnoses. Four of the 10 controlled studies included cardiac patients (Pandey et al., 2006; Mehta et al., 2002; Hajek et al., 2002; Bolman et al., 2002), two studies included pregnant women (Walsh et al., 2000; Campbell et al., 2006), two studies included patients with a range of diagnoses (Rigotti et al., 1997; Allen et al., 1998), one study included cancer patients (Schnoll et al., 2003), and one study included pre-surgical patients (Wolfenden et al., 2005b). Five of the controlled studies assessed improvement in smoking cessation care among hospital in-patients (Rigotti et al., 1997; Pandey et al., 2006; Mehta et al., 2002; Hajek et al., 2001; Bolman et al., 2002) and the remainder in out-patient settings.

In measuring smoking cessation care prevalence, 10 studies used patient report, two studies used health professional report, 15 studies used medical notes audit, and one study used direct observation. Three studies used two data collection types. Studies were set in a single unit addressing patients with multiple diagnoses, in a single unit with a single diagnosis, across a single hospital with varied diagnoses, across more than one hospital with a single diagnosis, and across more than one hospital

with multiple diagnoses. Of the studies set across more than one hospital, the number of hospitals receiving the intervention ranged from five to more than 3,000 (median 17 hospitals).

The majority of studies (24 of 25) reported the proportion of patients receiving smoking cessation care. Two studies described the proportion of health professionals providing care. One study described both. Smoking cessation care was the sole care practice reported for 13 studies and one of a number of care practices reported for 12 studies. Seven studies reported patient smoking cessation as the primary outcome.

Intervention strategies applied

Table 3 summarises the intervention strategies reported in the review studies. Organisational change strategies and educational meetings were most frequently reported and most often combined with reminders, and audit and feedback. Compared to all studies, controlled trials more often used educational meetings, reminders, patient resources and educational outreach visits. Six of the 10 controlled trials, and 11 of all 25 studies, reported implementing five or more intervention strategies. One controlled study reported using one strategy (Rigotti et al., 1997). The majority of controlled trials (seven of 10) reported that control groups received no additional resources or support to increase the provision of smoking cessation care. Control groups in the other controlled trials received minimal smoking cessation care (Hajek et al., 2002), a simple dissemination intervention (Cooke et al., 2001a; Campbell et al., 2006; Cooke et al., 2001b), and an electronic quality monitoring resource (Pandey et al., 2006).

Methodological quality

The methodological quality of all studies for the first six criteria is summarised in Table 4. No study was assessed as ‘strong’ or ‘moderate’ for all applicable assessment criteria. It is difficult to draw firm conclusions regarding the overall study quality because a varying number of criteria were applicable across studies. However, only eight of the 25 studies were rated as ‘moderate’ or ‘strong’ on at least

three of the six criteria. All eight of these studies were controlled trials, with uncontrolled studies generally not rating highly across the majority of criteria.

Six of the 10 controlled trials were randomised controlled trials (RCT) (Wolfenden et al., 2005b; Walsh et al., 2000; Schnoll et al., 2003; Rigotti et al., 1997; Hajek et al., 2002; Cooke et al., 2001b; Cooke et al., 2001a; Campbell et al., 2006), and four were quasi-experimental studies (Pandey et al., 2006; Mehta et al., 2002; Bolman et al., 2002; Allen et al., 1998). Four of the five RCT studies reported an appropriate method of allocation (one study did not state the method of allocation (Rigotti et al., 1997)). Three RCT studies reported concealment of the random allocation (Wolfenden et al., 2005b; Hajek et al., 2002; Walsh et al., 2000). The majority of the controlled studies (eight of 10) were assessed as 'moderate' or 'strong' in minimising selection bias, as eligible participants were likely to be representative of the target population and 60% or more eligible participants agreed to participate (or consent was not required). Three controlled trials were rated as being 'weak' regarding confounding (Pandey et al., 2006; Mehta et al., 2002; Allen et al., 1998), as studies either did not describe potentially important confounders, or if differences were found, did not control for such differences in analysis.

Where blinding was applicable, only one of three studies reported that the outcome assessor was blind to group allocation. No studies were assessed as 'strong' in their use of data collection tools, as none reported using a validated data collection tool. Of the three controlled studies undertaking audit or observation, two were assessed as being 'moderate' in their use of data collection tool, as they reported adequate reliability. When participant withdrawal was relevant, five of seven controlled studies were assessed as being 'moderate' or 'strong'.

Appropriateness of analysis varied between studies. Four studies did not undertake statistical analysis of smoking cessation care outcomes (Allen et al., 1998; Barr Taylor et al., 2005; California Acute Stroke Pilot Registry Investigators, 2005; Schnoll et al., 2003). The majority of studies (19 of 21) undertaking statistical analysis reported using an appropriate statistical test (one study did not provide

sufficient information to determine appropriateness) (Williams et al., 2005). Of the nine controlled studies that undertook statistical analysis, three had a unit of allocation that differed to the unit of analysis (Bolman et al., 2002; Campbell et al., 2006; Cooke et al., 2001a; Cooke et al., 2001b; Mehta et al., 2002). One of these three studies adjusted for the effect of clustering and did not find a significant intervention effect on smoking cessation care delivery. The two studies that did not adjust for clustering reported at least one significant positive effect on smoking cessation care.

Six controlled studies reported at least one aspect of intervention integrity and in general indicated moderate integrity. For example, studies reported training was often shorter than planned (Cooke et al., 2001a; Campbell et al., 2006; Cooke et al., 2001b), or follow-up training did not occur (Bolman et al., 2002; Campbell et al., 2006; Cooke et al., 2001a; Cooke et al., 2001b). Four studies indicated control groups may have received some intervention components (Hajek et al., 2002; Schnoll et al., 2003; Walsh et al., 2000; Wolfenden et al., 2005b). Four studies reported on the timing of the follow-up measurement. For example, there was a one month overlap between the intervention and follow-up measurement in one study (Mehta et al., 2002), and in another measurement occurred six months after intensive support was withdrawn (Cooke et al., 2001a; Campbell et al., 2006; Cooke et al., 2001b).

Intervention effect on smoking cessation care practices

Controlled trials reported between one and four smoking care practices each (five controlled studies examined one smoking care practice outcome (Rigotti et al., 1997; Pandey et al., 2006; Mehta et al., 2002; Hajek et al., 2002; Allen et al., 1998)). Assistance or counselling to quit was most commonly reported (eight studies), followed by advice to quit (six studies), assessment of smoking status (two studies), referral or follow-up (two studies), and provision or discussion of NRT (two studies). Compared to controlled trials, all studies included in the review reported a similar pattern in care practice frequency, except for advice to quit which was less often reported. Eleven of the 15 non-controlled studies examined one smoking care practice outcome. Five controlled trials described a number of care items to report one care practice (Wolfenden et al., 2005b; Walsh et al., 2000; Schnoll et al., 2003; Hajek et al., 2002; Cooke et al., 2001b; Cooke et al., 2001a). For example, Schnoll et al

reported the prevalence of the discussion of quitting benefits, assistance to set a quit date, sending a reminder letter, and provision of written resources to describe the prevalence of counselling or counselling to quit (Schnoll et al., 2003).

Meta-analyses of controlled trial intervention effect

As only one controlled study described the proportion of health professionals providing care, meta-analysis was undertaken to examine the intervention effect on the proportion of patients receiving smoking cessation care only. The results of the meta-analyses for controlled trials are presented in Table 5.

Meta-analyses of controlled studies demonstrated a significant intervention effect for the care practice counselled or assisted to quit (PRD 16.6, CI 4.9-28.3). This indicated that approximately 17% more intervention patients were assisted or counselled to quit, compared to control group patients, and as such indicated a moderate effect size (between 10% and 20%) (Grimshaw et al., 2004). A significant intervention effect for assessed smoking status, advised to quit, or for the offer or provision of NRT, was not demonstrated. Substantial heterogeneity was indicated for all smoking cessation care practices examined. The PRD was not calculated for referral or follow-up, as only one controlled study reported this care practice. In this study the intervention group provision of referral or follow-up was increased over the control group by 47.1%.

The controlled study reporting the proportion of health professionals providing care demonstrated variable intervention effect between smoking cessation care practices (Cooke et al., 2001b; Cooke et al., 2001a). The study demonstrated significantly more health professionals in the intensive intervention group provided three out of seven care items describing assistance or counselling to quit. A similar effect was not demonstrated for assessment of smoking status, advice to quit, or referral or follow-up.

Discussion

This review is the first to examine the effectiveness of interventions in increasing the routine provision of smoking cessation care in hospitals. A relatively small number of studies were identified and these were primarily United States-based and addressed cardio-vascular patient smoking cessation care, rather than hospital-wide smoking cessation care provision. Most studies examined a limited number of smoking cessation care practices. Five of the ten controlled trials assessed one care practice only. Furthermore, over half of the studies (15 of 25) were uncontrolled trials and of these a 'weak' study methodology was predominantly used. The majority of studies (21 of 25) used a multi-strategic approach, for example combining educational meetings with reminders and written resources. The review also indicated interventions can have a 'moderate' effect in increasing the routine provision of one smoking cessation care practice; provision of assistance and counselling to quit.

The lack of controlled studies identified by this review, in particular the lack of RCT evidence, reflects the types of studies generally found in public health and health promotion research (Jackson & Waters, 2006; Rychetnik, Frommer, Hawe, & Shiell, 2002). Although not considered 'gold standard', non-randomised controlled trials can provide an estimate of the direction and size of effects that may be sufficient to recommend promising interventions (Jackson et al., 2006). The feasibility of undertaking rigorously designed health promotion research in 'real world' settings, including the availability of sufficient resource, may have limited the number of controlled trials implemented (Rychetnik et al., 2002). Although difficult, it is important that researchers continue to design innovative studies of a high standard, preferably using a controlled design (Rychetnik et al., 2002).

Although controlled trials were generally assessed as being stronger than non-controlled studies across the methodological criteria, such studies were assessed as 'weak' for some criteria. A poor methodological quality has the potential to over- or under-estimate intervention effect but, it is difficult to determine which of these is true for this review (Higgins et al., 2005). In particular, validated data collection tools were not used to assess outcome. The development of such a tool is not without difficulties, given the known limitations of notes audit, patient report and health professional self-report (Conroy et al., 2005; Solberg, 1996; Ward & Sanson-Fisher, 1996). In the absence of a

validated tool, using multiple data collection tools to demonstrate consistent direction and size of effect may assist in drawing firmer conclusions regarding intervention effect (Dootson, 1995). Two controlled studies included in this review attempted this (Walsh et al., 2000; Wolfenden et al., 2005b).

Meta-analysis seemed an appropriate approach given all studies examined the same general clinical practice (and the effect on specific smoking cessation care practices was examined separately), and were all hospital-based. However, significant statistical heterogeneity was found across all care practices examined. The small number of controlled studies precluded closer examination by meta-regression or subgroup analysis. The variability in study quality and intervention strategies used, along with unknown intervention integrity, most likely contributed to such heterogeneity (Higgins et al., 2005). However, the possibility that there may be other factors at play in the hospital setting should be considered. For example, variations in setting (inpatient and outpatient) and in patient diagnosis (cardiac, antenatal, cancer, surgical, and medical) were also evident. Although heterogeneity existed, the evidence regarding the efficacy of interventions in increasing smoking cessation care in the hospital setting should not be dismissed. Although a systematic review involving non-randomised trials with significant statistical heterogeneity occur lower on the hierarchy of evidence, it remains an acceptable level of evidence within its limitations (Scottish Intercollegiate Guidelines Network (SIGN), 2001; Mosteller & Colditz, 1996). Furthermore, the evidence of intervention effect found by this review, in the context of varying hospital setting and patient diagnosis, can also be interpreted as such evidence being broadly applicable to hospitals (Jackson et al., 2006).

The finding that interventions were able to increase at least one element of hospital-based smoking cessation care provision is encouraging, as the provision of smoking cessation care to hospitalised patients has been demonstrated to significantly impact on patient cessation rates (Wolfenden et al., 2005a; Rigotti, Munafo, & Stead, 2007). Given a significant proportion of smokers are hospitalised each year, the routine provision of such care could have substantial public health benefits (Wolfenden et al., 2005a; Wolfenden et al., 2004). Such a finding also provides evidence to hospital administrators that an increase in smoking cessation care delivery is achievable. Examination of controlled trials

indicated moderate increases in the provision of assistance and counselling to quit. It should be acknowledged however, these increases may not increase smoking cessation care to recommended levels (Curry, 2000; New South Wales Department of Health, 2003). Further, given the limited information provided on measurement timing in relation to the intervention component, it is difficult to determine if the intervention effects indicated by this review were short-term or sustained changes. Such information would be of importance to hospital administrators to enable a revision of the evidence in terms of sustainable improvements in practice. Intervention effectiveness on the assessment of smoking status, advice to quit and the provision of NRT was not supported by this review, although the small number of controlled studies (two, six, and two studies respectively) examining these care practices limits the ability to comment meaningfully. There were also insufficient data to meta-analytically assess intervention impact on the proportion of health professionals providing care.

Apart from advice to quit, and assistance or counselling to quit, few studies examined other aspects of smoking cessation care. It is important that researchers focus on increasing the provision of a broad range of smoking cessation care practices, as a comprehensive package of smoking cessation care provides hospitalised patients with the best chance of quitting (Wolfenden et al., 2003; Rigotti et al., 2007). The majority of studies recruited smokers only, and investigated the care they received, thereby limiting the ability to examine routine assessment of smoking status among the broader patient population. As the majority of studies included in this review involved cardiac or antenatal patients, the lack of studies reporting the provision of NRT may be explained. Until recently NRT was contraindicated for cardiac and antenatal patients (Raw, McNeill, West, Arnott, & Armstrong, 2006; Zwar, Bell, Peters, Christie, & Mendelsohn, 2006). The lack of studies reporting referral and follow-up probably reflects a lack of knowledge and limited availability of referral options (Orleans, Kristeller, & Gritz, 1993; Borland & Segan, 2006). The introduction of quit services, such as Quitlines, should facilitate investigation of this care practice in the future (Bentz et al., 2006; Borland et al., 2006).

The majority of studies used a multi-strategic approach to increase smoking cessation care, and most often incorporated educational meetings. Such an approach would seem appropriate when implementing an effectiveness trial in the complex hospital setting (Curry, 2000; Nagle et al., 1999; Nagle, Hensley, Schofield, & Koschel, 2005; Wolfenden et al., 2005b). This review cannot suggest which particular strategy or combination of strategies are important in increasing routine smoking cessation care provision in hospitals, but it does suggests that such a multi-strategic approach can increase such care. Unfortunately, only a small minority of studies reported on intervention integrity, which had it been reported, would have informed strategy selection and implementation in either future studies or practice change initiatives (Glasgow, Klesges, Dzewaltowski, Bull, & Estabrooks, 2004). Such information is essential if the field is to advance further (Glasgow et al., 2004). However, it was encouraging that the majority of studies used reminders and organisational change strategies, as general reviews of clinical practice change suggest reminders are an important strategy in increasing smoking cessation care provision (Dijkstra et al., 2006; Fiore et al., 1996; Fiore et al., 2000; Fiore et al., 2008; Hopkins et al., 2001; Grimshaw et al., 2006), and that systems change is required to ensure sustainable improvements in clinical practice (Lancaster et al., 2000; Nagle et al., 2005).

In addition to statistical heterogeneity, this review should be considered in light of a number of other limitations. First, some studies may not have provided a rigorous account of all study descriptors. This may have resulted in this review under-reporting, for example, indicators of methodological quality or the type of intervention strategies implemented. However, in the case of methodological quality it is unlikely that major methodological strengths would be omitted. Second, controlled studies included in the meta-analysis were not culled on methodological quality. Although there is no unreserved recommendation regarding study quality (Higgins et al., 2005), this consequently means there is a risk that bias has been introduced. Furthermore, the meta-analysis included non-randomised trials. As already suggested non-randomised controlled trials can provide an estimate of intervention effect (Jackson et al., 2006), and such studies have been included in previous reviews using meta-analytic approaches (Anderson & Jane-Llopis, 2004; Dijkstra et al., 2006; Lumley, Oliver, Chamberlain, & Oakley, 2004).

Despite these limitations, this review indicates that interventions can be effective in increasing the routine provision of at least one aspect of smoking cessation care in the hospital setting. In particular, it suggests a multi-strategic approach can be effective in achieving moderate increases in assistance and counselling to quit. Future research should endeavour to use stronger study designs that examine hospital-wide provision of a broader range of smoking cessation care practices, particularly NRT and follow-up or referral to further quitting assistance. Such research would be strengthened by improved reporting of intervention implementation, including integrity and timing of measurement in relation to implementation. Hospital administrators ought to focus on increasing compliance with existing best practice guidelines.

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Competing interests

There are no known competing interests for any of the authors.

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None

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Table 1. Intervention strategies to change health professional practice [a]

Intervention strategy	Description
Distribution of education materials	Distribution of published or printed recommendations for smoking cessation care, including clinical practice guidelines, protocols, audiovisual materials, electronic publications and example policies.
Educational meetings	Health professionals have participated in conference, lectures, workshops or traineeships.
Local consensus processes	Inclusion of health professionals in discussion to ensure that they agree smoking cessation care is important and/or the approach to patient smoking cessation care was appropriate.
Educational outreach visits	A trained person met with health professionals in the hospital setting to give information, including performance feedback, with the intent of changing smoking cessation care practice.
Local opinion leaders	Use of providers nominated by their colleagues as 'educationally influential'.
Patient-mediated interventions	New clinical information collected directly from patients and given to providers.
Audit and feedback	Any summary of clinical performance of healthcare. The summary may also include recommendations for clinical action.
Reminders	Patient or encounter specific information which is designed or intended to prompt health professionals to recall information or provide care.
Marketing	Use of personal interviewing, group discussion, or a survey of targeted health professionals to identify barriers to change and subsequent interventions that address identified barriers.
Mass media	Use of communication that reached great numbers of health professionals or patients including television, radio, newspapers, posters, leaflets, and booklets.
Organisational	Influencing the organisation of services, including the process of care (teamwork, task delegation), the structure of care (follow-up system) and the content of care (health charts, flow sheets).
Regulatory	Establishing rules for reimbursable services and for supply of smoking cessation care.
Financial	Provision of financial rewards or penalties to clinicians/institutions for performing specific smoking cessation care practices.
Patient resources	Distribution or addition of resources that may aid discussion of smoking or allow previously unavailable options for smoking cessation care, including flipcharts, educational resources for patients and referral opportunities (e.g. quitlines)

[a] modified from the classification of professional interventions from EPOC taxonomy (Grimshaw et al., 2001)

Table 2. Summary of methodological quality assessment criteria [a]

Criteria
1. Selection bias Were eligible individuals "missed" during the recruitment phase? What percentage of selected individuals agreed to participate?
2. Allocation bias Was the study a randomised control trial, quasi-experimental or other design? If a randomised control trial: Is the method of random allocation stated? If the method of random allocation is stated is it appropriate? Was the method of random allocation reported as concealed?
3. Confounders Prior to the intervention were there between group differences for important confounders reported? If there were important confounder differences, were they adequately managed in the analysis? Were there important confounders not reported in the paper? *Confounders were age, gender, level of nicotine dependence and the existence of a smoking related illness when patient was the unit of analysis; and age, smoking status, type of health professional and unit worked when health professionals were the unit of analysis.*
4. Blinding Was the outcome assessor blinded to the intervention status of the participants? *Blinding not applicable to non-controlled studies or if measurement was by self- report or electronic audit.*
5. Data collection method [b] Were the data collection tools shown or are they known to be valid? Were the data collection tools shown or are they known to be reliable?
6. Withdrawals What was the percentage of participants completing the study? *Withdrawal was only applicable when outcomes were measured at a time after recruitment.*
7. Appropriate statistical analysis Were appropriate statistical test used? Was cluster analysis undertaken when appropriate? *Cluster analysis was not applicable to non-controlled studies.*
8. Intervention integrity and timing Were intervention components provided consistently to all participants? Were control participants contaminated by receiving any intervention components? When did follow-up measurement occur in relation to the intervention phase?

[a] modified from the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies (Effective Public Health Practice Project, 2003)

[b] studies using notes audit to assess care provision that did not demonstrate validity but did demonstrate reliability were classified as moderate for data collection method

Table 3. Summary of intervention strategies utilised

Intervention strategy used	All studies (n=25)	Controlled studies (n=10)
Educational meetings	17	8[a]
Organisational	18	7[b]
Reminders	13	7[c]
Audit and feedback	15	5[d]
Distribution of education materials	8	5[e]
Patient resources	8	7[f]
Local consensus processes	9	3[g]
Educational outreach visits	7	6[h]
Local opinion leaders	5	2[i]
Mass media	3	2[j]
Incentives	1	1[k]
Marketing	1	0
Patient-mediated interventions	0	0
Regulatory	0	0
Number of strategies used per study		
One	4	1[l]
Two	3	0
Three	4	2[m]
Four	3	1[n]
Five	4	2[o]
Six	3	1[p]
Seven	1	1[q]
Eight	3	2[r]

[a] (Wolfenden et al., 2005b; Campbell et al., 2006; Walsh, Redman, Brinsmead, Byrne, & Melmeth, 1997; Walsh et al., 2000; Schnoll et al., 2003; Mehta et al., 2002; Hajek et al., 2002; Cooke et al., 2001b; Cooke et al., 2001a; Bolman et al., 2002; Allen et al., 1998)
[b] (Wolfenden et al., 2005b; Pandey et al., 2006; Cooke et al., 2001a; Cooke et al., 2001b; Campbell et al., 2006; Schnoll et al., 2003; Mehta et al., 2002; Hajek et al., 2002; Bolman et al., 2002)
[c] (Wolfenden et al., 2005b; Walsh et al., 1997; Walsh et al., 2000; Rigotti et al., 1997; Mehta et al., 2002; Hajek et al., 2002; Bolman et al., 2002; Allen et al., 1998)
[d] (Wolfenden et al., 2005b; Campbell et al., 2006; Pandey et al., 2006; Mehta et al., 2002; Cooke et al., 2001b; Cooke et al., 2001a; Allen et al., 1998)
[e] (Walsh et al., 1997; Campbell et al., 2006; Walsh et al., 2000; Mehta et al., 2002; Cooke et al., 2001b; Cooke et al., 2001a; Bolman et al., 2002; Allen et al., 1998)
[f] (Wolfenden et al., 2005b; Campbell et al., 2006; Walsh et al., 1997; Walsh et al., 2000; Schnoll et al., 2003; Hajek et al., 2002; Cooke et al., 2001b; Cooke et al., 2001a; Bolman et al., 2002; Allen et al., 1998)
[g] (Wolfenden et al., 2005b; Pandey et al., 2006; Mehta et al., 2002)
[h] (Wolfenden et al., 2005b; Campbell et al., 2006; Walsh et al., 1997; Walsh et al., 2000; Schnoll et al., 2003; Cooke et al., 2001b; Cooke et al., 2001a; Bolman et al., 2002; Allen et al., 1998)
[i] (Wolfenden et al., 2005b; Mehta et al., 2002)
[j] (Mehta et al., 2002; Allen et al., 1998)

[k] (Allen et al., 1998)
[l] (Rigotti et al., 1997)
[m] (Schnoll et al., 2003; Pandey et al., 2006)
[n] (Hajek et al., 2002)
[o] (Campbell et al., 2006; Cooke et al., 2001a; Cooke et al., 2001b; Walsh et al., 2000)
[p] (Bolman et al., 2002)
[q] (Wolfenden et al., 2005b)
[r] (Mehta et al., 2002; Allen et al., 1998)

Table 4. Methodological quality studies examining the effect of an intervention on smoking cessation care[a]

Author/year	Selection bias	Allocation bias	Confounders	Blinding	Data collection[c]	Withdrawals
Williams et al 2005	Strong	Weak	Weak	NA	Moderate	NA
Zhang et al 2005	Strong	Weak	Weak	NA	Weak	NA
CASPR 2005	Strong	Weak	Weak	NA	Weak	NA
Wolfenden et al 2005	**Strong**	**Strong**	**Strong**	**Weak/NA[b]**	**Weak**	**Strong**
Barr Taylor et al 2005	Weak	Weak	Weak	Weak	Weak	Moderate
LaBresh et al 2004	Moderate	Weak	Moderate	NA	Weak	NA
Mehta et al 2004	Strong	Weak	Weak	NA	Moderate	NA
Schnoll et al 2003	**Weak**	**Strong**	**Strong**	**NA**	**Weak**	**Moderate**
Bolman et al 2002	**Moderate**	**Moderate**	**Strong**	**NA**	**Weak**	**Weak**
Mehta et al 2002	**Strong**	**Moderate**	**Weak**	**Weak**	**Moderate**	**NA**
Hajek et al 2002	**Weak**	**Strong**	**Strong**	**NA**	**Weak**	**Strong**
Bratzler et al 2001	Strong	Weak	Weak	NA	Weak	NA
Campbell et al 2006, Cooke 2001[a,b]	**Strong**	**Strong**	**Strong**	**NA**	**Weak**	**NA**
Walsh et al 2000	**Moderate/Weak[b]**	**Strong**	**Strong**	**Strong/NA[b]**	**Strong/Weak[b]**	**NA**
Ahluwalia et al 1999	Strong	Weak	Strong	NA	Weak	NA

Author/year	Selection bias	Allocation bias	Confounders	Blinding	Data collection[c]	Withdrawals
McDaniel et al 1999	Strong	Weak	Weak	NA	Weak	NA
Allen et al 1998	**Moderate**	**Moderate**	**Weak**	**NA**	**Weak**	**NA**
Marciniak et al 1998	Strong	Weak	Weak	NA	Moderate	NA
Rigotti et al 1997	**Strong**	**Strong**	**Strong**	**NA**	**Weak**	**Strong**
Chang et al 1995	Moderate	Weak	Weak	NA	Weak	NA
Naudzinunas et al 2005	Weak	Weak	Weak	NA	Weak	NA
Puska et al 2005	Weak	Weak	Weak	NA	Weak	Moderate
Pandey et al 2006	**Moderate**	**Moderate**	**Weak**	**NA**	**Weak**	**NA**
Butler et al 2006	Moderate	Weak	Weak	NA	Weak	NA
Stoeckle-Roberts et al 2006	Moderate	Weak	Weak	NA	Weak	NA

[a] Bolded studies represent controlled trials.
[b] Studies could have more than one rating per criteria as they assessed two samples or used two data collection methods.
[c] Studies were assessed as being moderate for data collection if the reliability of data collection was measured and reported as adequate.

Table 5. Meta-analyses of controlled study's intervention effect on the proportion of patients receiving smoking cessation care

Smoking care practice	No. studies assessing care	Cochrane's Q, *df*, (*p* value)	I^2 (Inconsistency)	Pooled risk difference (CI)
Assessed status	2[c]	27.9,1 (<0.0001)	[a]	13.7 (-11.4-38.7)
Advised to quit	6[d]	243.0, 5 (<0.0001)	97.9%	21.0 (-0.6-42.6)
Assisted/counselled	8[e]	112.0, 7 (<0.0001)	93.7%	16.6 (4.9-28.3)
Provided/offered NRT	2[f]	171.5, 1 (<0.0001)	[a]	50.2 (-29.7-130.2)
Referral/ follow-up	1[g]	-	-	[b]

[a] The I^2 statistic could not be calculated as the meta-analysis only included two studies
[b] Meta-analysis was not undertaken as only one controlled study reported this smoking cessation care practice
[c] (Schnoll et al., 2003; Campbell et al., 2006)
[d] (Allen et al., 1998; Campbell et al., 2006; Bolman et al., 2002; Rigotti et al., 1997; Schnoll et al., 2003; Walsh et al., 2000)
[e] (Bolman et al., 2002; Pandey et al., 2006; Campbell et al., 2006; Hajek et al., 2002; Mehta et al., 2002; Schnoll et al., 2003; Walsh et al., 2000; Wolfenden et al., 2005b)
[f] (Schnoll et al., 2003; Wolfenden et al., 2005b)
[g] (Schnoll et al., 2003)