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DEVELOPING ASSESSMENT AND PROMOTION OF TOBACCO COUNSELLING: A CLUSTER-RANDOMISED COMMUNITY TRIAL AMONG ORAL HEALTH PROFESSIONALS

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ACADEMIC DISSERTATION

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CONTENTS

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ABBREVIATIONS

α	Cronbach's alpha
BCW	The Behaviour Change Wheel
CI	Confidence Interval
COM-B	'Behaviour system' ('Cabability', 'Opportunity' and 'Motivation' interact to create behaviour)
d	Standardised mean difference
EDR	Electronic Dental Record
F	F-test
FCTC	Framework Convention on Tobacco Control
OR	Odds Ratio
OSCE	Objective Structured Clinical Examination
PASW	Predictive Analytics Software
p	p-value
PRECEDE	Predisposing, Reinforcing and Enabling Constructs in Educational Diagnosis and Evaluation
PROCEED	Policy, Regulatory and Organisational Constructs in Educational and Environmental Development
r	Pearson's correlation
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
TDF	Theoretical Domains Framework
TDQ	Theoretical Domains Questionnaire
TUC	Tobacco Use Cessation
TUPAC	Tobacco Use Prevention and Cessation
UK	United Kingdom
US	United States
WHO	World Health Organization

ABSTRACT

Tobacco use adversely affects oral health. Tobacco use cessation (TUC) counselling guidelines recommend that oral health professionals should ask about each patient's tobacco use, assess each tobacco user's readiness and willingness to stop, document his or her tobacco use habits, advise the tobacco user to quit, assist and help him or her in quitting, and arrange to monitor each tobacco user's progress at follow-up appointments. In addition to TUC counselling, providing positive support to remain tobacco abstinent is particularly important among adolescents who are about to experiment with tobacco use. Despite excellent opportunities, tobacco use prevention and cessation (TUPAC) counselling among oral health professionals has proved challenging. To develop the assessment and promotion of TUPAC counselling, the present study aimed to (1) develop a theory-based questionnaire to assess factors influencing the provision of TUPAC counselling, (2) assess the provision of TUC counselling at baseline, (3) identify implementation barriers to and determinants of TUPAC counselling, and (4) develop educational and fee-for-service interventions to promote TUPAC counselling and evaluate their effects.

A sample of Finnish dentists (n = 73) and dental hygienists (n = 22) employed by community dental clinics of the municipal health care regions of Tampere (28 clinics) and Vaasa (9 clinics) were invited to participate. Of those invited, 73 (76.8%) oral health professionals from 34 (91.9%) dental clinics participated. Applying a Theoretical Domains Framework (TDF), a 35-item Theoretical Domains Questionnaire (TDQ) was developed to assess factors influencing TUPAC counselling among oral health professionals. The questionnaire was based on theoretically derived behavioural determinants (e.g. knowledge, skills, motivation) (TDF), the Current Care Guidelines for TUC counselling, and items related to tobacco prevention. The provision of TUC counselling at baseline was measured using a questionnaire and an electronic dental record audit to measure the effects of (1) educational and (2) educational + fee-for-service interventions.

The estimates of internal consistency supported the reliability of the TDQ developed. In addition, the results of factor analysis supported the validity of the questionnaire. The present study showed that the provision of TUC counselling among a sample of oral health professionals fell short of that recommended by the Current Care Guidelines. For example, the percentage of participants who reported asking most of their patients about tobacco use was 15.1%. In addition, the percentage of those who reported assessing patients' interest in quitting or advised them to quit using tobacco was under 10%. Identified implementation barriers suggest that the low adherence to TUPAC counselling could be due to reported environmental constraints (e.g. lack of support and resources), lack of skills, and low self-efficacy. The

following domains were identified as potential determinants for TUPAC counselling: (1) 'Professional Role and Identity' and (2) 'Memory, Attention and Decision Processes'.

In assessing the effects of (1) educational and (2) education + fee-for-service interventions on preventative counselling, no statistically significant time or group effects were found. Regarding differencies across professional groups, dental hygienists reported providing preventative counselling more often than dentists did ($F = 12.13$; $p = 0.001$). Regarding the provision of TUC counselling, group-by-time interaction was statistically significant. However, when (1) education and (2) education + fee-for-service groups were compared, no statistically significant group-by-time interaction were found. In all groups, dental hygienists improved their provision of TUC counselling more than dentists did (provider-by-time-by-group interaction: $F = 5.95$; $p < 0.001$).

In conclusion, the present study showed that the provision of TUC counselling was low. Regarding TUPAC counselling, data indicated a lack of competencies, environmental support and resources. Educational intervention showed a favourable impact on the provision of TUC counselling. However, financial incentives showed no such effect. In addition to education, interventions that promote professional role and identity in TUPAC counselling as well as interventions offering tools to support decision making (e.g. reminders, feedback) could prove effective.

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following original articles referred to in the text by their Roman numerals.

I **Amemori M, Korhonen T, Kinnunen T, Michie S, Murtomaa H.** Enhancing implementation of tobacco use prevention and cessation counselling guideline among dental providers: a cluster-randomised controlled trial. Implement Sci 2011;6:13.

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III **Amemori M, Michie S, Korhonen T, Murtomaa H, Kinnunen T.** Assessing implementation difficulties in tobacco use prevention and cessation counselling. Implement Sci 2011;6:10.

IV **Amemori M, Virtanen J, Korhonen T, Kinnunen T, Murtomaa H.** Impact of an educational intervention on implementation of tobacco use prevention and cessation counselling: a cluster-randomised community trial in primary oral health care. Community Dent Oral Epidemiol 2012 Aug 30. doi: 10.1111/j.1600-0528.2012.00743.x. [Epub ahead of print]

1. INTRODUCTION

Tobacco use remains the leading risk factor for early morbidity and mortality (Danaei et al. 2009, Martelin et al. 2004). Today, tobacco use causes about six million premature deaths each year, a figure that is expected to rise to almost ten million by 2030 without effective actions (Mathers and Loncar 2006). In addition to its adverse effects on general health (e.g. lung cancer, cardiovascular diseases and chronic obstructive pulmonary disease) (Centers for Disease Control and Prevention 2008, Mathers and Loncar 2006), tobacco use harms oral health. Smoking, for example, is a significant risk factor for oral cancer, periodontal diseases and unsuccessful dental implant therapies (Gandini et al. 2008, Strietzel et al. 2007, Warnakulasuriya et al. 2010). In addition to the harms to users, those unvoluntarily exposed to cigarette smoke are at higher risk for respiratory and cardiovascular diseases as well as premature death (Leonardi-Bee et al. 2011, Menzies 2011, Treyster and Gitterman 2011).

Among Finnish adults, the prevalence of cigarette smoking among men is about 22%, and among women, 15% (Helakorpi et al. 2012). The prevalence of daily or occasional use of smokeless tobacco (snus) is about 3% (Helakorpi et al. 2012). Tobacco control policies, such as price measures (e.g. increasing taxes) and non-price measures, including regulations on the packaging, labelling and selling of tobacco products, have proved effective in reducing tobacco prevalence (De Beyer and Brigden 2003, World Health Organization 2003). Regarding tobacco control in health care, clinical guidelines for treating tobacco dependency are available (Fiore et al. 2008, The Finnish Medical Society Duodecim 2012). Even if brief tobacco use cessation (TUC) counselling (< 3 minutes) conducted by health care professionals has proved effective [odds ratio (OR) 1.3-1.7] (Carr and Ebbert 2012, Fiore et al. 2008), the provision of TUC counselling, especially among oral health professionals, remains low (Helakorpi et al. 2012, Tong et al. 2011, Tremblay et al. 2009). In Finland, for example, the percentage of daily smokers who received advice to quit from their physician, nurse or dentist was 33.4%, 24.1% and 9.5%, respectivelly (Helakorpi et al. 2012). This low prevalence of tobacco use prevention and cessation (TUPAC) counselling among oral health professionals may stem from a lack of competencies (e.g. knowledge, skills), resources (e.g. self-help materials) and reportedly lower priority than other professional duties (Helgason et al. 2003, Hu et al. 2006, Johnson et al. 2006, Trotter and Worcester 2003).

In Finland, municipal health centers provide primary health care services, including oral health care. About one third of Finnish residents visit dentists or dental hygienists in community dental clinics annually, on average 2.6 times a year (Saukkonen and Vuorio 2010). In addition to high population coverage, the finding

that about 80% of tobacco users are concerned about the harm caused by tobacco use and that 58% would like to quit (Helakorpi et al. 2012) provides an excellent opportunity for oral health professionals to provide TUC counselling. Studies show that among adults who become daily smokers, about 90% experimented with their first cigar by the age of 18, and 99% by the age of 26 (US Department of Health and Human Services 2012). Because oral health professionals in primary care meet over 70% of minors (< 18 years) almost three times annually (Saukkonen and Vuorio 2010), this professional group has great potential to have a major positive public health impact by providing TUPAC counselling. Thus, national and international medical and dental associations represent a compelling pressure for oral health professionals to improve their performance in TUPAC counselling (Fiore et al. 2008, Petersen 2008, Ramseier et al. 2011, The Medical Society Duodecim 2012).

2. LITERATURE REVIEW

2.1 Tobacco use and oral health

Tobacco use is a risk factor for a wide variety of oral diseases and conditions. After lung cancer, the highest risk for tobacco-related cancers is oral and upper digestive tract cancers (Gandini et al. 2008, Mathers and Loncar 2006). Even if the risk for oral cancer is highest among smokers with excessive alcohol consumption (Cruz et al. 2002, Petti 2009), the independent association of smoking is clear (Petti 2009). Evidence indicates that oral cancers caused by smoking stem from mutagenic events caused by carcinogens from cigarette smoke. Two of the main carcinogens present in cigarette smoke, benzopyrines and nitrosamines, are primarily metabolised to their activated molecules by cytochrome P450 and detoxified by glutathione S-tranferase (Bartsch et al. 1999, Hernando-Rodriguez et al. 2012). Without detoxification, metabolically activated tobacco products could alter the DNA (Bartsch et al. 1999, Hernando-Rodriguez et al. 2012). This could impair cell regulatory systems and thus cause oral cancer (Hanahan and Weinberg 2000). A recent meta-analysis estimated the relative risk for oral cancer to be 3.4 times higher among smokers than among non-users [95% confidence interval (CI) 2.4-4.9] (Gandini et al. 2008). In addition, the evidence suggests a dose-response relationship between smoking and oral cancer (Llewellyn et al. 2004, Petti 2009, Talamini et al. 1990). One study among non-drinkers showed that smokers who smoked fewer than 15 cigarettes a day had an OR for oral cancer of 3.8 (Talamini et al. 1990). Smokers who smoke 15 or more cigarettes a day had an OR for oral cancer of 12.9 (Talamini et al. 1990). After quitting smoking, the risk for oral cancer has been reported to decrease significantly. Pooled risk estimates of oral cancer, for example, are reportedly lower among ex-smokers (OR 1.4, 95% CI 1.0-2.0) than among current smokers (OR 3.4, 95% CI 2.4-4.9) (Gandini et al. 2008).

Periodontitis is a major oral health problem among the adult population (Baehni et al. 2010, Boehm and Scannapieco 2007, Mattila et al. 2010). In addition to pathogenic micro-organisms and host response, smoking is reportedly also a substantial contributer (Bergstrom 2006, Pihlstrom et al. 2005). For example, smoking reportedly favours the selection of anaerobic bacteria that are important in the pathogenesis of periodontitis (Hanioka et al. 2000). In addition, smoking reportedly induces altered vasculation of the periodontal tissue, suppression of neutrophil cell spreading, chemotaxis and chemokinesis as well as reduced phagosytosis in the periodontium (Palmer et al. 2005). Nicotine reportedly increases the secretion of bone resorption factors (Payne et al. 1996), which may also explain the increased risk for periodontitis among smokers. Thus, the relative risk for periodontal disease among smokers is estimated at between 1.4 and 5.0 (Warnakulasuriya et al. 2010). In addition to the adult population, smoking appears to be a risk

factor for periodontitis among adolescents (Heikkinen et al. 2008, Heikkinen et al. 2012). Evidence also suggests a dose and duration relationship between smoking and periodontitis (Moimaz et al. 2009). Smoking cessation has been reported to enhance the outcomes of periodontal treatment (e.g. probing depth reduction) (Preshaw et al. 2005).

In addition to oral cancer and periodontitis, smoking has many other negative effects on oral health. For example, systematic reviews of smoking and dental implant therapy suggest that smoking may be a significant risk factor for implant failure (Hinode et al. 2006, Klokkevold and Han 2007, Strietzel et al. 2007). Studies among among smokers estimate the OR for implant loss at 2.2 (95% CI 1.7-2.8) (Hinode et al. 2006). Smoking also negatively affects salivary function (Zappacosta et al. 2002), which may explain the elevated risk for dental caries found among smokers (Jette et al. 1993, Ravald et al. 1993). In addition, smoking reportedly delays wound healing after dental surgery (Balaji 2008), discolours teeth and dental restorations (Asmussen and Hansen 1986, Eriksen and Nordbo 1978), causes coated tongue (Meraw et at. 1998) and reduces one's ability to smell and taste (Pasquali 1997).

Regarding smokeless tobacco use, two recent meta-analyses among the US and European populations have reported a slightly elevated risk for oral cancer (Boffetta et al. 2008, Weitkunat et al. 2007). The meta-analysis by Weitkunat et al. (2008), for example, reported random-effect estimates for oral cancer of 1.9 (95% CI 1.4-2.5). Althought evidence suggests that smokeless tobacco products increase risk for oral cancer in South Asia and the US, the data from northern Europe do not support these findings (Boffetta et al. 2008, Weitkunat et al. 2007). Nevertheless, evidence indicates that Swedish smokeless tobacco use (snus) increases cardiovascular diseases and cancers of the esophagus, stomach and pancreas (Wickholm et al. 2012). Among female users, reports indicate elevated risk for premature birth, neonatal apnea and pre-eclampsia (Wickholm et al. 2012). Regarding oral health, smokeless tobacco use has been associated with severe periodontal disease (OR = 2.1; 95% CI 1.2-3.7) among the US population (Fisher et al. 2005). Although Swedish smokeless tobacco use reportedly causes no periodontal bone loss (Bergström et al. 2006), gingival recession reportedly occurs more often among snus users (42%) than among non-users (17%) (Monten et al. 2006).

2.2 Tobacco control

In recent decades, countries around the world have successfully implemented tobacco control using a wide range of tobacco control policies (De Beyer and Brigden 2003). Because single initiatives have proved insufficient, tobacco control policies should be comprehensive and include, for example, legislative and taxational approaches, prevention and cessation programmes, as well as media and community campaigns (De Beyer and Brigden 2003). In his review of present and future tobacco control policies, West (2006) divides tobacco control policies into three types: (1) those that influence the behaviour of current or potential tobacco users, (2) those that limit opportunities for the tobacco industry to influence current or potential tobacco users, and (3) those that reduce harm from the use of tobacco products. According to West (2006), influencing tobacco use behaviour could include strategies that educate people about the health effects of tobacco use, legislative and taxational actions (restricting sale and use, price regulation), competition and incentives for tobacco users to quit, as well as medical and psychological support for those willing to quit. Tobacco industry regulation includes restrictions on advertisements and the development of tobacco products as well as monitoring of the information published by the tobacco industry (West 2006). Reducing the harmful effects of tobacco use involves strategies that reduce toxins from tobacco products and promote switching from the most harmful ways to ingest nicotine (e.g. cigarettes, pipes, bidis) to less harmful ways (e.g. nicotine gum, patches) (West 2006).

The WHO Framework Convention on Tobacco Control (FCTC), signed by more than 165 countries, emphasises many tobacco control strategies, including price and non-price approaches (Wipfli and Samet 2009, World Health Organization 2003). Price measures may comprise tax and price policies aiming to reduce tobacco use, especially among youth (World Health Organization 2003). Non-price measures, in contrast, could include the following strategies: (1) protecting public health policies with respect to tobacco control from commercial and other vested interests of the tobacco industry; (2) protecting people from exposure to tobacco smoke; (3) regulating the content of tobacco products and of tobacco product disclosures; (4) regulating the packaging and labelling of tobacco products; (5) promoting education, communication, training and public awareness; (6) banning tobacco advertising, promotion and sponsorship; and (7) demanding measures to reduce tobacco dependence and promoting cessation (World Health Organization 2003). In addition, the FCTC highlights the need to reduce the supply of tobacco by restricting its illicit trade and sale, especially among minors (World Health Organization 2003).

One example of a successful tobacco control policy that includes the above-mentioned strategies comes from Finland. In the 1960s, when tobacco control activities

began in Finland, the prevalence of tobacco use among the adult male population was close to 70% (Rimpelä 1978), and tobacco-attributable deaths were the highest among the high-income countries (Preston et al. 2010). In 1966, the Finnish Tobacco Committee proposed restricting both tobacco advertising and smoking in public places. In 1969, the tobacco industry voluntarily stopped advertising its products on television, which was then banned in 1970. The Second Tobacco Committee for pre-legislative work was nominated in 1972, and the Finnish Tobacco Control Act was passed in 1976. The Finnish Tobacco Control Act prohibited smoking in most public places and on public transport, restricted tobacco advertising, and set a 16-year age limit for tobacco purchases. Manufacturers were obliged to include health warnings on tobacco packaging, and about 0.5% of tobacco tax revenue was allocated to tobacco control programmes and other health promotion initiatives. A total advertising ban was enforced in 1978 (Leppo and Vertio 1986, Leppo and Puska 2003). Today, Finland has one of the world's toughest measures of tobacco control and aims to gradually end the use of tobacco products (Ministry of Social Affairs and Health 2010). The purpose of the updated Act that entered into force on 1 October 2010 is to restrict the marketing and supply of tobacco products, especially in the everyday lives of children (Ministry of Justice 1976).

2.2.1 Tobacco control in health care

Regarding tobacco control, health care professionals play a key role in both providing tobacco dependency treatments and encouraging non-users to remain tobacco-free (De Beyer and Brigden 2003, World Health Organization 2003). As tobacco use causes a wide variety of health problems and effective strategies for tobacco dependency treatments exists (Carr and Ebbert 2012, Fiore et al. 2008), health care professionals have an ethical as well as professional responsibility to provide TUPAC counselling. As such, national and international health care organisations have emphasised the need to promote TUPAC counselling among health care professionals (Fiore et al. 2008, Petersen et al. 2008, Ramseier et al. 2010, US Department of Health and Human Services 2012), and clinical guidelines for treating tobacco dependency have been published (Fiore et al. 2008, The Finnish Medical Society Duodecim 2012). A meta-analysis by Fiore et al. (2008) concluded that a brief (< 3 minutes) TUC counselling session conducted by a health care professional increases the OR for tobacco abstinence by 1.3 (95% CI 1.0-1.6) (Table 1). Even if the effect of a single brief tobacco counselling session remains relatively low, the population-wide impact could be significant, especially when combined with other tobacco control policies (Levy and Friend 2002). In addition, TUC counselling is highly cost-effective, as it can prevent many costly chronic diseases (Fiore et al. 2008).

Table 1. A meta-analysis of the efficacy and estimated abstinence rates for TUC counselling among health care professionals (adapted from Fiore et al. 2008).

Level of contact	Estimated OR (95% CI)	Estimated abstinence rate (95% CI)
No contact	1.0	10.9
Brief counselling (< 3 minutes)	1.3 (1.0-1.6)	13.4 (10.9-16.1)
Low intensity counselling (3 to 10 minutes)	1.6 (1.2-2.0)	16.0 (12.8-19.2)
Higher intensity counselling (> 10 minutes)	2.3 (2.0-2.7)	22.1 (19.4-24.7)

In Finland in 2003, the Finnish Medical Society Duodecim (2012) first published the Current Care Guidelines for TUC counselling. For TUC counselling, the Current Care Guidelines recommend what is known as the six As approach (Table 2), which corresponds closely to the five As used in the US and in many other countries (Fiore et al. 2008). The Current Care Guidelines recommend that health care professionals (1) ask about each patient's tobacco use at least once a year, (2) assess his or her nicotine dependence and motivation to quit, (3) advise patients to quit, (4) assist them in quitting, and (5) arrange for follow up of their progress in cessation. Additionally, the six As approach recommends (6) accounting these discussions in the patient's medical record, an action also recommended in the five A's approach (Fiore et al. 2008).

If Finland has successfully, if gradually, tightened legislation and taxation regarding tobacco control, efforts for the health care sector have not been equally succesful (Helakorpi et al. 2012, Joossens and Raw 2006). In 2011, for example, the percentage of daily smokers visiting a physician or dentist who during their visit advised them to quit using tobacco was 33.4% and 9.5%, respectively (Figure 1) (Helakorpi et al. 2012). Thus, as part of tobacco control, the need to promote TUPAC counselling in Finnish health care, and especially among oral health professionals, is evident.

Table 2. The six As approach to brief TUC counselling

(adapted from The Finnish Medical Society Duodecim 2012).

Intervention	Further information
ASK about the patient's smoking status at least once annually	This is easy to achieve in connection with medical examinations or when instigating treatment or prophylaxis for an illness.
ASSESS the patient's readiness and willingness to stop. Ask about previous attempts to quit.	
Keep **ACCOUNT** of smoking status	Preferably on the same sheet in the medical notes (e.g. a dedicated sheet) Smoking habits: cigar, cigarette, snuff, pipe Quantity Duration (in total pack-years of smoking; e.g., 20 years of ½ a pack per day = 10 pack-years)
ADVISE the patient to stop smoking and initiate supportive measures where necessary.	If you feel that stopping smoking will improve the prognosis of a particular illness, make this clear to the patient. Explain to the patient how to prepare for situations where the temptation to smoke is great and about possible withdrawal symptoms. Discuss the support options available.
ASSIST the patient in his/her attempt to stop smoking	Positive feedback is essential for success. Each smokeless day is an achievement and warrants further encouragement. Where necessary, guide the patient toward further intervention (e.g. an organized group, a smoking cessation nurse, regional centres).
ARRANGE monitoring of progress at follow-up appointments.	

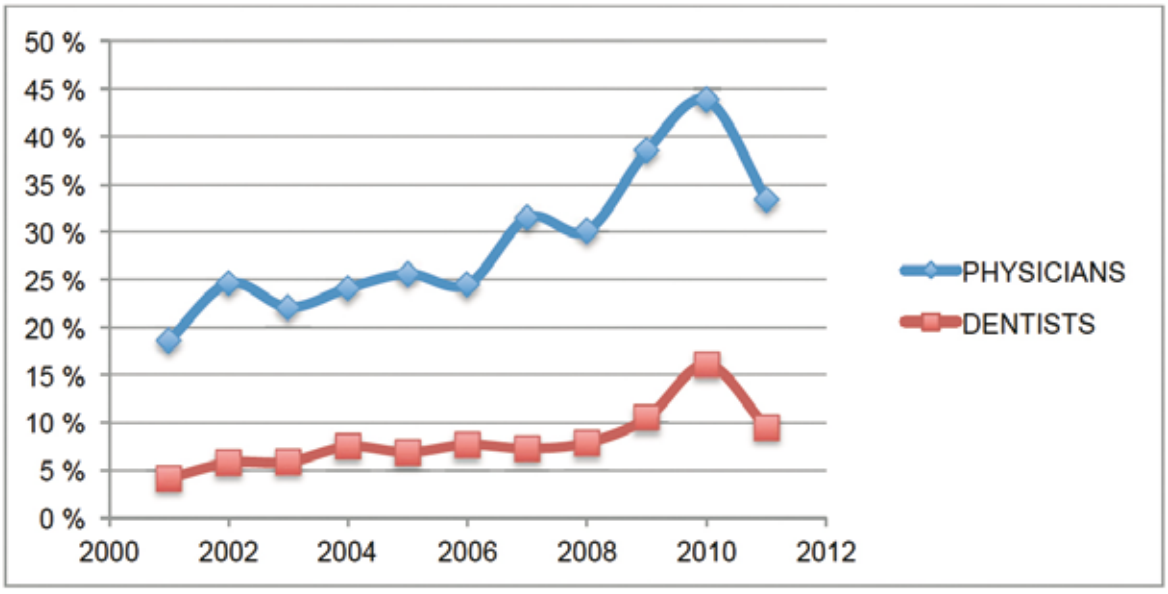

Figure 1. Percentages of Finnish adult daily smokers visiting a physician or dentist who advised them to quit smoking (Helakorpi et al. 2001-2012).

2.3 TUPAC counselling in oral health care

The oral health care setting provides an excellent opportunity for TUC counselling, as the same professional often meets patients regularly and individually. Because the early signs of tobacco use are easily noticed from the mouth (e.g. stained teeth, changes in the oral mucosa), oral health professionals can easily record not only tobacco use, but also its effects (photographs, dental record), show them to the patient, and arrange follow up visits. As dental appointments are usually regular and tobacco use adversely affects the prognosis of many dental treatments (e.g. dental implants, periodontal treatments) (Warnakulasuriya et al. 2010), the provision of TUPAC counselling should be easy to include in everyday practise. When implemented, TUC counselling provided by an oral health professional has reportedly increased patients' tobacco cessation. For example, a recent Cochrane review of the effectiveness of brief TUC counselling sessions conducted by oral health professionals reported increased tobacco cessation among patients (OR 1.7, 95% CI 1.4-2.0) at six or more months (Carr and Ebbert 2012). However, adoption of TUC counselling into everyday practise has been limited (Gordon et al. 2006, Helakorpi et al. 2012, Needleman et al. 2006). In surveys of US dentists, for example, the percentage of tobacco-using patients asked about their tobacco use has been about 56-59%, the percentage of those advised to quit about 46-63%, and the percentage whose interest in quitting was assessed came to some 32-48% (Applegate et al. 2008, Succar et al. 2011).

In Finland, about one third of Finnish residents visit dentists or dental hygienists in community dental clinics each year, on average 2.6 times annually (Saukkonen and Vuorio 2010). In addition to the high population coverage, the finding that about 80% of tobacco users worry about the health effects of their tobacco use and that 58% would like to quit using tobacco (Helakorpi et al. 2012) represents an exellent opportunity for successful TUC counselling. However, less than 20% of tobacco users regularly receive advice to quit from oral health professionals (Helakorpi et al. 2012). Compared to other health care professionals, the provision of TUC counselling among oral health professionals has reportedly been low (Helakorpi et al. 2012).

In addition to tobacco cessation, oral health professionals could play a key role in promoting tobacco abstinence, especially among adolescents. In Finland, oral health professionals meet about 70% of minors (< 18 years) on average 2.6 times each year (Saukkonen and Vuorio 2010). That 88% of adults who become daily smokers had experimented with their first cigar by the age of 18, and that 99% had done so by the age of 26 (US Department of Health and Human Services 2012), underscores the importance of preventative counselling among adolescents. Because no clinical guidelines are available for tobacco prevention in Finland, preventative

counselling in oral health care could include, for example, asking patients about their tobacco use as well as encouraging non-users to remain tobacco abstinent. Kentala et al. (1999), for example, conducted a community-based trial in Finland where adolescents in intervention groups received either TUC counselling (for tobacco users) or preventative counselling (for non-users) annually. The preventative counselling included an assessment of their tobacco use, information about the effects of tobacco use on oral health, and encouragement to remain tobacco free. At the end of a two-year follow-up period, tobacco prevalence in the control group was 20.8%, and in the intervention group, 18.1% (this result was statistically non-significant, however) (Kentala et al. 1999). Even if the impact of a single intervention might be moderate (Kentala et al. 1999, Thomas and Perera 2006), combined with other tobacco control policies such as price increases, school-based programmes and mass media campaigns, the population-wide impact could be substantial (de Beyer and Brigden 2003, Levy and Friend 2002, US Department of Health and Human Services 2012, World Health Organization 2003). The World Health Organization (WHO) has therefore designated the promotion of TUPAC counselling as a priority in dentistry (Petersen 2008). In addition, a recently published consensus report by the 2nd European Workshop on Tobacco Use Prevention and Cessation for Oral Health Professionals has emphasised the need for action to improve TUPAC counselling among oral health professionals (Ramseier et al. 2010).

2.3.1 Implementation difficulties

Many studies have reported evidence of potential implementation challenges for TUPAC counselling among oral health professionals (Table 3). Almost 20 years ago, studies from the US (Fried and Cohen 1992), Canada (Cambell and Macdonald 1994) and the United Kingdom (UK) (Chestnutt and Binnie 1995) all found a lack of competency could be one of the most important barriers among oral health professionals to providing TUPAC counselling. Today, a lack of competency remains one of the most commonly reported barriers to TUPAC counselling (Table 3). This is unsurprising as undergraduate education on TUPAC counselling has reportedly been insufficient (Warren et al. 2011). The Global Health Professions Student Survey recently revealed that over 80% of dental students felt they should receive specific training in TUC counselling techniques, whereas less than 40% of the same students reported having received such training (Warren et al. 2011). In addition to a lack of education, reports worldwide have identified other barriers such as a lack of environmental support and resources, lower priority than other treatments, and low success rate (Table 3).

Table 3. Barriers to providing TUPAC counselling identified among oral health professionals.

Author / year	Country	Participants (n)	Identified barriers
Fried and Cohen 1992	US	Dentists (n = 210)	Lack of training No reimbursement
Campbell and Macdonald 1994	Canada	Dentists (n = 755)	Lack of co-ordination between dentistry and cessation services Low success rate Lack of training Lower priority than other treatments
Chestnutt and Binnie 1995	UK	Dentists (n = 448)	Lack of time Lack of knowledge
Albert et al. 2002	US	Dentists (n = 75)	Lack of training Lack of time Lack of reimbursement
Helgason et al. 2003	Sweden	Dentists (n = 354) Dental hygienists (n = 215)	Lack of experts to refer No reimbursement Lack of knowledge Lack of time
Trotter and Worcester 2003	Australia	Dentists (n = 250)	Low patient acceptance Low success rate Lack of confidence No reimbursement
Rikard-Bell et al. 2003	Australia	Dental students (n = 248)	Low success rate Lack of skills
Victoroff et al. 2004	US	Dental students (n = 139)	Low success rate Lower priority than other treatments Low patient acceptance
Polychonopoulou et al. 2004	Greek	Dental students (n = 165)	Lack of training Lack of patient education material Low patient acceptance Lack of time
Lund et al. 2004	Norway	Dentists (n = 1020) Dental hygienists (n = 318)	Not their role to provide counselling Lack of time
Watt et al. 2004	UK	Dentists (n = 149)	Not their role to provide counselling Low patient acceptance Lack of relevance to dentistry Organisational factors
Sears and Hayes 2005	US	Dentists (n = 119)	Lack of time Low patient acceptance
Albert et al. 2005	US	Dentists (n = 184)	Low patient acceptance Lack of time No reimbursement Low success rate Lack of patient education material

Monson and Engeswick 2005	US	Dental hygienists (n = 51)	Lack of patient education material Low success rate
Johnson et al. 2006	UK	Dentists and dental students (n = 870)	Lack of time No reimbursement Lack of training Lack of patient education material Lack of referral resources
Wyne et al. 2006	Saudi Arabia	Dentists (n = 208)	Low success rate Lack of confidence Lack of training
Hu et al. 2006	US	Dentists (n = 783)	Lack of training Lower priority than other treatments
Stacey et al. 2006	UK	Dentists (n = 100) Dental hygienists (n = 118) Dental nurses (n =106)	Lack of training No reimbursement Lack of time
Pendharkar et al. 2010.	US	Dental students (n = 70)	Low patient acceptance Lack of time Forget to counsel Lack of knowledge Lack of skills
Clareboets et al. 2010	UK	Dental students (n = 161)	Patient disinterest in receiving advice Lack of training Lack of patient education material Lack of time Low success rate
Chandrashekar et al. 2011	India	Dentists (n = 114)	Lower priority than other treatments No reimbursement Low patient acceptance Low success rate Lack of training
Amit et al. 2011	India	Dentists (n = 168)	Lack of training Low patient acceptance Lack of patient education material Lack of time
Rosseel et al. 2011	Netherlands	Dentists (n = 31) Dental hygienists (n = 32)	Lack of time Low patient acceptance
Studts et al. 2011	US	Dental hygienists (n = 308)	Lack of knowledge Lack of confidence
Uti and Sofola 2011	Nigeria	Dentists (n = 63) Dental students (n = 73)	Not their role to counsel Low success rate Lack of time Lack of patient education material Lack of knowledge
Patel et al. 2011	US	Dentists (n = 231)	Low patient acceptance Lack of time Lack of training
Succar et al. 2011	US	Dentists (n = 1232)	Lack of training Low patient acceptance Low success rate Lack of referral resources Lack of educational material

2.3.2 Promoting TUPAC counselling

2.3.2.1 Theories of Behaviour Change

Promoting TUPAC counselling among oral health professionals will require a behaviour change toward the provision of TUPAC counselling. As such, theories of behaviour change could serve in assessing and promoting TUPAC counselling. Theories of behaviour change aim to explain individuals' behaviour. These theories include different determinants, such as environmental and personal characteristics, that influence an individual's behaviour. Because theories of behaviour change also apply to health care professionals, these theories have been used, for example, to design interventions to promote the adoption of clinical guidelines (Bonetti et al. 2010, French et al. 2012). As such, the following section briefly summarises three planning models for behaviour change: the Theory of Planned Behaviour (Ajzen 1991), the PRECEDE-PROCEED model (Green et al. 1980, Green and Kreuter 1991), and the Behaviour Change Wheel model (Michie et al. 2011). In addition to these theories, theories of behaviour change, such as the Transtheoretical model of Behaviour Change (Prochaska and DiClemente 1982) and Social Cognitive Theory (Bandura 1986), have seen considerable use especially in population-based interventions (Hashemian et al. 2012, Scott et al. 2012).

2.3.2.1.1 Theory of Planned Behaviour

One example of a widely used theory of behaviour change often applied to health care professionals is the Theory of Planned Behaviour (Ajzen 1991). In the Theory of Planned Behaviour, an individual's behaviour is purportedly influenced by three factors: 'Behavioural Beliefs', 'Normative Beliefs', and 'Control Beliefs' (Figure 2). In this model, 'Behavioural Beliefs' presumably yield a favourable or unfavourable 'Attitude Toward the Behaviour', 'Normative Beliefs' result in a 'Subjective Norm', and 'Control Beliefs' yield 'Perceived Behavioural Control'. The combination of 'Attitude Toward the Behaviour', 'Subjective Norm', and 'Perceived Behavioural Control' purportedly leads to the formation of an 'Intention'. Thus, the more favourable the attitude toward the behaviour and subjective norm, and the greater the perceived behavioural control, the stronger the person's intention to perform the behaviour in question. Finally, given a sufficient degree of control over the behaviour, people are expected to implement their intentions when the opportunity arises. Applied to health care professionals, Simms et al. (2012) successfully changed the clinical practice of providing inspiratory muscle training for people with chronic obstructive pulmonary disease using an intervention based on the Theory of Planned Behaviour.

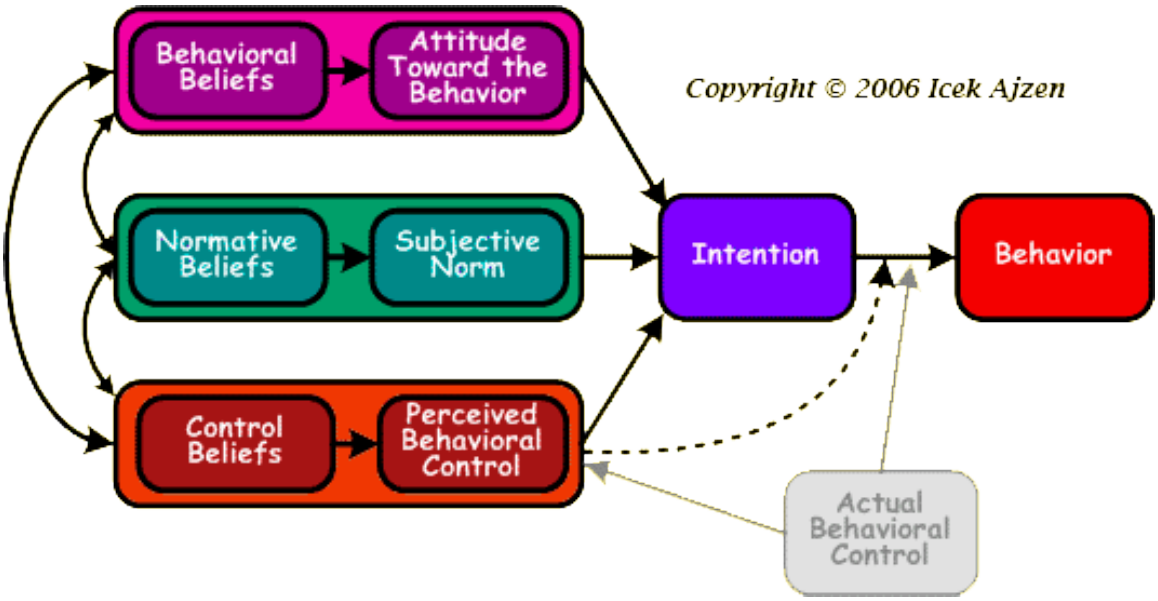

Figure 2. Theory of Planned Behaviour.

2.3.2.1.2 PRECEDE-PROCEED model

The second widely used model for understanding and influencing the behaviour of health care professionals is the PRECEDE-PROCEED model (Green et al. 1980, Green and Kreuter 1991), which began as a cost-benefit evaluation framework (Green 1974). The PRECEDE-PROCEED model provides a framework for assessing, implementing and evaluating intervention programmes. This model guides intervention planners through a process from desired outcomes to identifying strategies for achieving objectives (Table 4). The PRECEDE-PROCEED model is divided into two distinctive parts: (1) an "educational assessment" (PRECEDE) and (2) an "ecological assessment" (PROCEED).

The first part of the PRECEDE-PROCEED model, the PRECEDE Framework (Green et al. 1980), presumes that assessing the implementation problem is essential before designing interventions. The PRECEDE Framework specifies three types of factors that influence an individual's behaviour: 'Predisposing', 'Enabling', and 'Reinforcing' factors. 'Predisposing' factors include knowledge, attitudes, beliefs, personal preferences, existing skills, and self-efficacy towards the desired change in behaviour. 'Enabling' factors include skills or physical factors such as the availability and accessibility of resources or services that facilitate the achievement of motivation to change one's behaviour. Finally, 'Reinforcing' factors include factors, such as social support, economic rewards, and changing social norms, that reward or reinforce the desired change in behaviour. The PRECEDE Framework

proposes that these three factors ('Predisposing', 'Enabling', and 'Reinforcing' factors) are essential to behaviour change.

The PROCEED Framework, introduced in 1991, was added to the PRECEDE Framework because of the growing recognition that factors such as media, politics, and business – factors not included in the PRECEDE Framework – influence many intervention programmes. This model includes these new methods of assessing and influencing these environmental and social factors. The PRECEDE-PROCEED model thus empasises that, in order to achieve a change in behaviour, efforts to effect behavioural, environmental, and social change must be multidimensional, multisectoral, and participatory (Green and Kreuter 1991). An example of the successful application of the PRECEDE-PROCEED model to change the behaviour of oral health professionals was introduced by Cannick et al. (2007). In their study, educational intervention based on the PRECEDE-PROCEED model enhanced dental students' competencies in oral cancer prevention and detection (Cannick et al. 2007).

Table 4. The PRECEDE-PROCEED model.

PRECEDE Phases		PROCEED Phases	
Phase 1	Social assessment	**Phase 5**	Implementation
Phase 2	Epidemiological, behavioural and environmental assessment	**Phase 6**	Process evaluation
Phase 3	Educational and Ecological assessment	**Phase 7**	Impact evaluation
Phase 4	Administrative and policy assessment	**Phase 8**	Outcome evaluation

2.3.2.1.3 Behaviour Change Wheel model

The recent framework approach to understanding the behaviour of health care professionals (Michie et al. 2011) has proposed a model of behaviour change based on two different sources: the consensus approach of behavioural theorists (Fishbein et al. 2001) and the principles of US criminal law (Fletcher 1998). According to Fishbein et al. (2001), three factors are necessary and sufficient prerequisites to perform a specified behaviour: the necessary skills, a strong intention and a sufficient environment. Regarding US criminal law, to prove that someone is guilty of a crime, one must demostrate three supporting facts: capability, opportunity, and motive. Concluding these two separate lines of thought, Michie et al. (2011) suggested that three factors were necessary for a specific behaviour to occur: 'Capability', 'Motivation', and 'Opportunity' (referred to as COM-B system) (Figure 3). This model defines 'Capability' as the psychological and physical capacity (e.g. the

knowledge and skills) to perform a certain behaviour. 'Motivation' includes processes that energise and direct behaviour (e.g. goals, decision-making, emotional responses, habitual processes). 'Opportunity' includes all those factors originating outside the individual (physical and social factors) that make behaviour possible or prompt it. In this model, all three factors have equal status to generate a certain behaviour that in turn influences these components (Michie et al. 2011).

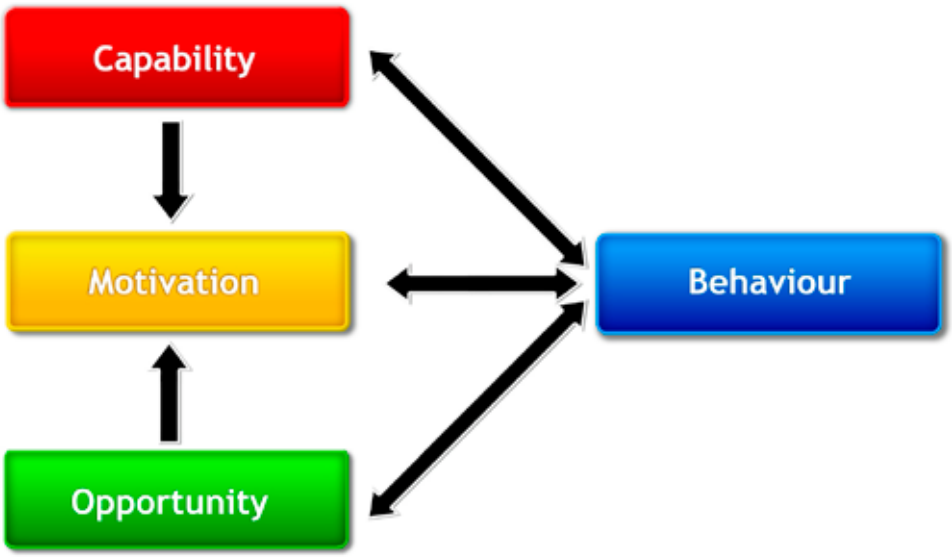

Figure 3. The COM-B model (Michie et al. 2011).

To combine the COM-B system with potentially effective intervention techniques, a new framework for changing the behaviour of health care professionals was developed based on a systematic review and consultation with experts in behaviour change (Michie et al. 2011). The Behaviour Change Wheel model (BCW) (Figure 4) includes nine intervention functions (Table 5) and seven policy categories (Figure 4). At the centre of the proposed new framework is the COM-B system. This framework forms the core of the BCW, which is surrounded by nine intervention functions aimed at influencing one or more of these conditions ('Capability', 'Motivation', 'Opportunity'). Around this are seven categories of policy that could facilitate those interventions.

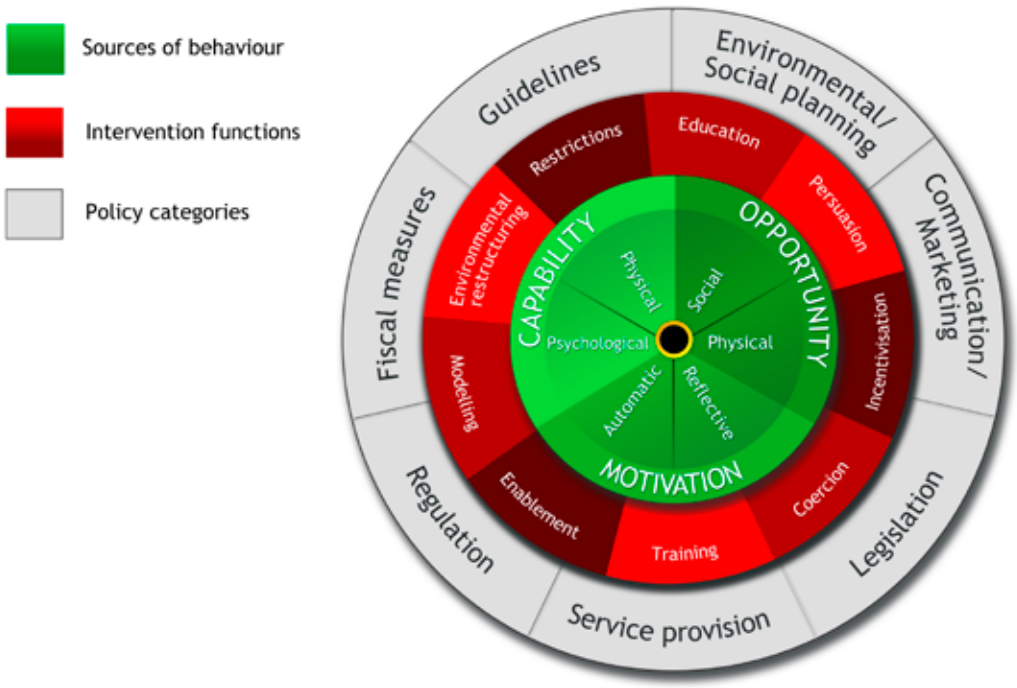

Figure 4. Behaviour Change Wheel model for developing interventions to change the behaviour of health care professionals (Michie et al. 2011).

Table 5. Definitions of BCW interventions (adapted from Michie et al. 2011).

Intervention	Definition
Education	Increasing knowledge or understanding
Persuasion	Using communication to induce positive or negative feelings or to stimulate action
Incentivisation	Creating an expectation of reward
Coersion	Creating an expectation of punishment or cost
Training	Imparting skills
Enablement	Increasing means for/reducing barriers to increasing capability
Modelling	Providing an example for people to aspire to or to imitate
Environmental restructuring	Changing the physical or social context
Restriction	Using rules to reduce the opportunity to engage in the target

2.3.2.2 Potentially effective strategies to promote TUPAC counselling

The majority of studies regarding TUPAC counselling as well as oral health professionals have focused on barriers to implementation rather than predictors for TUPAC counselling. To date, no intervention trials reporting behavioural determi-

nants for TUPAC counselling among oral or other health care professionals have been found. In addition, despite the large number of theories of behaviour change (Ajzen 1991, Fishbein et al. 2001, Green et al. 1980, Michie et al. 2011) and implementation trials (Grimshaw et al. 2001), our understanding of why some interventions are more effective than others remains limited (Grimshaw et al. 2004, Grimshaw et al. 2001). However, the evidence indicates few potentially effective strategies to promote TUPAC counselling among oral health professionals.

2.3.2.2.1 Continuing education

The purpose of continuing education is to facilitate health care professionals' improvement of their clinical performance and ultimately the enhancement of patient outcomes. Because a lack of competencies has reportedly been one of the most notable barriers to oral health professionals' provision of TUPAC counselling (Table 3), studies have suggested continuing education to promote TUPAC counselling (Coan et al. 2007, Davis et al. 2010, Gordon et al. 2009, Rosseel et al. 2012). Because the basic education regarding TUPAC counselling should be provided during undergraduate education (Davis et al. 2010, Gordon et al. 2009), continuing education could be a viable method for promoting TUPAC counselling among oral health professionals who have already graduated (Rosseel et al. 2012).

Fox and Bennett (1998) divides continuing education into three levels: (1) self-directed learning, including self assessment and the acquisition of knowledge and skills; (2) organised individual and group education that provides information, knowledge and skills based on expertise and evidence; and (3) learning within an organisation by developing practices and standards that suit local problems and needs. In all levels, continuing education should, rather than provide didactic teaching alone, facilitate health care professionals' adaptation of evidence-based practice (Fox and Bennett 1998). Thus, there is pressure for continuing education to extend beyond increasing knowledge to improving health care professionals' clinical practice and ultimately to better patient health. As such, continuing education programmes that are interactive, use multiple methods and are designed specifically for certain groups have proved effective (Bloom 2005, Davis et al. 1999, Robertson et al. 2003). A meta-analysis of seven studies by Davis et al. (1999), for example, showed that didactic continuing education failed to change participants' clinical practice [d (standardised mean difference) = 0.34]. Interactive and mixed educational sessions, however, showed a significant effect on clinicians' performance (d = 0.67) (Davis et al. 1999). In addition to basic information on tobacco use and nicotine dependency, interactive education could include the rehearsal of relevant counselling techniques, role-play, problem solving, decision making and goal setting (Gordon et al. 2009, Michie et al. 2008, Rosseel et al. 2012). Some researchers have proposed a minimum of four hours of training to teach basic brief intervention techniques, and at least two days of training for more intensive TUPAC counselling techniques (Wickholm et al. 2006). Because interactive workshops require more resources and are potentially

expensive, self-study material could be a viable alternative in continuing education for motivated individuals (Akers et al. 2006, Gordon et al. 2005).

Applied to theories of behaviour change, the effects of continuing education could be explained not only through increased competencies, but also through enhanced motivation and the social environment. Applied to the Theory of Planned Behaviour, continuing education could increase at least 'Behavioural Beliefs' and 'Normative Beliefs' (Ajzen 1991), the 'Predisposing' and 'Enabling' factors of the PRECEDE-PROCEED model (Green et al. 1980), and the 'Capability' and 'Motivation' as well as 'Opportunity' (social environment) of the BCW model (Michie et al. 2011). As such, continuing education could have widespread positive effects on factors influencing oral health professionals' provision of TUPAC counselling. In addition to knowledge and skills, continuing education could also enhance problem solving and decision making as well as support the professional role of TUPAC counselling (Michie et al. 2008).

2.3.2.2.2 Financial incentive

In addition to educational intervention, financial incentives may be an effective and feasible way to promote TUPAC counselling among health care professionals (Amundson et al. 2003, Coleman et al. 2007, Millett et al. 2007, Roski et al. 2003). The Cochrane review of 32 studies of financial incentives found mostly positive results in changing health care professionals' behaviour (Flodgren et al. 2011). For example, financial incentives for providing specific care for patients proved generally effective, improving 48 of 69 outcomes in 13 studies (Flodgren et al. 2011). Regarding TUPAC counselling, Millett et al. (2007) performed a population-based study among diabetics and found that when physicians were offered financial incentives to provide TUC counselling, documented smoking cessation advice increased from 48% to 84% ($p < 0.001$). In addition, the prevalence of smoking among patients decreased from 20% to 16% ($p < 0.001$) (Millett et al. 2007). Consequently, a recently published consensus report by the 2nd European Workshop on Tobacco Use Prevention and Cessation for Oral Health Professionals stated that oral health professionals should receive compensation for providing TUPAC counselling (Crail et al. 2010). Regarding the amount of financial incentive, incentive size and effect seem to have no clear relationship (Van Herck et al. 2010). However, too small an amount could have either a negative effect or none at all (Van Herck et al. 2010).

As an extrinsic source of motivation, financial incentives are expected to compel individuals to act in a particular way. As such, the effects of financial incentives could be attributed to influence through increased 'Behavioural Beliefs' (Ajzen 1991), 'Enabling' and 'Reinforcing' factors (Green et al. 1980), as well as 'Opportunity' (Michie et al. 2011). Thus, financial incentives would be expected to enhance motivation and the environmental support experienced (Michie et al. 2008). Because financial incentives partly affect different factors of behavioural determinants, financial incentives would be expected to strengthen the effects of educational intervention.

3. AIMS OF THE STUDY

The working hypothesis was that educational and fee-for-service interventions will promote TUPAC counselling among oral health professionals in Finnish community dental clinics.

3.1 General aim

The general aim was to reduce tobacco use in Finland by promoting TUPAC counselling among oral health professionals.

3.2 Specific objectives

Among a sample of oral health professionals, this study aimed to:

1. Develop a questionnaire using the Theoretical Domains Framework to assess factors influencing TUPAC counselling (I, III).
2. Assess the provision of TUC counselling at baseline (I, II).
3. Identify potential barriers to and determinants for TUPAC counselling using the questionnaire developed for that purpose (I, II, III).
4. Develop educational and fee-for-service interventions and assess their effectiveness in promoting TUPAC counselling (I, IV).

4. MATERIALS AND METHODS

4.1 Participants and settings

This study was conducted in Finnish municipal community dental settings. The study participants were dentists and dental hygienists employed by the municipal health care authorities of Vaasa (9 clinics) and Tampere (28 clinics), Finland. The municipal health care regions of Tampere and Vaasa were invited to participate in the study because (1) there have been no recent (during last 15 years) TUPAC counselling programmes, (2) these health care regions had enough community dental clinics and dental staff for an appropriate sample size to test the hypothesis, (3) electronic dental records were identical in both health care regions, (4) they represented different geographical regions of Finland, and (5) the chief dental officers approved our study proposal. To ensure the similarity of settings, two dental clinics were excluded from Tampere (an emergency care clinic and a special treatment clinic) and one clinic from Vaasa (specialised in undergraduate education). Oral health professionals employed by the 34 dental clinics included in the study received an explanatory statement describing the study, a consent form, and instructions on how to participate (I). Of the 95 eligible oral health professionals selected, 73 (76.8%) participated.

4.2 Measures

4.2.1 Theoretical Domains Framework

A large number of theories of behaviour change and potential theoretical constructs or domains could serve in implementation research to investigate potential explanations for behaviour change among health care professionals. To simplify the theories and make them more applicable, a consensus group of implementation research experts compiled a list of theoretically derived behavioural determinants relevant to implementation research among health care professionals (Michie et al. 2005). The 12 key domains identified as influencing health care professionals' behaviour were 'Knowledge', 'Skills', 'Professional Role and Identity', 'Beliefs about Capabilities', 'Beliefs about Consequences', 'Motivation and Goals', 'Memory, Attention and Decision Processes', 'Environmental Context and Resources', 'Social Influences', 'Emotion', 'Behavioural Regulation', and 'Nature of the Behaviours' (Michie et al. 2005). These 12 domains constructs provide a guide to relevant explanations of current behaviours and key prompts to behaviour change. This Theoretical Domains Framework (TDF) has proved useful in implementation research studies among health care professionals (Dyson et al. 2010, Godin et al. 2008, Islam et al. 2012, Michie et al. 2007).

Table 6. Theoretical domains and constructs for each domain (Michie et al. 2005).

DOMAINS	CONSTRUCTS
Knowledge	Knowledge, Knowledge about condition/scientific rationale, Schemas + mindsets + illness representations, Procedural knowledge
Skills	Skills, Competence/ability/skill assessment, Practice/skills development, Interpersonal skills, Coping strategies
Professional Role and Identity	Identity, Professional identity/boundaries/role, Group/social identity, Social/group norms, Alienation/organisational commitment
Beliefs about Capabilities	Self-efficacy, Control of behaviour and social environment, Self-confidence/professional confidence, Empowerment, Self-esteem, Perceived behavioural control, Optimism/pessimism
Beliefs about Consequences	Outcome expectancies, Anticipated regret, Appraisal/evaluation/review, Consequences, Attitudes, Contingencies, Reinforcement/punishment/consequences, Incentives/rewards, Beliefs, Unrealistic optimism, Salient Events/sensitisation/critical incidents, Characteristics of outcome expectancies – physical, social, emotional, sanctions/rewards, proximal/distal, valued/not valued, probable/improbable, salient/not salient, perceived risk/threat
Motivation and Goals	Intention; stability of intention/certainty of intention, Goals (autonomous, controlled), Goal target/setting, Goal priority, Intrinsic motivation, Commitment, Distal and proximal goals, Transtheoretical model and stages of change
Memory, Attention and Decision Processes	Memory, Attention, Attention control, Decision making
Environmental Context and Resources	Resources/material resources (availability and management), Environmental stressors, Person x environmental interaction, Knowledge of the task environment
Social Influences	Social support, Social/group norms, Organisational development, Leadership, Teamwork, Group conformity, Organisational climate/culture, Social pressure, Power/hierarchy, Professional boundaries/roles, Management commitment, Supervision, Inter-group conflict, Champions, Social comparisons, Identity; group/social identity, Organisational commitment/alienation, Feedback, Conflict — competing demands, conflicting roles, Change management, Crew resource management, Negotiation, Social support: personal/professional/organisational, intra/interpersonal, society/community, Social/group norms: subjective, descriptive, injunctive norms, Learning and modelling
Emotion	Affect, Stress, Anticipated regret, Fear, Burnout, Cognitive overload/tiredness, Threat, Positive/negative affect, Anxiety/depression

4.2.2 Theoretical Domains Questionnaire and its development

To assess potential implementation difficulties and determinants for TUPAC counselling among oral health professionals, a questionnaire was developed based on TDF (Michie et al. 2005) and the Current Care Guidelines for TUC counselling (The Finnish Medical Society Duodecim 2012). Because the Current Care Guidelines include no tobacco prevention, separate items for tobacco prevention were added. Because no national or international guidelines for tobacco prevention were available, tobacco prevention in this context were defined as (1) asking about tobacco use and (2) promoting non-users to remain tobacco free.

The aim of developing the questionnaire was to create a feasible method for measuring the key constructs of each of the 12 domains of TUPAC counselling. First, a systematic search of published questionnaires on TUPAC counselling from PubMed was conducted using the following search terms: Topic = (tobacco OR smoking) AND Topic = (counselling OR counseling) AND Topic = (questionnaire OR survey) AND Topic = (dentist OR "dental hygienist" OR hygienist OR nurse OR physician OR doctor OR "healthcare provider" OR "health care provider" OR "general practitioner"). Of the 1,240 articles found (by 31 January 2009), about 60 different questionnaires were identified. Second, corresponding authors were contacted to ask whether they could provide the questionnaire as well as their permission to use the questionnaire items to develop the Theoretical Domains Questionnaire (TDQ). Of the 25 questionnaires received, three questionnaires proved to be the most suitable, as they covered a wide range of implementation aspects among health care professionals (Applegate et al. 2008, Hayes et al. 1997, Hudmon et al. 2006). In addition, the US medical students' competency requirements for TUC counselling were used to develop the questionnaire (e.g. in developing the domains 'Knowledge', 'Skills', 'Beliefs about Capabilities') (Geller et al. 2005). Of these questionnaires and competence requirements, appropriate items under each theoretical domain were assigned according to the component constructs and elicited questions provided by the consensus group (Table 6) (Michie et al. 2005). Because not all domains had enough adequate items, additional items were created (III). To maximise the chance that items would reflect the main component constructs of each domain while keeping the questionnaire as short as possible, advice from experts on behaviour change and tobacco dependency treatment were sought through discussions. For example, several meetings were held where appropriate items for each domain were sought according to domain construct (Table 6) (Michie et al. 2005). The final version of the questionnaire consisted of 35 items (two to six items per domain) and covered the following 10 domains: 'Knowledge', 'Skills', 'Professional Role and Identity', 'Beliefs about Capabilities', 'Beliefs about Consequences', 'Motivation and Goals', 'Memory, Attention, and Decision Proc-

esses', 'Environmental Context and Resources', 'Social Influences' and 'Emotion'. Domain 'Behavioural Regulation' was excluded because, in the context of community dental setting, the component constructs of behavioural regulation (e.g. goal/target setting, goal priority, feedback and project management) (Michie et al. 2005) are mediated mostly by the clinical environment and chief dental officers rather than controlled by study participants. Additionally, the domain 'Behavioural Regulation' overlapped too much with the domain 'Environmental Context and Resources' (environmental stressors, persons and environmetal interaction, knowledge of the task environment) (Michie et al. 2005). In addition to 'Behavioural Regulation', the domain 'Nature of Behaviour' was excluded because it relates more to an understanding of the behaviour itself rather than to influencing it (Michie et al. 2011).

The questionnaire was developed in English and translated (by Language Services, University of Helsinki) into both Finnish and Swedish, the national languages of Finland. Lastly, the questionnaire was back-translated into English by independent translators to verify the quality of the translations. If the original and the back-translated versions differed, a further round of back-translation was conducted until the items showed satisfactory agreement. To confirm the validity and reliability of the TDQ, a pilot study was conducted among a sample of dentists and dental hygienists (n = 30) working in community dental clinics in Helsinki, Finland. The piloting indicated that oral health professionals understood and received the questionnaire well, so no changes to the content of items were necessary. In addition, estimates of the internal consistency of the theoretical domains provided sufficient reliability (> 0.50) for the pilot study (Nunnally 1967).

4.2.3 TUC counselling questionaire

The provision of TUC counselling was assessed using one item per six As as follows: What percentage of your new or recall patients do you (1) "Ask about tobacco use?" ('Ask'), (2) "Assess interest in changing tobacco use behaviour?" ('Assess'), (3) "Document tobacco-relevant discussion and plans in dental record?" ('Account'), (4) "Give clear, strong, personalised advice to quit?" ('Advise'), (5) "Assist those who are interested in quitting to develop a plan to quit or taper?" ('Assist'), and (6) "Provide treatment maintenance and follow-up services to those who have quit?" ('Arrange') (Table 9). The questions were selected from a previously used and validated instrument (Applegate et al., 2008, Zapka et al. 1997) to cover the core concept of each 'A' based on the national and international guidelines for TUC counselling (Fiore et al. 2008, The Finnish Medical Society Duodecim 2012). The questionnaire was back-translated and piloted together with the TDQ as described above.

4.2.4 Electronic dental record audit

The measures for TUPAC counselling were created according to a meta-analysis by Fiore et al. (2008) showing that the time dedicated to counselling was one of the most accurate measures for predicting the effectiveness of TUC counselling. We therefore measured whether preventative or cessation counselling was implemented at all, and if so, the estimated time dedicated to TUC counselling. For data collection, procedure codes were created for the electronic dental record (EDR) system (Effica® by Tieto Finland, Helsinki) for TUPAC counselling. A similar documentation system is widely used in Finland for all dental procedures. Prior to data collection, the chief dental officers provided notices and instructions for the new TUPAC counselling codes equally to all oral health professionals in a staff meeting and via e-mail.

The provision of preventative counselling was assessed using one procedure code that included asking patients about their tobacco use, and for non-users, encouraging them to remain tobacco-free. Regarding TUC counselling, the following procedure codes were available: minimal counselling (< 3 minutes), low-intensity conselling (3 to 10 minutes), and higher-intensity counselling (> 10 minutes). The the meta-analysis by Fiore et al. (2008) served as the basis for the procedure codes for TUC counselling; the estimated effectiveness of TUC counselling conducted by health care professionals was: OR 1.3 for minimal counselling (< 3 minutes), OR 1.6 for low-intensity counselling (3 to 10 minutes), and OR 2.3 for higher-intensity counselling (> 10 minutes) (Table 1). For preventative counselling, procedure codes were calculated per 100 patient visits. For TUC counselling, procedure codes were multiplied by the respective effect sizes and summed them per 100 patient visits, thereby creating a continuous outcome score. All procedure codes were collected for the six-month follow-up period in all clinics.

4.3 Study design and randomisation

Before interventions, baseline data on the provision of TUPAC counselling were collected using the TUC counselling questionnaire and an EDR audit. Additionally, potential implementation barriers to and determinants for TUPAC counselling were assessed using the TDQ. This was followed by randomisation where 34 clinics were matched to 13 clusters according to (1) municipal health care regions (Vaasa or Tampere), (2) the number of oral health professionals per clinic and, (3) the probability of contamination between intervention and control participants. Oral health professionals usually work in one clinic only. If participants were known to work in more than one clinic, the chief dental officers merged two or more clinics to minimise potential contamination across study groups. After merging clinics and forming clusters, the chief dentists provided a concealed sequence of clusters

to the investigators, who then allocated the clusters randomly to (1) control, (2) education, or (3) education + fee-for-service groups by drawing lots. The allocation was concealed from the investigators until after completion of the data collection. The nature of the study setting made it impossible to blind participants to group allocation. The flowchart of the study design appears in Figure 5.

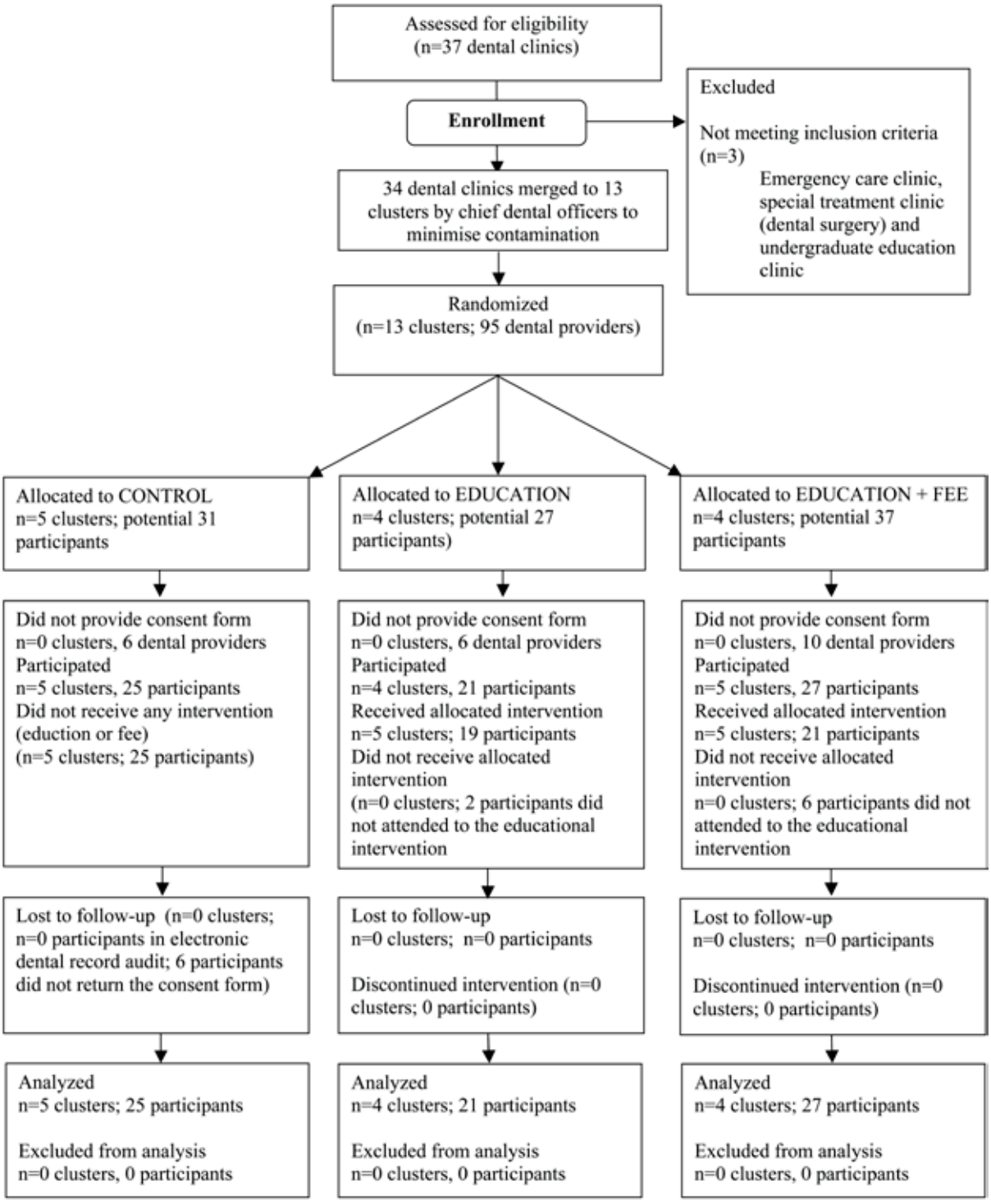

Figure 5. Flowchart of clusters and participants.

Regarding the patient characteristics of those visiting community dental clinics during the six-month trial period, 50.4% were under the age of 18 and 52.9% were women (Table 13). Although no data were available for tobacco prevalence, the Finnish national survey has reported that tobacco prevalence among adult men is about 22% and among adult women, 15% (Helakorpi et al. 2012). Daily smoking among 15- to 24-year-old men is about 12% and among women, 14% (Helakorpi et al. 2012). Presumably, whatever the rates of current tobacco users in each dental clinic, the randomisation should eliminate differences in tobacco prevalence across the three intervention groups.

4.4 Interventions

4.4.1 Educational intervention

Two senior experts in the field of tobacco dependence treatment and research designed and implemented the educational intervention. These interventions were implemented separately but in an identical manner in both Tampere (September 15, 2009) and Vaasa (September 16, 2009). The education lasted five hours (excluding breaks) and included lectures, interactive sessions, multimedia demonstrations, and a role-play session with patient cases typical of oral health care settings (e.g. adolescents, tobacco users with periodontal problems). The teaching modules were as follows: (1) Epidemiology of tobacco use and its health consequences, (2) Role of oral health professionals in the prevention and cessation of tobacco use, (3) Tobacco dependence, (4) Pharmacological treatment of tobacco dependence, (5) Non-pharmacological treatment of tobacco dependence, (6) How to implement brief TUPAC counselling intervention in oral health care settings, (7) Youth and tobacco, (8) Resources and self-help materials, and (9) Rehearsal of TUPAC counselling in small groups using standard patient cases.

In addition to providing knowledge, all sessions included components to enhance the attitudes, motivation and self-efficacy of the participants towards TUPAC counselling as part of their everyday routine. One important component was skill training, which the last session especially targeted. The training sessions comprised a total of six typical patient cases (two female/four male; two adolescent/four adult; four cigarette smokers/two smokeless tobacco users) performed by professional actors and/or students. Each group followed a written protocol and time schedule to ensure that each participant of the session had an opportunity to practice TUPAC counselling. After the group sessions, all participants received feedback on possible solutions for treatment and counselling in each patient case. In addition, participants had access to a comprehensive selection of self-help materials and nicotine replacement therapy options in treating tobacco dependence. The study material included a binder with handouts for each teaching session as well as for

the patient cases. All these materials were posted on the project website for later access in electronic format for all participants of the educational intervention (the participants all received usernames and passwords).

4.4.2 Fee-for-service intervention

In Finland, dentists in community dental clinics are paid according to a hybrid system involving (1) capitation and (2) fee-for-service (per treatment item completed). The fee-for-service bonus comprises about 30-40% of the total salary. Dental hygienists' salaries consist of a fixed salary only (about 40-60% of the dentist's total salary). In this study, both dentists and dental hygienists received time-based fees for providing TUC counselling comparable to other time-based fee-for-service incentives paid to dentists in community settings. For preventative counselling, the fee was equivalent to minimal TUC counselling (< 3 minutes). All fees were paid on a monthly basis during the six-month trial period.

4.5 Power calculation

The sample size was calculated based on population reports collected by the National Institute for Health and Welfare from a random sample (n = 5000) of Finnish adults (Helakorpi et al. 2010). The survey showed that among tobacco users who visited a dentist at least once during the past year, 10.5% had received advice to quit (Helakorpi et al. 2010). Because our primary aim was to compare the provision of TUC counselling between control versus two intervention groups, sample size was calculated based on the following assumptions: the percentage of counselled patients will increase from 10.5% (control) to 33% in the educational intervention group and to 63% in the education + fee-for-service intervention group as validated by the EDR audit. Achieving 80% power with a two-sided 5% significance level and with an estimated intra-class correlation of 0.02 will require a total of 72 participants and 12 clusters with an average of six participants per cluster. Assuming a baseline response rate of 76%, an initial sample of 95 oral health professionals was needed.

4.6 Ethical review and study permission

All participants were legally competent adult subjects who volunteered to participate. The Ethics Committees of the Pirkanmaa Hospital District and Vaasa Central Hospital reviewed the questionnaires, explanatory statements and consent forms and approved the research plan. The Research Permission Committee of the City of Tampere and the medical director of the Vaasa health centre granted their permission to conduct the study.

4.7 Statistical methods

Background variables (gender, age, profession, mean clinical years in practice, mean clinical hours per week, municipal health care region, tobacco use, received undergraduate and continuing education in TUPAC counselling) were analysed using the chi square test for categorical variables and t-tests for continuous variables. The baseline assessment of reported TUC counselling was analysed using a four-point scale indicating the percentage of patients who reportedly received TUC counselling: 0-25% (later referred to as never or rarely), 26-50%, 51-75% or 76-100% (later referred to as mostly) (Table 9).

Estimates of the internal consistency of the theoretical domains and factors were calculated using Cronbach's alpha (with a cutoff of 0.50) deemed sufficient for preliminary research (Nunnally 1967). Scores for theoretical domains were based on responses measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree; later re-coded from 0 to 4 for sum scores). For negatively worded items, the scale scores were reversed. Dividing the sum of the item scores (0-4 per item) by the maximum possible score for the given domain yielded a total score for each domain. The domain scores were then reported as a percentage of the maximum possible. A low percentage value for a particular domain is interpreted as the potential for implementation difficulty.

For factor analysis, exploratory method were used because the TDF approach did not identify causal processes of behaviour change per se, and no prior theory could explain behaviour change or behaviour regulation. In the factor analysis, theoretical domains served as the unit of analysis and met the conditions for exploratory factor analysis (Kaiser-Meyer-Olkin = 0.67, Bartlett's test < 0.001). For the extraction criteria, an eigenvalue of 1.0 and the Varimax method for matrix rotation were used. The cutoff for factor loadings was set at 0.6, and statistical significance at $p < 0.05$. Factors were labelled based on their component domains and the broader behavioural and theoretical literature (Fishbein et al. 2001, Michie et al. 2011). Factor correlations were calculated using Pearson's correlation.

To analyse the associations between TUC counselling behaviours (six As) and theoretical domains, the scale of reported TUC counselling was dichotomised to a binary scale so that the category 0-25% was combined with 26-50% and the category 51-75% with 76-100%. In the correlation analysis, Spearman's rank correlation coefficient was used.

To assess potential determinants for TUC counselling behaviours, logistic regression analysis with the backward stepwise method were used. First, all theoretical domains were included in the model. Domains were excluded one by one based on their highest p-values. Because the aim was to identify positive determinants, domains that showed a negative association (OR < 1) were excluded from the final

model. In all models, Omnibus tests of model coefficients were < 0.05.

In the statistical analyses of the intervention trial, intention-to-treat principles were followed from baseline on both individual and cluster levels. As such, the optimal strategy by excluding all randomised oral health professionals (n = 95) but those who participated in the study at baseline (n = 73) were followed (Hollis and Campbell 1999). The intervention groups were analysed using seven repeated measures of baseline and follow-up months on a general linear model. The cluster effect was compensated for by including the randomisation unit (dental clinics) into the model as a covariate. Based on differences between groups in the distributions of baseline variables (IV), the effects of municipal health care regions (Tampere vs. Vaasa) and whether oral health professionals received continuing education in TUPAC counselling were tested if they had a statistically significant effect on preventative or TUC counselling. The analysis showed that the effect of these background variables on preventative or TUC counselling were statistically insignificant. Thus, municipal health care regions as well as received post-graduate TUPAC counselling education were not considered confounders and were excluded from the final model. A general linear model for repeated measures served to compare the changes in outcome measures by intervention group. These analyses provided the time effect (if the outcome measure changed significantly over time), the group effect (if, on average, the means of the outcome measure differed across various conditions) and the group-by-time interaction (if the time effect differed significantly under the conditions analysed). The effects were indicated by F-values and corresponding p-values.

All analyses were performed using PASW Statistics version 18.0 (SPSS, Inc., Chicago, IL) or SPSS Statistics version 19.0 (SPSS, Inc., Chicago, IL) for Mac OS X. The statistical significance was set at $p < 0.05$.

5. RESULTS

5.1 Participant characteristics (I)

Of the study participants, 86.3% were female and 74.0% dentists, and the mean age was 45.8 (SD 10.4). When comparing age and gender distributions, the sample of dentists well represents dentists employed by community dental clinics in Finland (Table 7). When comparing participants and non-participants on mean age or gender, no statistically significant differences were found.

Table 7. The gender and mean age of study participants (n = 73), non-participants (n = 22) and Finnish dentists employed by municipal community dental clinics (n = 2002).

	Participants		**Non-participants**		**Total**		**Municipal dental practitioners in Finland**
	Dentists n = 54	Hygienists n = 19	Dentists n = 19	Hygienists n = 3	Dentists n = 73	Hygienists n = 22	Dentists* n = 2002
Female (%)	81.5	100	68.4	100	78.1	100	77.4
Mean age (SD)**	48.7 (9.1)	37.3 (9.5)	51.1 (9.3)	46.7 (16.7)	48.9 (9.5)	38.6 (10.7)	49.5 (8.7)

*Finnish Dental Association statistics 2010

**SD = standard deviation

Regarding background variables, dentists' mean age was higher than that of dental hygienists ($p < 0.001$) (Table 8). In addition, dentists had practised longer than dental hygienists had ($p < 0.001$), but received less undergraduate education in TUPAC counselling ($p < 0.001$). Regular tobacco use was low (4.1%) among both provider groups, yet slightly higher among dental hygienists than among dentists (Table 8).

Table 8. Participant characteristics (SD = standard deviation) (n = 73).

	Dentists n = 54	**Hygienist n = 19**	**p-value**	**Total n = 73**
Response rate (%)	74.0	86.4	0.27	76.8
Age (SD)	48.7 (9.1)	37.3 (9.5)	< 0.001	45.8 (10.4)
Years in practice (SD)	22.4 (9.1)	10.2 (7.6)	< 0.001	19.2 (10.2)
Mean clinical hours per week (SD)	28.0 (7.4)	31.1 (8.2.)	0.14	28.8 (7.7)
Tobacco use (%)				
Occasional	1.9	10.5	0.10	4.1
Daily	3.7	5.3	0.71	4.1
Undergraduate education received in TUPAC counselling (%)	24.1	84.2	< 0.001	39.7
Continuing education received in TUPAC counselling (%)	37.0	31.6	0.67	35.6

P-values calculated using chi-square and t-tests.

5.2 Provision of TUC counselling at baseline (II)

On average, the provision of TUC counselling at baseline was low (Table 9). The percentage of oral health professionals who reported asking most of their patients about their tobacco use was 15.1%. Less than 10% reported assessing their patients' interest in quitting (8.2%) or advising them to quit (5.5%). The percentage of participants who never or rarely documented tobacco-relevant discussions in their patients' dental records was 65.8%. Arranging follow-up services for those who had quit using tobacco was rare. Of the six cessation counselling behaviours, dental hygienists reported assessing ($p = 0.018$), accounting for ($p = 0.001$) and assisting ($p = 0.001$) their patients significantly more often than dentists did.

Table 9. Dentists' (n = 54) and dental hygienists' (n = 19) responses to items enquiring about the provision of TUC counselling.

	What percentage of your new or recall patients do you		**0-25% n (%)**	**26-50% n (%)**	**51-75% n (%)**	**76-100% n (%)**
Ask	Ask about tobacco use?	Dentists	26 (48.1)	16 (29.6)	5 (9.3)	7 (13.0)
		Hygienists	3 (15.8)	9 (47.4)	3 (15.8)	4 (21.1)
		Total	29 (39.7)	25 (34,2)	8 (11.0)	11 (15.1)
Assess	Assess interest in changing tobacco use behaviours?	Dentists	30 (55.6)	9 (16.7)	12 (22.2)	3 (5.6)
		Hygienists	5 (26.3)	3 (15.8)	8 (42.1)	3 (15.8)
		Total	35 (47.9)	12 (16.4)	20 (27.4)	6 (8.2)
Account	Document tobacco-relevant discussion and plans in dental record?	Dentists	43 (79.6)	6 (11.1)	3 (5.6)	2 (3.7)
		Hygienists	5 (26.3)	6 (31.6)	2 (10.5)	6 (31.6)
		Total	48 (65.8)	12 (16.4)	5 (6.9)	8 (11.0)
Advice	Give clear, strong, personalised advice to quit?	Dentists	36 (66.7)	6 (11.1)	10 (18.5)	2 (3.7)
		Hygienists	8 (42.1)	7 (36.8)	2 (10.5)	2 (10.5)
		Total	44 (60.3)	13 (17.8)	12 (16.4)	4 (5.5)
Assist	Assist those who are interested in quitting to develop a plan to quit or taper?	Dentists	42 (77.8)	7 (13.0)	3 (5.6)	2 (3.7)
		Hygienists	11 (57.9)	0	6 (31.6)	2 (10.5)
		Total	53 (72.6)	7 (9.6)	9 (12.3)	4 (5.5)
Arrange	Provide treatment maintenance and follow-up services to those who have quit?	Dentists	54 (100)	0	0	0
		Hygienists	17 (89.5)	2 (10.5)	0	0
		Total	71 (97.3)	2 (2.7)	0	0

5.3 Validity and reliability analysis of developed TDQ (III)

Assessing the reliability of the developed TDQ, the internal consistency for each domain was as follows: 'Knowledge' = 0.54, 'Skills' = 0.55, 'Professional Role and Identity = 0.57, 'Beliefs about Capabilities' = 0.64, 'Beliefs about Consequences' = 0.60, 'Motivation and Goals' = 0.60, 'Memory, Attention and Decision Processes' = 0.52, 'Environmental Context and Resources' = 0.71, 'Social Influences' = 0.52, and 'Emotion' = 0.50 (Figure 6). Evaluation of the construct validity was performed using exploratory factor analysis. From ten theoretical domains, three factors were extracted with a combined explained variation of 70.8%. Factors were labelled based on the work of the behavioural theorists, who conceptualised three factors necessary for behaviour to occur (Fishbein et al. 2001, Michie et al. 2011). Factors were therefore labelled as follows: 'Motivation' (47.6% of variance, α = 0.86), 'Capability' (13.3% of variance, α = 0.83), and 'Opportunity' (10.0% of variance, α = 0.71). Correlations between factors were statistically significant.

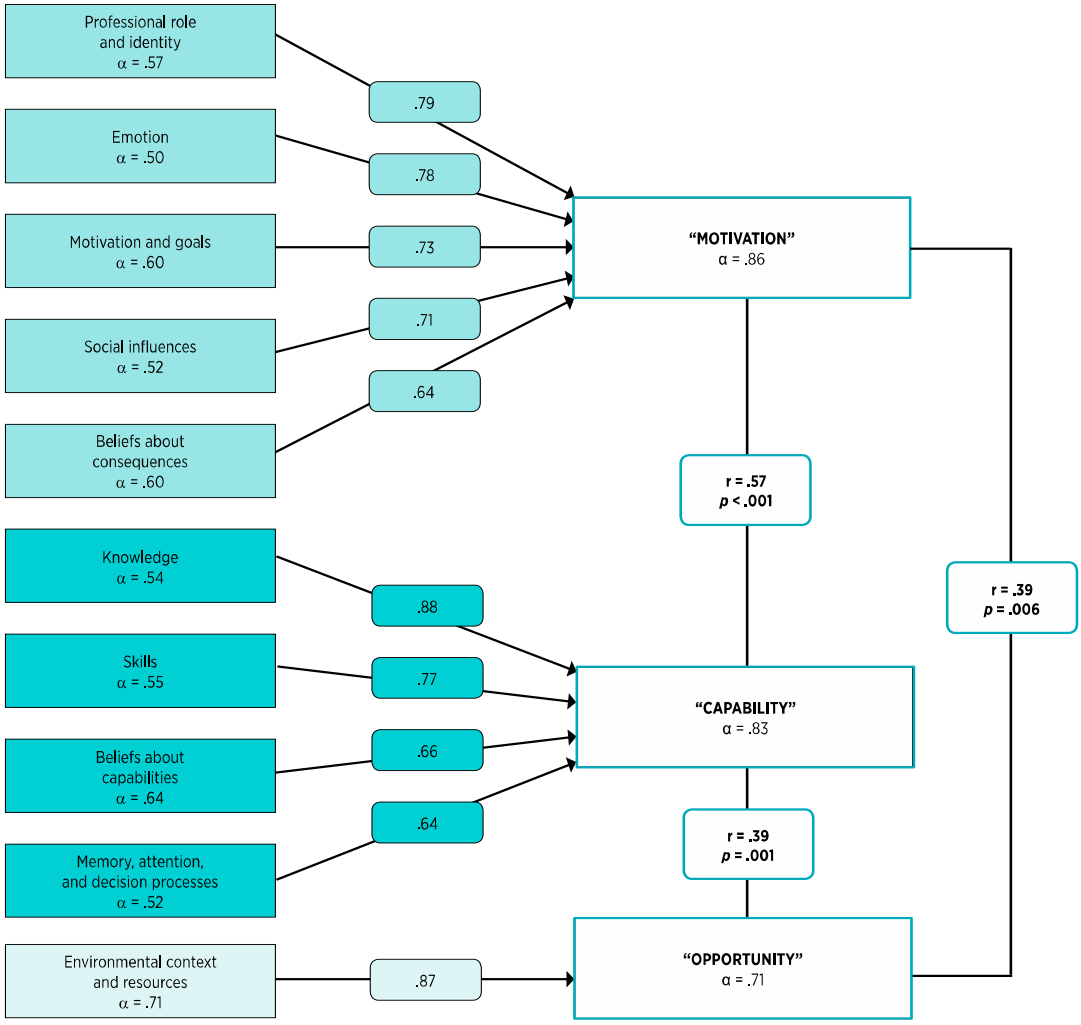

Figure 6. Theoretical domains and extracted factors with Cronbach's alpha (α) and domain loadings (n = 73). Factor correlations (r) are provided with p-values (two-tailed).

5.4 Identified implementation barriers (III)

Reflecting potential implementation difficulties for TUPAC counselling, mean scores for theoretical domains were calculated. Among both provider groups, the same domains yielded the lowest mean scores and were thus identified as potential barriers to implementation. These domains were 'Skills', 'Beliefs about Capabilities' and 'Environmental Context and Resources' (Figures 7 and 8). Additionally, the domains 'Emotion', 'Memory, Attention and Decision Processes', 'Motivation and Goals', 'Professional Role and Identity', and 'Beliefs about Consequences' provided the highest mean scores among both provider groups. Differences in domain scores across provider groups remained statistically non-significant.

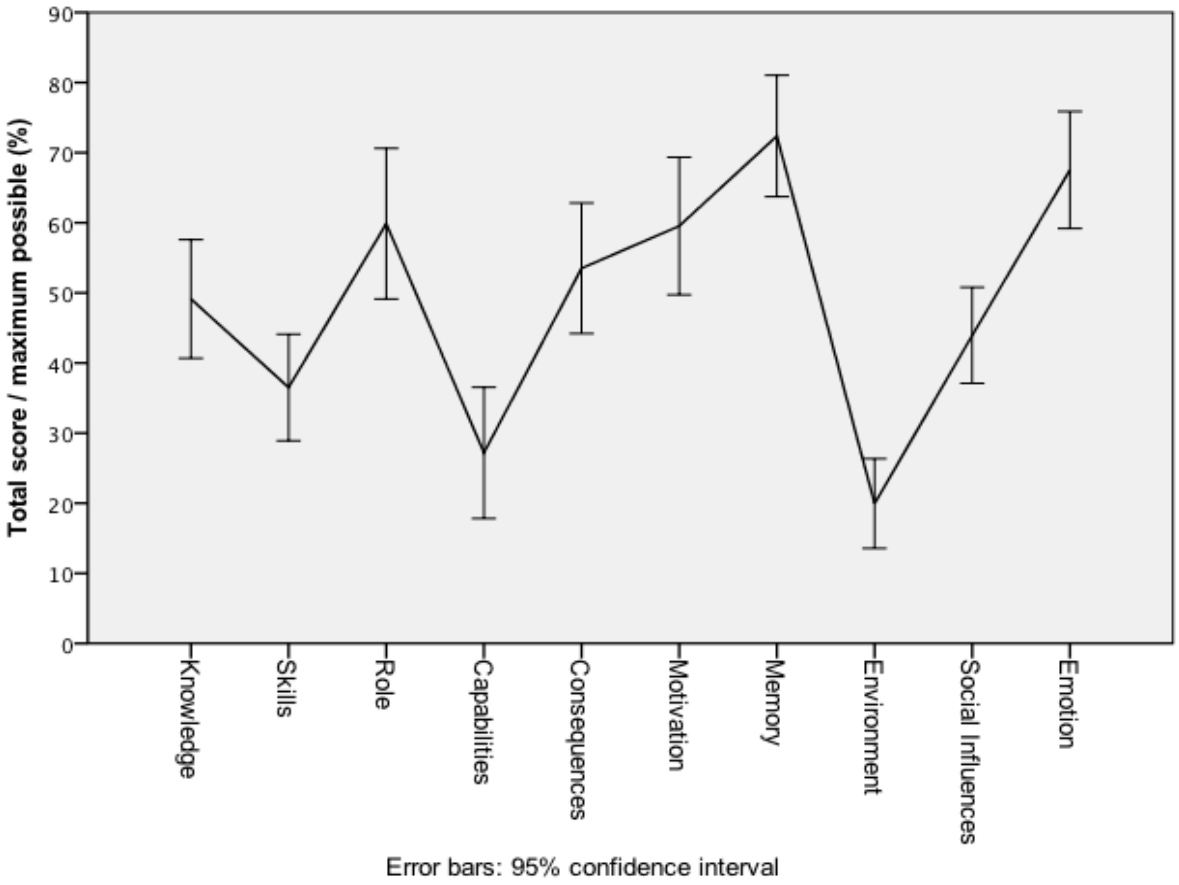

Figure 7. Mean domain scores of dental hygienists (n = 19) with 95% confidence intervals.

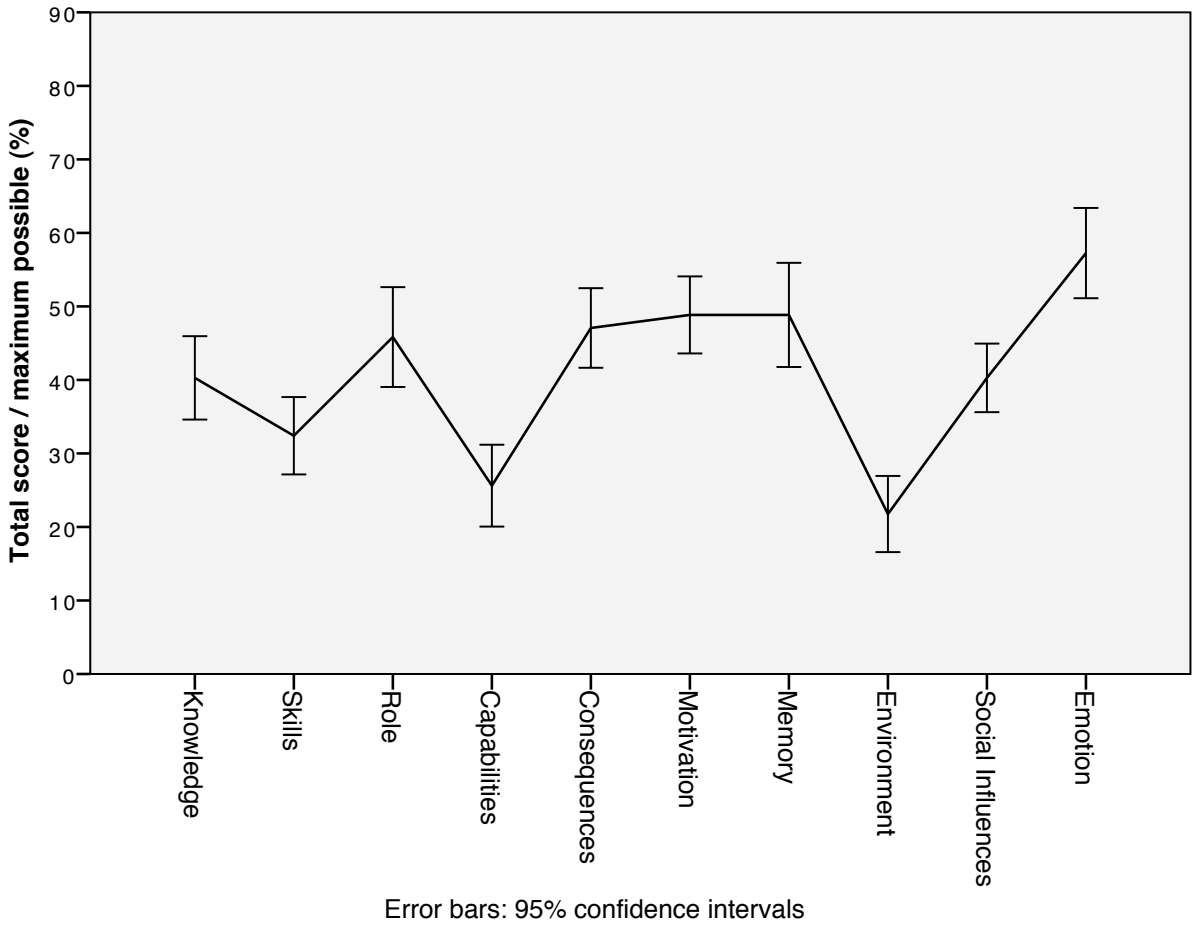

Figure 8. Mean domain scores of dentists (n = 54) with 95% confidence intervals.

5.5 Determinants identified for TUC counselling (II)

Correlation analyses of TUC counselling and theoretical domains showed that two domains were most often associated with TUC counselling behaviours: 'Professional Role and Identity' and 'Memory, Attention and Decision Processes' (Tables 10 and 11). The following domains yielded no statistically significant correlation with any of the six behaviours assessed: 'Beliefs about Consequences', 'Environmental Context and Resources' and 'Social Influences' (Tables 10 and 11). In addition, some differences between provider groups were found. For example, the domain 'Beliefs about Capabilities' showed statistically significant correlations with the behaviours 'Assess' and 'Advice' among dental hygienists, but not among dentists.

Table 10. Spearman's correlation coefficients between theoretical domains and cessation counselling behaviours among dental hygienists (n = 19).

	Ask	Assess	Account	Advice	Assist
Knowledge	0.26	0.13	0.10	0.16	0.16
Skills	-0.12	0.39	0.33	0.13	0.36
Professional role and identity	0.48*	0.56*	0.46*	0.50*	0.54*
Beliefs about capabilities	0.02	0.52	0.35	0.49*	0.42
Beliefs about consequences	0.08	0.19	0	0.08	0
Motivation and goals	0.54*	0.18	0.30	0.13	0.45
Memory, attention and decision process	0.59**	0.56*	0.52*	0.35	0.60**
Environmental context and resources	0.03	-0.25	-0.15	0.01	-0.01
Social influences	0.23	0.27	0.04	0.05	0
Emotion	0.49	0.40	0.09	0.32	0.09

*Significant $p < 0.05$; **significant $p < 0.01$ (two-tailed).

Table 11. Spearman's correlation coefficients between theoretical domains and cessation counselling behaviours among dentists (n = 54).

	Ask	Assess	Account	Advice	Assist
Knowledge	0.23	0.11	0.004	0.20	0.37**
Skills	0.15	0.27*	0.16	0.12	0.12
Professional role and identity	0.02	0.34*	0.28*	0.23	0.21
Beliefs about capabilities	-0.02	-0.003	0.15	0.04	0.12
Beliefs about consequences	-0.02	-0.06	0.24	0.16	0.11
Motivation and goals	0.10	0.36**	0.004	0.19	0.11
Memory, attention and decision process	0.37**	0.23	0.07	0.34*	0.34*
Environmental context and resources	0.12	-0.03	-0.07	-0.02	-0.09
Social influences	0.04	0.23	0.20	0.22	0.16
Emotion	-0.07	0.31*	0.08	0.13	0.09

*Significant $p < 0.05$; **significant $p < 0.01$ (two-tailed).

In the multiple logistic regression analysis (Table 12), the only domain that remained a statistically significant determinant for asking about patient's tobacco use was 'Memory, Attention and Decision Processes' ($p = 0.002$). To assess patients' readiness and willingness to stop their tobacco use, two determinants were found: 'Professional Role and Identity' ($p = 0.006$) and 'Memory, Attention and Decision Processes' ($p = 0.042$). The only determinant for the behaviours 'Account' and 'Advice' was 'Professional Role and Identity' ($p = 0.002$ and $p = 0.016$, respectively). Finally, the behaviour 'Assist' was determined by 'Memory, Attention and Decision Processes' ($p < 0.001$). For the behaviour 'Arrange', this analysis proved impossible due to the distribution of observations.

Table 12. Multiple logistic regression analyses of theoretical domains associated with TUC counselling behaviours (n = 73).

Behaviour	Domain associated with the behaviour	*p*	OR (95% CI)	Nagelker R Square
Ask	Memory, attention and decision processes	0.002	2.89 (1.49-5.57)	0.23
Assess	Model 1			0.52
	Professional role and identity	< 0.001	7.03 (2.45-20.22)	
	Skills	0.037	3.78 (1.09-13.15)	
	Beliefs about consequences	0.011	0.26 (0.09-0.74)	
	Beliefs about capabilities	0.020	0.21 (0.06-0.78)	
	Model 2			0.42
	Professional role and identity	0.001	4.14 (1.79-9.55)	
	Memory, attention and decision processes	0.020	2.26 (1.14-4.49)	
	Beliefs about consequences	0.016	0.31 (0.12-0.80)	
	Model 3			0.32
	Professional role and identity	0.006	2.47 (1.29-4.71)	
	Memory, attention and decision processes	0.042	1.91 (1.02-3.55)	
Account	Professional role and identity	0.002	3.44 (1.55-7.62)	0.25
Advice	Professional role and identity	0.016	2.20 (1.16-4.18)	0.13
Assist	Model 1			0.55
	Memory, attention and decision processes	0.001	11.19 (2.60-48.06)	
	Professional role and identity	0.013	3.66 (1.32-10.21)	
	Emotion	0.033	0.21 (0.05-0.88)	
	Model 2			0.40
	Memory, attention and decision processes	< 0.001	5.92 (2.20-15.94)	

5.6 Education and financial incentives to promote TUPAC counselling (IV)

5.6.1 Participant characteristics in randomised groups

Across control and intervention groups, differences in two background variables were statistically significant. The education group had fewer participants from Tampere municipal community dental clinics (42.9%) than did the control group (76.0%) (p = 0.022) (Table 13). In addition, more participants in the education + fee-for-service group had received continuing education in TUPAC counselling (59.3%) than did participants in the control (16.0%) (p = 0.001) or education groups (28.6%) (p = 0.034).

Table 13. Participant characteristics at baseline in the control, education and education + fee-for-service groups.

	Control n = 25		**Education n = 21**		**Education + Fee n = 27**	
	Dentists n = 18	Dental hygienists n = 7	Dentists n = 16	Dental hygienists n = 5	Dentists n = 20	Dental hygienists n = 7
Attended educational intervention (%)	0	0	14 (87.5)	5 (100)	14 (70.0)	7 (100)
Age (SD)	46.7 (8.3)	37.6 (12.8)	49.2 (10.4)	37.0 (10.6)	50.2 (8.7)	37.3 (5.8)
Mean clinical years practised (SD)	21.2 (8.1)	10.4 (9.7)	23.1 (10.5)	9.8 (8.1)	22.9 (9.1)	10.1 (5.9)
Mean clinical hours per week (SD)	30.6 (3.8)	34.9 (3.3)	25.9 (8.3)	29.4 (13.4)	27.5 (8.6)	28.6 (6.7)
Tampere health care region (%)	12 (66.7)	7 (100)	5 (31.3)	4 (80.0)	14 (70.0)	5 (71.4)
Tobacco use (%)						
Occasional	0	1 (14.3)	1 (6.3)	0	0	1 (14.3)
Daily	1 (5.6)	1 (14.3)	0	0	1 (5.0)	0
Received TUPAC education (%)						
Undergraduate	4 (22.2)	6 (85.7)	3 (18.8)	5 (100)	6 (30.0)	5 (71.4)
Continuing education	3 (16.7)	1 (14.3)	5 (31.3)	1 (20.0)	12 (60.0)	4 (57.1)

5.6.2 Patient characteristics

Patient characteristics reveal that differences in gender and age distributions between the control and intervention groups were statistically non-significant (Table 14). Of all patients visiting participating dental clinics during the six-month trial period, about half were 17 or younger.

Table 14. Patient characteristics in municipal dental clinics of Tampere and Vaasa health care regions during the six-month study period.

	CONTROL n = 5 clusters n = 31 oral health professionals			**EDUCATION n = 4 clusters n = 27 oral health professionals**			**EDUCATION + FEE n = 4 clusters n = 37 oral health professionals**		
Age	Men	Women	Total (%)	Men	Women	Total (%)	Men	Women	Total (%)
0-6	860	866	1726 (5.7)	1129	1075	2204 (8.3)	868	603	1471 (4.8)
7-17	6155	6083	12 238 (40.6)	4922	4665	9587 (36.0)	7110	7028	14138 (46.0)
18-46	4092	5258	9350 (31.0)	3742	4820	8562 (32.1)	3462	4376	7838 (25.5)
47-56	1151	1552	2703 (9.0)	1110	1322	2432 (9.1)	1003	1242	2245 (7.3)
57-64	764	1030	1794 (5.9)	722	893	1615 (6.1)	651	803	1454 (4.7)
65-70	375	462	837 (2.8)	407	465	872 (3.3)	440	467	907 (2.9)
71-75	212	302	514 (1.7)	320	307	627 (2.4)	312	384	696 (2.3)
76-125	427	590	1017 (3.4)	358	395	753 (2.8)	684	1332	2016 (6.6)
TOTAL (%)	14 036 (46.5)	16 143 (53.5)	30 179	12 710 (47.7)	13 942 (52.3)	26 652	14 530 (47.2)	16 235 (52.8)	30 762

5.6.3 Impact of interventions

Compliance with educational intervention was fairly high in both the education (90.5%) and education + fee-for-service (77.8%) groups. During the first two months after implementing the educational and fee-for-service interventions, the provision of preventative counselling reportedly increased not only in both intervention groups, but also in the control group (Figure 9). From the third month onwards, the provision of preventative counselling was about the same in all groups. Thus, statistically significant time or group effect during the six-month trial period was not found. Additionally, a statistically significant time-by-group interaction between the education and the education + fee-for-service groups was absent. When comparing provider groups, dental hygienists reported providing preventative counselling more often than did dentists ($F = 12.13$; $p = 0.001$). During the six-month trial, dental hygienists increased their provision of preventative counselling more than dentists did (provider-by-time interaction; $F = 6.03$; $p < 0.001$).

Similarly to preventative counselling, the provision of TUC counselling increased in both intervention groups during the first two months, followed by a relapse from the second month onwards (Figure 10). Despite the relapse, group-by-time interaction remained statistically significant (Table 15). However, comparison of

the education and education + fee-for-service groups revealed that group-by-time interaction was statistically non-significant. Dental hygienists increased their provision of TUC counselling more in all groups than dentists did (provider-by-time-by-group interaction: $p < 0.001$). Comparison of dentists and dental hygienists revealed statistically significant group-by-time interaction between the education and education + fee-for-service groups ($F = 1.78$; $p = 0.12$).

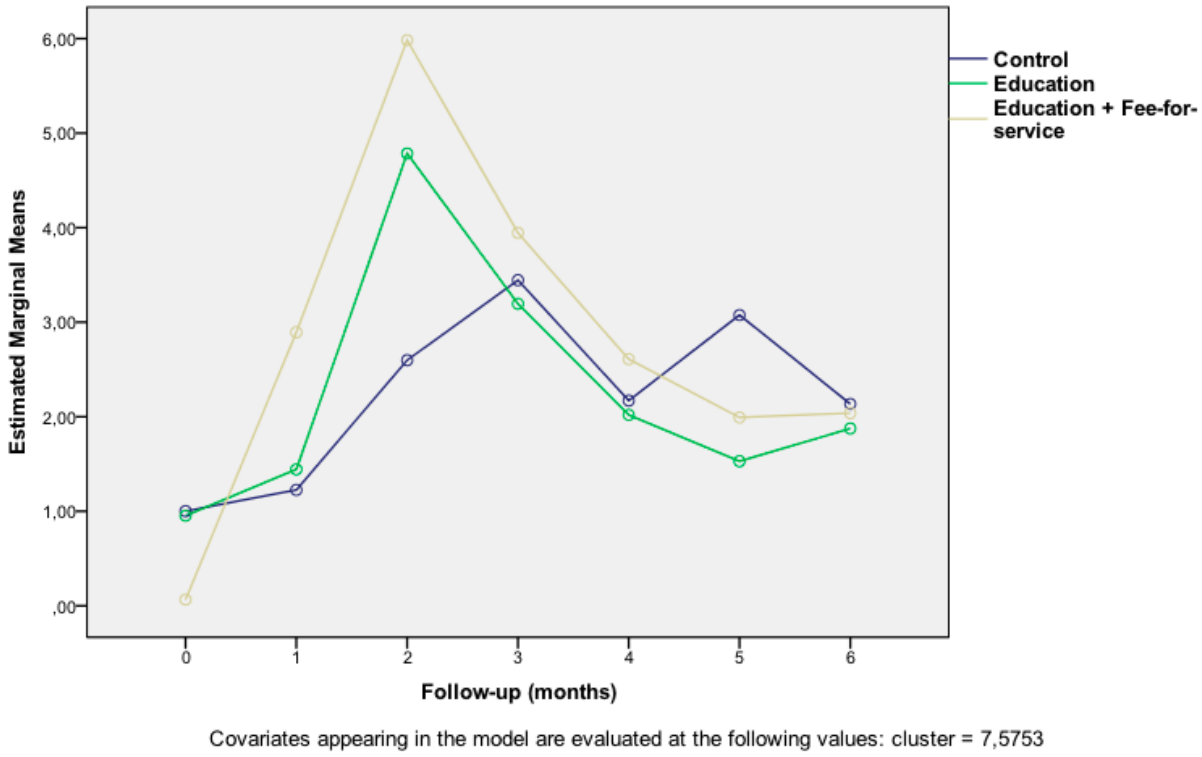

Figure 9. The effects of the educational and education + fee-for-service interventions on preventative counselling (reported counsels/100 visits) during the follow-up period.

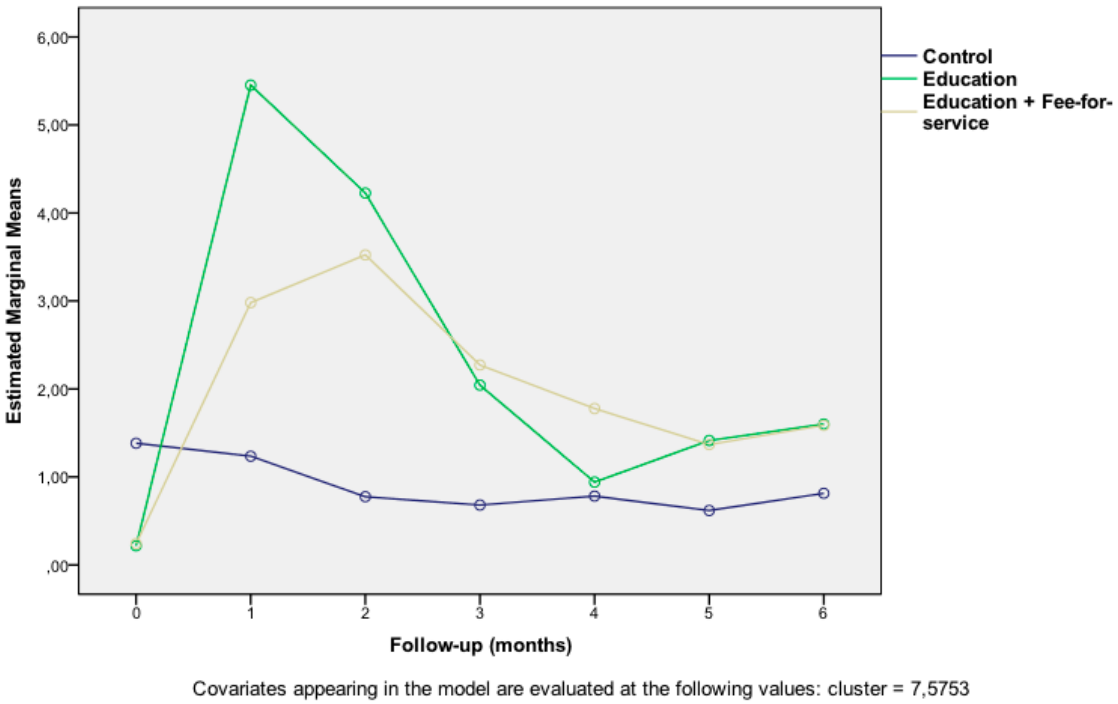

Figure 10. The effects of the educational and education + fee-for-service interventions on TUC counselling (sum scores of reported counsels/100 visits) during the follow-up period.

Table 15. The effects of the education and education + fee-for-service interventions on TUC counselling (n = 73).

	Group-by-time-by-provider effect		Group-by-time effect		Group effect		Time effect		Effect size (95% CI)
	F	p	F	p	F	p	F	p	
1 month	12.04	< 0.001	3.81	0.027	1.16	0.32	2.94	0.091	0.55 (0.057-1.04)
2 months	6.49	< 0.001	2.78	0.029	1.69	0.19	2.09	0.13	0.57 (0.079-1.06)
3 months	6.57	< 0.001	2.53	0.022	1.52	0.23	1.81	0.15	0.55 (0.059-1.04)
4 months	6.76	< 0.001	2.60	0.009	1.18	0.31	1.95	0.10	0.44 (-0.054-0.92)
5 months	6.37	< 0.001	2.48	0.007	1.06	0.35	1.85	0.10	0.55 (0.057-1.04)
6 months	5.95	< 0.001	2.31	0.007	.93	0.40	1.91	0.078	0.52 (0.034-1.02)

5.7 Main results

Table 16. The main results of the study.

Development of TDQ
Internal consistency and factor analysis provided support for the reliability and validity of the developed TDQ
Provision of TUC counselling at baseline
In general, the provision of TUC counselling was low
Of the six TUC counselling behaviours, the least implemented behaviours were “assisting in quitting” and “arranging follow-up services”
Dental hygienists reported providing TUC counselling more often than did dentists
Identified barriers to and determinants for TUPAC counselling
The following domains yielded the lowest mean scores and were thus identified as potential barriers to implementation: ‘Skills’, ‘Beliefs about Capabilities’ and ‘Environmental Context and Resources’
The following domains were identified as potential determinants for TUPAC counselling: ‘Professional Role and Identity’ and ‘Memory, Attention and Decision Processes’
Impact of education and fee-for-service on TUPAC counselling
Developed educational intervention was effective in promoting TUPAC counselling
Financial incentives provided no additional effect over education
Both interventions were more effective among dental hygienists than among dentists

6. DISCUSSION

This study was conducted among 73 oral health professionals in community dental settings in Finland. As one of the first studies to develop a questionnaire based on TDF, statistical analysis supported the reliability and validity of the developed TDQ. The provision of TUC counselling at baseline was low, possibly due to reportedly low competencies and environmental constraints. Two factors, 'Memory, Attention and Decision Processes' and and 'Professional Role and Identity', were identified as determinants for TUC counselling and thus potentially effective targets for interventions. Educational intervention was found to have at least short-term favourable effects on promoting TUC counselling. Financial incentive showed no such effect.

The study protocol (I) was implemented almost entirely, however, designing the inteventions according to the study protocol proved impossible due to the time constraints (funding schedule) of this project. Nevertheless, interventions were designed according to existing evidence and, in retrospect, were well selected, taking account the determinants identified for TUPAC counselling. As one of the first studies to develop a questionnaire based on TDF and to apply TDF to investigate factors influencing the implementation behaviours of oral health professionals, the present study provided a novel approach to developing the assessment of TUPAC counselling. This is especially important in increasing understanding the implicit and explicit pathways between implementation difficulties and their solutions to promoting TUPAC counselling.

6.1 Provision of TUC counselling

Although oral health professionals' adherence to TUC counselling guidelines has reportedly been low (Gordon et al. 2006, Helakorpi et al. 2012, Needleman et al. 2006), the level of TUC counselling in our sample at baseline was even lower. For example, the percentage of oral health professionals who asked most of their patients about their tobacco use was only 15.1%. Moreover, fewer than one in ten reported assessing patients' interest in quitting or advising them to quit. Of the six TUC counselling behaviours, 'Assist' and 'Arrange' were the least frequently implemented.

Regardless of the Current Care Guidelines for tobacco dependency treatment, first published in 2003, TUC counselling among oral health professionals in Finland has not improved significantly in the past decade (Figure 1). Moreover, Telivuo et al. (1991) conducted a survey in the late 1980s to investigate the provision of TUC counselling among 540 Finnish dentists. The study showed that more than

20 years ago, the reported provision of TUC counselling was at about the same level as today. For example, the percentage of dentists asking about patients' tobacco use was always or often 26% and occasionally 62% (Telivuo et al. 1991). The proportion of dentists who always advised their patients to quit smoking was 4% and occasionally 15% (Telivuo et al. 1991). The national survey among the adult population yielded similar results where the provision of TUC counselling among oral health professionals remained low (Helakorpi et al. 2012). Thus, compared to previous surveys of TUC counselling among oral health professionals in Finland, the present results are consistent. Compared to international studies, surveys of US dentists, for example, have reported substantially higher adherence to TUC counselling. The percentage of tobacco-using patients who were asked about their tobacco use was about 56-59%, those who were advised to quit, about 46-63%, and those whose interest in quitting was assessed, some 32-48% (Applegate et al. 2008, Succar et al. 2011). Because Finland has some of the toughest tobacco controls (e.g. legislation and taxation) in the world (Ministry of Social Affairs and Health 2010), the health care sector has not been equally successful (Joossens and Raw 2006). As such, oral health professionals, along with other health care professionals in Finland, should receive support and encouragement to more actively participate in TUPAC counselling.

6.1.1 TUC counselling questionnaire

The baseline data on the provision of TUC counselling were collected using a self-reported questionnaire. As in all survey studies, potential bias may result if participants answer according to social desirability rather than the actual situation (Sjöström and Holst 2002, Tourangeau and Yan 2007). Thus, the level of TUC counselling provided could be lower than that reported. However, because the level of TUC counselling reported was about the same as that reported by the Finnish national survey (9.5% were advised to quit) (Helakorpi et al. 2012), any potential reporting bias should be absent or low.

The TUC counselling questionnaire was developed based on the Current Care Guidelines for tobacco dependency treatment (The Finnish Medical Society Duodecim 2012) and the specific items drawn from previously used and validated questionnaires (Applegate et al., 2008, Zapka et al. 1997). The validity of translated items was confirmed by back-translation, a pilot study and content review by a tobacco dependency treatment expert involved in the development of the Current Care Guidelines. Because each of the six As was measured using one item, the statistical reliability test was impossible to conduct.

6.2 Identified barriers to and determinants for TUPAC counselling

The majority of Finnish dentists surveyed agreed more than 20 years ago that they should play an active role in TUC counselling (Telivuo et al. 1991). Despite the good will and the Current Care Guidelines for tobacco dependency treatments, the past 20 years have seen only minor if any improvement (Telivuo et al. 1991) (Figure 1). Implementation difficulties may stem from identified implementation barriers such as environmental constraints and a lack of competencies ('Beliefs about Capabilities' and 'Skills'). These finding are supported by earlier findings, as these same barriers recur in studies worldwide (Table 3). Regarding potential determinants for TUC counselling, the results showed that the domains 'Memory, Attention and Decision Processes' and 'Professional Role and Identity' were most often associated with TUC counselling behaviours. Because these domains could potentially be vital to the promotion of TUC counselling among oral health professionals, interventions that improve their professional role and identity as well as memory, attention and decision making could be effective.

6.2.1 Potential strategies to promote TUPAC counselling

Regarding environmental resourses and stressors, each dental clinic has a unique setting shaped by available resources and its employees. Because environmental factors are important in changing the behaviour of health care professionals (Fishbein et al. 2001, Michie et al. 2011), these results suggests that better environmental support for providing TUPAC counselling might be needed. This could mean, for example, facilitating organisational learning and adaptation to TUPAC counselling requirements by adjusting appointment durations, monitoring the quality and delivery of care (e.g. patient surveys) and increasing the availability of TUPAC counselling materials. As Confessore (1997) has stated, learning organisations gather and process information and feedback to solve local problems and develop everyday practice. Thus, by providing continuous learning opportunities, supporting collaboration within and with other organisations, local needs for successful TUPAC counselling could be improved. However, at best, enhancing the environmental context and resources could facilitate the provision of TUPAC counselling, but would be insufficient if requirements for motivation and capabilities remain unmet (Fishbein et al. 2001, Green and Kreuter 1991, Michie et al. 2011).

The present study showed low domain scores for 'Skills' and 'Beliefs about Capabilities'. This is unsurprising, as only 39.7% of study participants received undergraduate education in TUPAC counselling and only 35.6% received continuing education in TUPAC counselling (I). The lack of education in TUPAC counselling, however, is not only a problem among oral health professionals in Finland, but ap-

plies to all health care professionals internationally (Warren et al. 2008, Warren et al. 2011). Fortunately, studies have reported a positive attitude and willingness of oral health professional students to receive training in TUPAC counselling (Cannick et al. 2006, McCartan et al. 2008, Warren et al. 2008).

To improve skills and self-efficacy in TUPAC counselling, undergraduate and continuing education should be feasible (Davis et al. 2010, Freeman et al. 2012, Gordon et al. 2009, Ramseier et al. 2006, Rosseel et al. 2011). In addition to improving skills and competencies, both undergraduate and continuing education should provide comprehensive support, including a professional role and responsibilities in TUPAC counselling (Davis et al. 2010, Gordon et al. 2009). As such, different aspects that influence the implementation of TUPAC counselling (e.g. a lack of skills and competencies, problems in decision making or attitudes about professional responsibilities) could be met. With regard to the content of educational intervention, interactive education, including rehearsing relevant counselling techniques, role-play, problem solving, decision making and goal setting, have proved to be more effective than conventional lectures (Bloom 2005, Robertson et al. 2003). As Davis et al. (2010) suggested, undergraduate education in TUPAC counselling could be arranged as part of (1) periodontics and oral pathology training by introducing the effects of tobacco use, (2) pharmacology courses by including the concept of nicotine addiction and medications for tobacco cessation, (3) doctor-patient communication courses, and (4) clinical training. In addition to TUPAC education, assessing knowledge and competencies should be integrated into undergraduate education to improve students' learning and to confirm their knowledge of and competencies in TUPAC counselling (Schoonheim-Klein et al. 2006). Knowledge could be assessed with written or oral exams, and clinical competencies with, for example, the Objective Structured Clinical Examination (OSCE) (Davis et al. 2010). The OSCE tests have been successfully and widely used for testing a variety of clinical competencies among medical and dental students (Brannick et al. 2011, Manogue and Brown 1998). However, OSCE tests are not always reliable, especially when testing communication skills. Consequently, methods for measuring relevant TUPAC competencies should be well defined and designed (Brannick et al. 2011, Mattheos et al. 2006).

Regarding the educational intervention the present study offered, the five-hour educational intervention included, for example, lectures (epidemiology of tobacco use, professional role of oral health professionals in TUPAC counselling, tobacco dependence and treatment options), multimedia demonstrations and rehearsing TUPAC counselling in small groups. In addition, participants had access to a comprehensive selection of self-help materials and nicotine replacement therapy options. As such, the present educational intervention had components that, in addition to increasing 'Capabilities', potentially facilitated decision making and the

promotion of professional role and identity in TUPAC counselling.

As mentioned earlier, educational interventions may improve one's memory, attention and decision making as well as professional role and identity in TUPAC counselling. Consequently, the domain construct 'Memory, Attention and Decision Processes' includes memory, attention, attention control and decision making. According to Michie et al. (2008), intervention techniques to foster 'Memory, Attention and Decision Processes' could include, for example, rehearsing relevant skills, graded tasks, time management, self-monitoring, feedback and reminders for specific behaviour (Michie et al. 2008). 'Professional Role and Identity', in contrast, involves social and professional identities, professional roles and norms. Social support, problem solving and role-play could be used to improve oral health professionals' role and identity (Michie et al. 2008). When developing interventions that aim to influence professional role and identity, oral health professionals' professionalism and typical professional characteristics should be noted. As Leach (2009) stated, "...physicians are thought to be extremely cautious, conservative, and resistant to change. We pride ourselves on keeping up, and yet are clumsy when it comes to major organised efforts to bring about change". If this works for physicians, it surely applies to oral health professionals and to dentists, too. Chambers (2001) reviewed studies of typical personalities and value structures of dentists and found that dentists typically hold fundamental beliefs in the primacy of the concrete and useful, and antipathy for the abstract. Dentists reportedly avoided controlling others outside of their practice, coupled with a defensiveness against others' attempts to control them (Chambers 2001). They are not necessarilly highly autonomous or independent, but may seek situations where their efforts could be considered concrete and useful (Chambers 2001). Because TUPAC counselling is fairly abstract compared to most dental procedures, dentists may not be the easiest provider group among health care professionals to promote professional role and identity in TUPAC counselling. No studies of dental hygienists' typical personalities and value structures were found. However, because one of the main responsibilities of dental hygienists is health education and prevention, their undergraduate education has prepared them to do so. Thus, it is no wonder that dental hygienists more often provide TUC counselling than dentists do (Brothwell and Gelskey 2008, Rosseel et al. 2009, Tremblay et al. 2009) and receive new health promotion programmes well (Arpalahti et al. 2012).

6.2.2 Validity and reliability of TDQ

The validity of the developed TDQ was confirmed by careful item selection based on TDF (Michie et al. 2005) and the Current Care Guidelines for TUC counselling (The Finnish Medical Society Duodecim 2012). In addition, items to cover tobacco prevention, which were absent from the Current Care Guidelines, were included.

Based on a systematic search of published questionnaires on TUPAC counselling, suitable questionnaires were selected (Applegate et al. 2008, Hayes et al. 1997, Hudmon et al. 2006). In addition, US medical students' competency requirements for TUC counselling served to develop the questionnaire (Geller et al. 2005). Thereafter, specific items were assigned to each theoretical domain (Michie et al. 2005). The questionnaire was developed with experts in the field of tobacco dependency and behaviour change, and the final version was refined through discussions. Further confidence in the validity of the questionnaire came from factor analysis of the developed domains. With a combined explained variation of 70.8% (III), extracted factors ('Capability', 'Opportunity', 'Motivation') have been found to be central in explaining health care professionals' behaviour (Fishbein et al. 2001, Michie et al. 2011) and closely represents, for example, the PRECEDE Framework ('Predisposing', 'Enabling', 'Reinforcing' factors) (Green et al. 1980). Whilst the present study has shown the usefulness of the developed TDQ, it may not reveal all potentially relevant constructs associated with the provision of TUPAC counselling, as length constraints related to questionnaire development precluded measuring all possible aspects of the domains.

To confirm the validity as well as reliability of the TDQ, a pilot test was conducted among a sample of dentists and dental hygienists (n = 30). The pilot test indicated that the items were understood and no changes to the content of the items were necessary. Reliability analysis was calculated using Cronbach's alpha, and developed domains provided sufficient reliability (> 0.50) (Nunnally 1967) in the pilot test as well as in the present study.

Of the 12 theoretical domains (Michie et al. 2005), two domains, namely 'Behavioural Regulation' and 'Nature of the Behaviours' were excluded. As domain constructs of 'Behavioural Regulation' were included in the domain 'Environmental Context and Resources', and the domain 'Nature of the Behaviours' is more related to understanding the behaviour rather than influencing it, the potential effect of excluding these two domains is assumed to be either low or absent.

As mentioned in relation to the TUC counselling questionnaire, social desirability may have affected the results with the TDQ. For example, socially acceptable implementation difficulties, such as a lack of environmental support ('Environmental Context and Resources') or self-efficacy (Beliefs about Capabilities'), are more likely to be over-reported than, for example, motivation ('Motivation and Goals') (Sjöström and Holst 2002, Tourangeau and Yan 2007). This applies to all studies conducted earlier; consequently, the results of barriers to implementation in TUPAC counselling should be interpreted with caution. Reported barriers to implementation, namely environmental constraints, low success rate and lack of monetary incentives (Albert et al. 2005, Stacey et al. 2006, Trotter and Worcester 2003), may be less critical than previously thought. This is supported by the find-

ing in which determinants for TUC counselling were identified. Instead of environmental constraints and beliefs about capabilities, for example, domains 'Memory, Attention and Decision Processes' and 'Professional Role and Identity' were identified as more accurate predictors of TUC counselling.

6.3 Intervention effects

During the six-month trial, the effect of educational intervention on TUC counselling was statistically significant. Soon after the two-month point, however, the effect of a single educational event began to fade rapidly in both prevention and TUC counselling. Interestingly, the added financial incentive proved ineffective in boosting and maintaining the intervention effect. When analysing the results separately by professional groups, dental hygienists seemed to do better than dentists did regardless of how they were randomised. Additionally, both interventions proved more effective in increasing TUC counselling among dental hygienists than among dentists.

Applied to the BCW model by Michie et al. (2011), the present educational intervention included the following intervention components: 'Education' (increasing knowledge or understanding), 'Persuasion' (using communication to induce positive or negative feelings or stimulate action), 'Training' (imparting skills), 'Modelling' (providing an example for people to aspire to or to imitate), and 'Enablement' (increasing means of/reducing barriers to increasing one's capability or opportunity). Thus, the educational intervention included all three components suggested to be vital to behaviour change among health care professionals, namely the capability to implement the behaviour in question, the opportunity that makes that behaviour possible, and the motivation to engage in certain behaviour (Fishbein et al. 2001, Michie et al. 2011). Thus, one could suggest that different components of the educational intervention, namely 'Education', 'Persuasion', 'Training', 'Modelling', and 'Enablement', enhanced a wide range of factors that influence the behaviour of oral health professionals.

The relapse in provided TUPAC counselling may be due to the lack of sufficient support for maintaning the acquired behaviour change, as financial incentive showed no effect on incentivising the provision of TUPAC counselling. According to the Transtheoretical model of Behaviour Change (Prochaska and DiClemente 1982), behaviour change is a process involving progress from Precontemplation (not ready for behaviour change) to the Action and Maintenance stages (Prochaska et al. 1994). As most oral health professionals provided no TUC counselling at baseline, most study participants were presumably at the Precontemplation (not ready), Contemplation (getting ready) or Preparation (ready) stages of TUPAC counselling. Accordingly, exposure to educational intervention made some oral health profes-

sionals proceed to the Action stage. As progress from Action to the Maintenance stage takes at least six months (Prochaska et al. 1994), other approaches following continuing education that reinforce TUPAC counselling to the point of habit are needed. For example, interventions promoting professional role and identity as well as memory, attention and decision making could be effective.

The present study showed that monetary incentive or 'Incentivisation' (creating expectation of reward) had no additional effect on education. A recently published fissure-sealing trial among dentists found the opposite trial effect, as educational intervention had no statistically significant intervention effect, although financial compensation did (Clarkson et al. 2008). The explanation for these contrary results may stem from the different implementation difficulties and determinants for these two procedures. In their analysis of potential determinants for placing fissure sealants, two domains emerged: (1) behavioural habits and (2) beliefs about outcomes (Bonetti et al. 2010). One could suggest that the financial incentive in the fissure sealing trial increased dentists' outcome expectations and/or changed their habits regarding fissure-sealing and thus improved their fissure sealing activity. In the present study, however, financial incentive may have had no such effect on improving the identified determinants 'Professional Role and Identity' and 'Memory, Attention and Decision Processes'.

Regarding conditions for payment, financial incentives should focus on promoting outcomes (e.g. reducing tobacco prevalence) rather than on recording risk factors, for example, or health behaviours (e.g. tobacco use habits) (Langham et al 1995). As appointed targets are often difficult to assess (e.g. tobacco prevalence), measures that have successfully predicted outcomes, such as time used for TUC counselling, could be both feasible and facilitate the achievement of appointed targets for financial incentive. However, as time-based interventions do not necessarily assure the quality of the intervention provided, quality assurance using patient surveys, for example, may be needed.

The findings of previous studies support our finding that dental hygienists were more active in TUPAC counselling than were dentists (Brothwell and Gelskey 2008, Rosseel et al. 2009, Tremblay et al. 2009). As mentioned previously, this result may stem not only from different competencies in providing TUPAC counselling, but also from differing values and personal characteristics between dentists and dental hygienists. This may, at least, affect the professional role and identity of oral health professionals with regard to TUPAC counselling. Because it seems easier to get dental hygienists to provide TUPAC counselling, their expertise should be more effectively utilised.

6.3.1 Electronic dental record audit

Regarding data from electronic dental records, the results are likely an under- rather than an over-estimation, as the under-reporting and under-registering of treatments provided is more likely among oral health professionals than is over-reporting (Helminen et al. 2002, Osborn et al. 2000). In addition, because the results of the education + fee-for-service group were comparable to those of the education group, financial compensation presumably led to no over-reporting of TUPAC counselling.

6.4 Study setting

The present study was conducted in 34 community dental clinics in Tampere and Vaasa, Finland. The study took place in a natural community dental setting to permit an understanding of oral health professionals' perspectives of and behaviours regarding TUPAC counselling. Because of the study setting, the blinding of the intervention groups proved impossible. Dental clinics were therefore cluster-randomised so that all participants in each clinic fell into the same study group to limit potential contamination. However, contamination across control and intervention groups was naturally possible. One example of possible contamination was evident in preventative counselling where the control group enhanced their preventative counselling during the six-month trial period. However, no similar effect was observed in TUC counselling. The study setting should also be noted when interpreting the results, especially regarding environmental constraints. These results could not be generalised, as the clinical context varies across municipal health regions, health care sectors (private vs. public health), and across countries.

6.5 Representativeness of the study sample

The participants of the present study formed a representative sample of oral health professionals in community dental clinics in Finland. In addition, the sample of patients visiting the study clinics during the six-month trial period is well comparable to the patient characteristics of other community dental clinics in Finland (Saukkonen and Vuorio 2010). Even if gender was found to have no significant effect on any of the outcomes measured, it should be noted that most of the study participants (82.3%) were female. In larger study samples or other settings, this could potentially affect the results, as female dentists are reportedly more active in TUC counselling than their male colleagues (Brothwell and Gelskey 2008, Ebn Ahmady et al. 2011).

6.6 Ethical considerations

The study followed the Good Clinical Practice standards of the International Conference on Harmonisation (European Medicines Agency 2002). More specifically, the study was conducted in compliance with the study protocol approved by two independent ethics committee as well as the Research Permission Committee of the City of Tampere and the medical director of the Vaasa health centre. All participants were legally competent adult subjects who volunteered to participate and freely provided their informed consent prior to participation. All study information was recorded and stored on a secured hard drive maintained by the IT Services of the University of Helsinki where backup files were made daily. The data were entered and stored using identifiers. No identifying information was available to the investigators. In reporting the data, Consolidated Standards of Reporting Trials were followed (I, IV). After the trial, participants from the control group received educational intervention identical to that provided to the intervention groups.

7. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the present study, following conclusions and recommendations were made:

1. The developed TDQ proved reliable and valid in assessing factors influencing the provision of TUPAC counselling.

2. The provision of TUC counselling at baseline was low. Providing patients with advice to quit, assisting them in quitting and arranging follow-up services for them were less frequently implemented than were other TUC counselling behaviours.

3. Based on the developed TDQ, the results showed clear differences across theoretical domains. The following domains yielded the lowest mean scores and were thus identified as potential barriers to the implementation of TUPAC counselling: 'Environmental Context and Resources', 'Beliefs about Capabilities', and 'Skills'.

4. Two domains were identified as potential determinants for TUC counselling: 'Memory, Attention and Decision Processes' and 'Professional Role and Identity'.

5. Educational intervention seems to have at least short-term favourable impact on the provision of TUC counselling. Adding financial incentives, however, seems to have no such effect.

6. Undergraduate and continuing education in TUPAC counselling should be developed and provided in order to improve competencies as well as professional roles and decision making in TUPAC counselling.

7. Facilitating organisational adaptation to TUPAC counselling requirements by adjusting appointment durations and providing feedback and reminders of TUPAC counselling as well as increasing the availability of TUPAC counselling materials could facilitate the provision of TUPAC counselling.

8. The role of dental hygienists in TUPAC counselling should be better recognised and employed.

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9. APPENDICES

Appendix I. Self-evaluation questionnaire (translated).

SURVEY OF DENTAL STAFF

INSTRUCTIONS FOR RESPONDENTS

Please complete the following questionnaire by circling the appropriate number or by writing your answer in the field provided.

Please respond to all applicable questions. You should also record a negative response either by circling the "No" option or by writing "0" in the field provided.

Example 1. What is your position in the dental care team?

(1) Dentist
2 Dental hygienist
3 Dental nurse

Some questions relate to more than one topic. Please select the appropriate option for each item.

		Never		Occasionally		Always
Example 2.	I have sufficient leisure time.	1	2	3	(4)	5

Some questions include options followed by the words "Please proceed to question ..." You may then proceed directly to that question and ignore the questions in between.

Please return the questionnaire to the University of Helsinki in the postage-paid envelope provided.

Background information

1. Gender

1 Male
2 Female

2. Year of birth 19_____

3. Position in the dental care team

1 Dentist
2 Dental hygienist

4. How many years in total have you performed clinical work?

_____years

5. How many hours of patient work do you perform on average per week?

_____hours

6. Please circle the dental clinics in which you have worked during the past week.

1 In Tampere

1.i.	Ahvenisjärvi	1.xv.	Myllyvuori
1.ii.	Aleksanteri	1.xvi.	Nekala
1.iii.	Amuri	1.xvii.	Olkahinen
1.iv.	Atala	1.xviii.	Peltolammi
1.v.	Hatanpää	1.xix.	Pispa
1.vi.	Hervanta	1.xx.	Rahola
1.vii.	Kaukajärvi	1.xxi.	Rantaperkiö
1.viii.	Kissanmaa	1.xxii.	Suupoli
1.ix.	Koivisto	1.xxiii.	Takahuhti
1.x.	Koukkuniemi	1.xxiv.	Tammela
1.xi.	Lamminpää	1.xxv.	Teisko
1.xii.	Lielahti	1.xxvi.	Tesomajärvi
1.xiii.	Linnainmaa	1.xxvii.	Tesoma
1.xiv.	Messukylä	1.xxviii.	Tullinkulma
1.xv.	Myllyvuori	1.xxix.	Vehmainen
1.xvi.	Nekala		

2 In Vaasa, Laihia, Vähäkyrö

2.i.	Gerby	2.vi.	Pääterveysasema
2.ii.	Hietalahti	2.vii.	Ristinummi
2.iii.	Huutoniemi	2.viii.	Laihia
2.iv.	Kirkkopuistikko	2.ix.	Vähäkyrö
2.v.	Malmöntalo		

Tobacco use and products

7. **Have you ever used tobacco (cigarettes, cigars, pipes or snuff)?**
   1 No (Please proceed to question 11)
   2 Yes (Please proceed to the next question)

8. **Have you used tobacco** (cigarettes, cigars, pipes or snuff) **at least 100 times?**
   1 No (Please proceed to question 11)
   2 Yes (Please proceed to the next question.)

9. **Have you ever used tobacco daily for at least one year? How many years in total?**
   1 I have never used tobacco daily.
   2 Yes, _____years

10. **When did you last use tobacco?** (If you use tobacco continuously, please select option 1.)
    1 Yesterday or today
    2 Two days to one month ago
    3 One month to six months ago
    4 Six months to one year ago
    5 More than one year ago

Education

	No	Yes
11. **Did your basic education include training in how to support patients in tobacco abstinence?**	1	2
12. **Did your basic education include training in how to support patients in tobacco cessation?**	1	2
13. **Since graduation, have you received training in how to support patients in tobacco abstinence?**	1	2
14. **Since graduation, have you received training in how to support patients in tobacco cessation?**	1	2

To what extent do you agree with the following statements?

1 = Fully disagree, 5 = Fully agree

15. I understand the health risks associated with tobacco use.	1	2	3	4	5
16. I'm unaware of the meanings and objectives of the six *A*s in the Current Care guidelines on tobacco dependence treatment (Ask, Assess, Account, Advise, Assist, Arrange).	1	2	3	4	5
17. I have sufficient therapeutic knowledge of the pharmaceutical products for tobacco cessation.	1	2	3	4	5
18. I don't know how to promote a tobacco-free lifestyle among youth.	1	2	3	4	5
19. I know the appropriate questions to ask patients when providing tobacco use cessation counselling.	1	2	3	4	5
20. I have the skills to monitor and assist patients throughout their quit attempt.	1	2	3	4	5
21. I know how to prescribe pharmaceutical products for those ready to quit.	1	2	3	4	5
22. My role does not involve assisting patients to stop tobacco use.	1	2	3	4	5
23. Most patients want to receive tobacco use cessation counselling.	1	2	3	4	5
24. Most of my colleagues in this clinic believe that promoting tobacco abstinence is an important part of their professional identity.	1	2	3	4	5
25. I am confident in my abilities to prevent patients from using tobacco products.	1	2	3	4	5
26. I am unsure how to assess patients in their efforts to stop tobacco use.	1	2	3	4	5
27. I am able to make decisions about the risks/benefits of the appropriate use of nicotine replacement therapy.	1	2	3	4	5
28. My counselling will increase a patients' likelihood of quitting.	1	2	3	4	5
29. I receive insufficient reimbursement for promoting tobacco abstinence.	1	2	3	4	5
30. Counselling for cessation is not an efficient use of my time.	1	2	3	4	5
31. Patients appreciate it when I promote tobacco abstinence.	1	2	3	4	5
32. I am unwilling to work on improving my provision of tobacco cessation services.	1	2	3	4	5
33. The importance of patient health helps me to overcome barriers such as lack of time and reimbursement in promoting a tobacco-free lifestyle.	1	2	3	4	5
34. Our dental clinic has a system to cue/prompt providers to counsel against tobacco use.	1	2	3	4	5
35. Deciding whether to promote tobacco abstinence is sometimes difficult.	1	2	3	4	5

1 = Fully disagree, 5 = Fully agree

36. Reinforcing tobacco abstinence is easy for me to remember.	1	2	3	4	5
37. I have insufficient time to promote tobacco abstinence.	1	2	3	4	5
38. Sufficient opportunities are available to learn about promoting a tobacco-free lifestyle.	1	2	3	4	5
39. My dental clinic has no tobacco-related self-help materials/pamphlets to distribute to patients.	1	2	3	4	5
40. Our dental clinic has a system to provide follow-up support between clinic visits.	1	2	3	4	5
41. Our clinic management has taken actions to remove barriers to the provision of tobacco use counselling.	1	2	3	4	5
42. Most patients do not want to receive tobacco counselling.	1	2	3	4	5
43. There is at least one respected individual in our dental clinic who is personally committed to leading our efforts to improve our provision of tobacco cessation services.	1	2	3	4	5
44. Helping with tobacco cessation makes me feel useful to patients.	1	2	3	4	5
45. I find counselling patients about tobacco to be frustrating.	1	2	3	4	5
46. Burn-out prevents me from providing more tobacco use cessation counselling.	1	2	3	4	5
47. In the dental clinic where I work, I receive no feedback from promoting tobacco abstinence.	1	2	3	4	5
48. My dental clinic provides insufficient reimbursement for promoting tobacco abstinence.	1	2	3	4	5
49. The patients we see in our clinic/department have so many other problems in their lives that stopping tobacco use is a very low priority for them.	1	2	3	4	5
50. Our clinic/department generally supports improving the way in which we promote a tobacco-free lifestyle.	1	2	3	4	5

Implementation

51. Do you ever ask your patients about tobacco use?
1 No (Please proceed to question 70.)
2 Yes (Please proceed to the next question.)

	0-25 %	26-50 %	51-75 %	76-100 %
52. What percentage of your new or recall patients do you ask about tobacco use?	1	2	3	4

What percentage of your tobacco-free patients (non-users and former users) do you conduct the following?

	0-25%	26-50%	51-75%	76-100%
53. Reinforce commitment to be tobacco-free.	1	2	3	4
54. Remind them why remaining tobacco-free is good especially for oral health.	1	2	3	4

What percentage of your tobacco using patients (occasional and daily users) do you conduct the following?

	0-25%	26-50%	51-75%	76-100%
55. Assess tobacco use history and status.	1	2	3	4
56. Assess nicotine dependency (e.g. "When do you take your first cigarette of the day", or "Is it difficult to not smoke when you are in a place where smoking is not allowed?")	1	2	3	4
57. Assess reasons for quitting.	1	2	3	4
58. Assess interest in changing tobacco use behaviours.	1	2	3	4
59. Give clear, strong, personalized advice to quit.	1	2	3	4
60. Assist those who are not interested in quitting to think about quitting.	1	2	3	4
61. Assist those who are interested in quitting to develop a plan to quit or taper.	1	2	3	4
62. Assist to develop strategies to prevent or manage relapse.	1	2	3	4
63. Discuss tobacco status at each follow-up visit.	1	2	3	4
64. Provide educational materials related to tobacco cessation.	1	2	3	4
65. Prescribe or recommend the purchase of nicotine replacement therapy products for patients attempting to quit.	1	2	3	4
66. Prescribe bupropion (Zyban) to those ready to quit.	1	2	3	4
67. Provide treatment maintenance and follow-up services to those who have quit.	1	2	3	4
68. Document tobacco-relevant discussion and plans in dental record.	1	2	3	4

69. How much time do you use for an average counselling of patients about tobacco use?

(e.g. 1 minute = 60 seconds, 2 minutes = 120 seconds, 3 minutes = 180 seconds, 4 minutes = 240 seconds)

_____seconds