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Economics of Tobacco Control Paper No. 5

Cost-Effectiveness of Treatment for Tobacco Dependence

A Systematic Review of the Evidence

Sandy Ronckers and Andre Ament

February 2003

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COST-EFFECTIVENESS OF TREATMENT FOR TOBACCO DEPENDENCE:

A systematic review of the evidence

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Health, Nutrition and Population (HNP) Discussion Paper

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ECONOMICS OF TOBACCO CONTROL PAPER NO. 5

Cost effectiveness of Treatment for Tobacco Dependence: *A systematic review of the evidence*

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Paper prepared for the Mediterranean regional conference on the Health and Economics of Tobacco Control, hosted by the Government of Malta, and organized by the Tobacco Free Initiative of the World Health Organization, in partnership with the World Bank
Malta, September 2002

Abstract: Good decisions on which health interventions to invest can be facilitated by high quality evaluations of the cost-effectiveness of interventions. Although there are several reviews of evaluations of the cost-effectiveness of smoking cessation programs, the reviews have had little to say about the quality of the studies. The present study tries to fill this gap by thoroughly evaluating the quality of economic evaluations of interventions to reduce tobacco consumption. First, the general characteristics of all the studies reviewed are described, and then the quality of epidemiological characteristics and of the economic evaluation is analyzed, using a criteria list proposed by Drummond et al. (1997). The analysis finds that the quality of many aspects of many of the studies leaves much to be desired, judged against the guidelines offered by Drummond et al. However, the studies do consistently conclude that stop-smoking interventions are cost-effective, and this conclusion is robust when sensitivity analyses are performed. The cost-effectiveness ratios estimated by the studies for smoking cessation interventions are much lower than most other health care treatments. The study this concludes that the broad conclusion that treatments to reduce the number of smokers are cost-effective at least in relative terms, is likely to be true, despite the concerns expressed about the quality of the economic evaluations. The implication for policymakers is that smoking cessation interventions are worthwhile.

Keywords: tobacco, tobacco use, smoking, nicotine dependence, treatment, cessation, economic evaluation, cost, cost-effectiveness, stop smoking, smoking cessation, cessation interventions, cessation programs, nicotine replacement therapy, cessation counseling, cessation campaigns, physician advice, quitters

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PREFACE

In 1999, the World Bank published "Curbing the Epidemic: governments and the economics of tobacco control", which summarizes the trends in global tobacco use and the resulting immense and growing burden of disease and premature death. By 1999, there were already 4 million deaths from tobacco each year, and this huge number is projected to grow to 10 million per year by 2030, given present trends in tobacco consumption. Already about half of these deaths are in high-income countries, but recent and continued increases in tobacco use in the developing world is causing the tobacco-related burden to shift increasingly to low- and middle-income countries. By 2030, seven of every ten tobacco-attributable deaths will be in developing countries. "Curbing the Epidemic" also summarizes the evidence on the set of policies and interventions that have proved to be effective and cost-effective in reducing tobacco use, in countries around the world.

Tax increases that raise the price of tobacco products are the most powerful policy tool to reduce tobacco use, and the single most cost-effective intervention. They are also the most effective intervention to persuade young people to quit or not to start smoking. This is because young people, like others with low incomes, tend to be highly sensitive to price increases.

Why are these proven cost effective tobacco control measures –especially tax increases– not adopted or implemented more strongly by governments? Many governments hesitate to act decisively to reduce tobacco use, because they fear that tax increases and other tobacco control measures might harm the economy, by reducing the economic benefits their country gains from growing, processing, manufacturing, exporting and taxing tobacco. The argument that "tobacco contributes revenues, jobs and incomes" is a formidable barrier to tobacco control in many countries. Are these fears supported by the facts?

In fact, these fears turn out to be largely unfounded, when the data and evidence on the economics of tobacco and tobacco control are examined. The team of about 30 internationally recognized experts in economics, epidemiology and other relevant disciplines who contributed to the analysis presented in "Curbing the Epidemic" reviewed a large body of existing evidence, and concluded strongly that in most countries, tobacco control would not lead to a net loss of jobs and could, in many circumstances actually generate new jobs. Tax increases would increase (not decrease) total tax revenues, even if cigarette smuggling increased to some extent. Furthermore, the evidence show that cigarette smuggling is caused at least as much by general corruption as by high tobacco product tax and price differentials, and the team recommended strongly that governments not forego the benefits of tobacco tax increases because they feared the possible impact on smuggling, but rather act to deter, detect and punish smuggling.

Much of the evidence presented and summarized in "Curbing the Epidemic" was from high income countries. But the main battleground against tobacco use is now in low- and middle-incomes countries. If needless disease and millions of premature deaths are to be prevented, then it is crucial that developing counties raise tobacco taxes, introduce comprehensive bans on all advertising and promotion of tobacco products, ban smoking in public places, inform their citizens well about the harm that tobacco causes and the benefits of quitting, and provide advice and support to help people who smoke and chew tobacco, to quit.

In talking to policy-makers in developing countries, it became clear that there was a great need for country-specific analytic work, to provide a basis for policy making, within a sound economic framework. So the World Bank and the Tobacco Free Initiative of the World Health

Organization (as well as some of the WHO regional offices and several other organizations, acting in partnership or independently) began to commission and support analysis of the economics of tobacco and tobacco control in many countries around the world.

The report presented in this Economic of Tobacco Discussion Paper makes a valuable contribution to our understanding of the issues and likely economic impact of tobacco control in a specific country-setting. Our hope is that the information, analysis and recommendations will prove helpful to policy makers, and help result in stronger policies to reduce the unnecessary harm caused by tobacco use.

Joy de Beyer

Tobacco Control Coordinator
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COST-EFFECTIVENESS OF TREATMENT FOR TOBACCO-DEPENDENCE:

A SYSTEMATIC REVIEW OF THE EVIDENCE

INTRODUCTION

Smoking is one of the biggest health threats facing society today. At present trends, an estimated 500 million of the five billion people alive in 2000 will die as a result of tobacco consumption[1]. Reducing tobacco consumption has enormous potential to improve public health.

During the last two decades, there has been much progress in identifying effective interventions in many areas of health care, including in reducing tobacco use. There are now a variety of proven, effective interventions and treatments to reduce tobacco use including, but not limited to, smoking cessation interventions[2,3].

Limited health care budgets mean that choices have to be made about which interventions to implement. Good decisions are facilitated by information about the cost-effectiveness of interventions. This information comes from careful economic evaluations. A number of cost-effectiveness studies have been carried out in the field of treatments for tobacco dependence, and there are several reviews of the results[4-7]. Authors of these reviews conclude that interventions to help people stop smoking are cost-effective. However, although the quality of studies is of paramount importance in reaching reliable conclusions[8], thorough evaluations of the quality of the individual studies reviewed were not carried out. The main objective of the reviews was to identify the principal findings of the studies evaluated. Sensitivity analysis was used to decide on the reliability of the cost-effectiveness estimates of the interventions. Brown and Garber (1998, 2000) tried to increase the reliability of their conclusions by limiting the studies reviewed to those that (1) presented outcomes in terms of years of life saved, (2) performed the analysis from a societal perspective, (3) discounted costs and effects in a consistent way, and (4) gave a description of the age and gender of the study population[4,5]. Although their main goal was to review a large and diverse set of different interventions and populations, many of the studies did not meet their inclusion criteria. This short overview of existing reviews concludes that the quality of studies on the cost-effectiveness of smoking cessation interventions has not been of primary concern up to now.

Careful evaluation in other fields of health care, however, indicates that many studies are not of sufficient quality[9]. Because an accurate evaluation on quality has not yet been performed in the field of smoking cessation, a knowledge gap exists on this subject. The present study tries to fill this gap by thoroughly evaluating the quality of economic evaluations of interventions to reduce tobacco consumption. First, the general characteristics of all the studies reviewed are described, and then the quality of epidemiological characteristics and of the economic evaluation is analyzed, using a criteria list proposed by Drummond et al. (1997)[8]. The results of the analysis, both from a scientific perspective and the perspective of practical information, are discussed in the last section of this paper.

METHODS

Literature Search

An extensive literature search was performed from 1966 to 2000, using the following databases: Medline, Embase, Dare, NHS EED, HTA, Cochrane, Psychlit, and EconLit. The ISTAHC journal was searched also.
Databases which included a thesaurus function were searched as follows:

- (costs and cost analysis) and smoking cessation
- Cost and smoking cessation

Data bases without a thesaurus function were searched using the following key words:

- (cost* or economic*) in title or abstract and (smoking and cessation) in title or abstract

(cost* or economic*) and smok*

- (cost* in title or economic* in title) and smok* in title
- The ISTAHC journal was searched with the following terms:
- economic in title
- smoking in title
- costs in title
- cost in title
- cost effectiveness in title
- cost-effectiveness in title

Additional literature was identified using citation tracking. Only English-language articles were included. Letters, editorials, and reviews were excluded from our review.

Assessing the quality of the studies

The quality of individual studies was assessed using the guidelines for economic evaluation proposed by Drummond et al. (1997). These guidelines incorporate the following aspects: general, measurement of effect, measurement of costs, and issues like discounting and sensitivity analysis. All interventions mentioned in the studies are reviewed for all aspects covered in the guidelines.

The study of Parrott et al. (1998)[7] is treated slightly differently than the others. This study includes cost-effectiveness analysis of a number of interventions. However, because the community interventions and related cost-effectiveness analyses were not clearly described, they are excluded from the present review.

RESULTS

After excluding letters, editorials, and reviews, 22 full economic evaluations were identified. All were cost-effectiveness studies. Cost-effectiveness was defined in 14 studies as costs per life year saved[7,10-23]. One study also included cost utility in its outcome and presented costs per quality adjusted life year[23.] The remaining seven studies defined cost-effectiveness in terms of costs per quitter[24-30]. Twelve of the identified studies were carried out in the United States[11,12,14-16,20,22-25,27,29 30.] Six studies were performed in the United Kingdom[7,10,13,18,19,21]. The three remaining studies were done in the Netherlands[28], Finland[26], and Spain[17].

General Characteristics

The general characteristics of the studies do not necessarily influence their quality, but definitely affect the way in which the results can be interpreted. Important general characteristics are described in the following sections and summarized in Table 1. Attention is paid to the viewpoint of the analysis, the interventions performed and alternative interventions, and to the study population.

Viewpoint of the Analysis

Studies can be performed from different points of view, and these differences greatly affect the interpretation of conclusions. Therefore, a study's viewpoint should be mentioned explicitly in economic evaluation studies. This, however, is the case in only 11 of the 22 studies[7,12,13,15,17,20,21,23,27 28,30].

Drummond et al.'s economic guidelines recommend that economic evaluations take a societal perspective to prevent decisions being based solely on costs and effects for a specific organization or population. But only four of the studies explicitly mention having performed cost-effectiveness analysis from a societal perspective[7, 12,17,28]. An organizational perspective[15,20,28,30] is also used, as well as the perspective of the National Health Service[13,21], the medical payer[28], the health authority[7], and the participants[28].

Interventions Performed

Literature on the cost-effectiveness of smoking cessation covers a wide range of interventions (Table 1). Interventions include self-help programs[7,24,25 28-30], counselling[7,12,14,15,17,18,25,28], quit-smoking contests[7,24,26], use of nicotine replacement therapy[7, 10,16,17,21-23], community health education programs[7,13,19,20], counseling combined with behavioral therapy[27], and other combinations of interventions. Interventions are compared with placebo therapy[10,16,21,27], counseling[7,14,23], physicians' advice[17,18,22], a school education program[19], and usual care[7,11-15,19,24-26,28-30]. The most frequent comparison is between counseling and usual care. Three studies compare self-help and usual care. Unfortunately, the studied interventions and alternative interventions to which they are compared are too heterogeneous to allow cost-effectiveness ratios of different studies to be compared.

Study population

Not only do the studies compare a wide variety of interventions, the study populations differ in characteristics as well. For example, some interventions were available for all smokers[7,11-13,15,17-20,24-31], while in other studies interventions were provided to heavy smokers only[10,21,22]. Furthermore, in contrast to studies encouraging healthy people to stop smoking, some studies were designed to promote non-smoking among patient populations[14,15,18,20]

Table 1: General characteristics of cost-effectiveness studies performed in the field of smoking cessation

first author	Main outcome measure	country	perspective	intervention	alternative intervention	study population	results ($)
Altman, 1987 [25]	costs per quitter	US	not stated	counselling	usual care	all smokers	235 - 399
				self help			22 - 144
				contest			129 - 236
Bertera, 1990 [26]	costs per quitter	US	not stated	counselling	usual care	all smokers	150
				self help			150
Korhonen, 1992 [27]	costs per quitter	Finland	not stated	contest, tv	usual care	all smokers	24
Miller, 1996 [28]	costs per quitter	US	not stated	NRT,behavioural therapy	placebo	all smokers	567 - 1699
Mudde, 1996 [29]	costs per quitter	Netherlands	society	counselling , self help	usual care	all smokers	648 - 1297
			organisation	counselling			200 - 411
				self help			37 - 66
			participants	counselling			686 - 1412
				self help			89 - 160
Nelson, 1989 [30]	costs per quitter	US	not stated	self-help	usual care	all smokers	90 - 352
Windsor, 1988 [31]	costs per quitter	US	organisation	counselling, self-help	usual care	pregnant women	51 - 118
Parrott, 1998 [7]	costs per yols	UK	society	brief advice	usual care	all UK smokers	300
				brief advice + self help	brief advice	all UK smokers	567
				brief advice + self help + NRT	brief advice + self help	all UK smokers	5950
				brief advice + self help + NRT + specialist help	brief advice + self help + NRT	all UK smokers	1515
			health authority	brief advice	usual care	all UK smokers	247
				brief advice + self help	brief advice	all UK smokers	513
				brief advice + self help + NRT	brief advice + self help	all UK smokers	
				brief advice + self help + NRT + specialist help	brief advice + self help + NRT	all UK smokers	171
Akehurst, 1994 [11]	costs per yols	UK	not stated	counselling	placebo	heavy smokers (h)**	1430
Croghan, 1997 [12]	costs per yols	US	not stated	variety of interventions	usual care	all smokers	1094 - 6828
Cummings, 1989 [13]	costs per yols	US	society	counselling	usual care	all smokers (h)	705 - 2058
Haycox, 1994 [14]	costs per yols	UK	NHS	community health education	usual care	all smokers (h)	-427 - -570

Table 1- continued

first author	Main outcome measure	country	perspective	intervention	alternative intervention	study population	results ($)
Krumholz, 1993 [15]	costs per yols	US	not stated	counselling	usual care	MI-survivors	80 - 19000
Meenan, 1998 [16]	costs per yols	US	organisation	counselling	usual care	hospital patients	1691 - 7444
Oster, 1986 [17]	costs per yols	US	not stated	NRT*	placebo	all smokers (h)	4113 - 9473
Plans-Rubio, 1998 [18]	costs per yols	Spain	society	NRT	medical advice	all smokers (h)	2608 - 8058
Prathiba, 1998 [19]	costs per yols	UK	not stated	counselling	medical advice	hospital patients	480 - 600
Ratcliffe, 1997 [20]	costs per yols	UK	not stated	community health education	usual care	all smokers	431 - 930
Secker-Walker, 1997 [21]	costs per yols	US	organisation	community health education	school program	children	445 - 1269
Stapleton, 1999 [22]	costs per yols	UK	NHS	counselling, NRT	placebo	heavy smokers	407 - 733
Wasley, 1997 [23]	costs per yols	US	not stated	NRT	counselling	heavy smokers (h)	965 - 4391
Fiscella, 1996 [24]	costs per qaly	US	medical payer	counselling, NRT	counselling	all smokers (h)	4390 - 10943

* NRT = Nicotine Replacement Therapy ** (h) = hypothetical cohort

The age and sex distribution of the study population is also relevant to determining whether the results of a specific study can be generalized. Eleven studies explicitly mentioned the age and sex distribution of the population receiving the intervention[12,16,17,19,20,22-25,27,28]. Five of these studies calculated age- and sex-specific cost-effectiveness ratios[12,16,17,22,23], while the other six studies simply reported age and sex characteristics of the population. The mean age of the population in these studies varied from 38 to 48 years of age. The percentage of male participants ranged from 0 percent in a self-help group for pregnant women to 73 percent in a combined intervention using nicotine replacement therapy and behavioral therapy performed among people on active military duty.

Eleven studies did not explicitly mention the age and sex distribution of the sample[7,10,11,13-15,18,21,26,29,20]. It might be possible, with additional work, to track down the age and sex distribution of the study population of five of these studies[7,10,13,14,15]. Three of these studies are cost-effectiveness analyses of previously performed effectiveness analysis[10,14,15]. The population for the study performed by Haycox (1994) consisted of the entire population of the southwest of England[13]. Parrot et al. (1998) estimated cost-effectiveness of the entire population of the United Kingdom[7].

Effectiveness of programs

There are two relevant questions concerning the effectiveness of programs. The first question concerns the way in which consequences are identified and measured. The second question is whether effectiveness was established before or during the period of economic evaluation. Economic evaluation is useful only when effectiveness has been proved. These aspects of effectiveness are addressed below.

Identification and measurement of consequences

Consequences can be divided into short-term consequences and long-term consequences. Long-term health effects are preferred to short-term (short lived) consequences because the aim of preventive interventions is to improve health during future life years. Long-term health effects can be expressed either in life years saved or in quality adjusted life years.

Identifying consequences in terms of quality adjusted life years is the preferred option. It includes long-term effects and takes into account aspects of quality of life. Changes in quality of life are difficult to measure for two reasons. First no consensus exists about methods of measuring quality of life. Second, quality of life changes take place in the future, making measuring them problematic. Because of these difficulties, only one study explicitly attempted to use quality adjusted life years as a measure of effect[23].

The next best measure of effect is life years saved. Using information about prevalence of smoking-related deaths and modelling techniques, an estimate of the years of life saved can be made based on the number of quitters. If costs per years of life saved are available, policymakers have the opportunity to compare non-smoking interventions not only with each other, but also with other health care interventions, with respect to their life-saving effects. Fifteen studies used years of life saved as the outcome measure[7,10-23].

The least favorable outcome measure from an economic perspective is the number of quitters, because of its short-term scope. This measure of effect in itself provides no information about changes in health, and studies using costs per quitter as the outcome measure cannot be

compared to anything other than other smoking cessation interventions. Yet, seven studies provide effects only in terms of number of quitters[24-30].

In short, the majority of economic evaluations reviewed are cost-effectiveness studies. Several studies reported outcomes in terms of the less preferred costs per number of quitters, and only one study used the most preferred outcome measure, namely cost utility.

Was effectiveness established?

When performing a cost-effectiveness analysis, it is important that reliable estimates are made of effectiveness. As mentioned in the previous section, a large number of studies calculated effects in terms of life years saved. To estimate long-term effects, modelling techniques are used. No tools are available to check the quality or validity of models that are used to extrapolate from the number of quitters to years of life saved. For this reason, the quality of the models will not be discussed. When reviewing studies on effectiveness, the analysis is restricted to establishing effectiveness of non-smoking programs in terms of number of quitters.

Attention is paid to the source of the information about the effectiveness (empirical data, secondary data), to the kind of effectiveness evaluation performed (randomized or observational), to the study period, and to the way relapse and unaided cessation are dealt with. Table 2 summarizes these results.

Thirteen studies empirically established the effectiveness of non-smoking interventions[11,15,18-21,24-30]. In other studies effectiveness estimates were based on secondary literature[7,10,12-14,16,17,22,23]. Most of the studies using secondary data performed a review of studies closely related to the intervention under study[7,12,16,22,23]. Two studies based effectiveness data on one study only[10,14]. One study did not clearly explain the source of the effectiveness information[13].

Most studies used observational designs to establish effectiveness[11,14,17-20,24-29]. Effectiveness was based on randomized controlled trials in six cases only[10,12,15,16,21, 31]. In four articles, the design used is not clear or both designs are used[7,13,22,23].

Other important features to take into account when interpreting effectiveness data are study period and relapse. Relapse is common among smokers attempting to quit. Follow-up should thus be long enough to be able to exclude excessive relapse. When the follow-up period is relatively short (less than 12 months), data will be more reliable when corrected for future relapse.

All but one study defining cost-effectiveness as costs per year of life saved had a follow-up period of at least one year[7,11,12,14-19,21-23]. Haycox (1994) was not clear about study duration[13].

Among the studies using number of quitters as final outcome, only one reported a study duration of 12 months[25]. Six- or nine-month follow-up of patients was used in the studies of Korhonen et al. (1992), Miller et al. (1996), Mudde et al. (1996), and Windsor et al. (1988)[26-28,30]. Two studies assessed smoking status one to three months after the program had ended[24,29]. Only one of the studies defining cost-effectiveness as costs per quitter examined effects of relapse in the sensitivity analysis[24].

In summary, this means that there were only five published cost-effectiveness studies that performed a randomized controlled trial and that also took account of relapse[10,12,15,16,21].

Table 2: Characteristics of sources of effectiveness data

first author	source effect-data	design effect-study	study period (in months)	taken account of relapse
Altman, 1987	empirical	observational	<3	yes (sens)
Bertera, 1990	empirical	observational	18	n.v.t.
Korhonen, 1992	empirical	observational	6	no
Miller, 1996	empirical	observational	6	no
Mudde, 1996	empirical	observational	6	no
Nelson, 1989	empirical	observational	<3	no
Windsor, 1988	empirical	RCT	9	no
Akehurst, 1994	secondary, 1 study	RCT	12	yes (sens)
Croghan, 1997	empirical	observational	12	yes
Cummings, 1989	secondary, review	RCT	>12	yes
Haycox, 1994	?	?	?	no
Krumholz, 1993	empirical	observational	12	n.v.t.
Meenan, 1998	empirical	RCT	12	n.v.t.
Oster, 1986	secondary, review	RCT	>12	yes
Plans-Rubio, 1998	empirical	?	12	n.v.t.
Prathiba, 1998	empirical	observational	12	n.v.t.
Ratcliffe, 1997	empirical	observational	12	n.v.t.
Secker-Walker, 199	empirical	observational	12	n.v.t.
Stapleton, 1999	secondary, review	RCT	12	yes
Wasley, 1997	secondary, 1 study	?	12	yes
Fiscella, 1996	secondary, review	?	12	yes

Economic Quality of Studies

When performing cost analysis, health care costs as well as non–health care costs (both direct and indirect) might be of interest. Direct health care costs include costs for prevention, diagnosis, therapy, and care related to the disease or risk factor of interest. Overhead costs, such as equipment, space, and telephone, are part of direct health care costs. Indirect health care costs include general medical costs that are generated during the life years gained by smoking cessation[32].

The most important direct cost outside the health care sector is the value of the time of the patients and their families. Indirect non–health care costs mainly consist of the costs associated with loss of work due to sick leave and lower productivity costs[32].

There are several ways in which costs can be identified, measured and valued. Drummond et al. (1997) offer recommendations for handling all three stages (i.e., identification, measurement, and valuation) to assure the quality of economic evaluation. Their advice is described below. It

should be noted, however, when trying to make judgments about the quality of the economic evaluation, that these three aspects are closely related.

Identification of Costs

As mentioned before, according to the guidelines of Drummond et al. (1997), for a study to be internally valid, costs included in the analysis have to be in concordance with the viewpoint of the analysis that the study uses[8]. Intervention costs, changes in health care costs due to changes in smoking related disease, changes in costs due to changes in lifetime health care costs, costs due to productivity changes, and participants' costs can be regarded as relevant cost components, depending on the perspective.

Economic evaluations are performed to facilitate future decision-making. Therefore, economic evaluations should exclude costs that are irrelevant for future performance. For intervention costs, this means that costs of intervention development should not be included in the cost analysis. The same is true for research costs. Implementation costs might arise in future, but only once. It is therefore preferable not to incorporate these costs into the cost-effectiveness analysis; they offer more useful information when mentioned separately.

When estimating intervention costs, it is also important to consider contributions from third parties. The total costs of the intervention should be reported, independent of the way the costs are financed.

When calculating intervention costs, the important costs to consider are performance and overhead (e.g., electric power, cleaning, and administration). Overhead costs can be identified either explicitly or implicitly. Costs can be estimated using an input-oriented approach, which means that all cost components are identified separately. Summing up the cost components of the intervention that are identified provides an estimate of the total intervention costs. A number of studies, especially those evaluating counseling or nicotine replacement therapy, made use of service units instead of an input-oriented approach. Service units are aggregated cost units, such as hospital visits or visits to a general practitioner. Although not explicitly mentioned, these costs include overhead costs.

The question of whether cost identification is done in concordance with the perspective mentioned in the study is discussed below. When there is no perspective mentioned in the study, a description of the identified cost categories is given.

Societal Perspective

The studies performed by Mudde et al. (1996), Cummings et al. (1989), Plans-Rubio (1998) and Parrot et al. (1998) were the only studies that explicitly mentioned that they were performed from the preferred societal perspective[7,12,17,28]. However, careful evaluation showed that none of the studies included all cost categories relevant for a societal perspective. Mudde et al. (1996) failed to include decreases in health care costs for smoking-related diseases due to the intervention[28]. Also not mentioned in the study were health care costs during additional life years, and declines in productivity losses due to lower absences from work of ex-smokers. In addition, intervention costs were not measured in an adequate way, as they contained development costs and implementation costs. The other studies mentioning a societal perspective did not perform the analysis completely from a societal view either. In the study by Plans-Rubio (1998), only the direct health care costs were assessed[17]. Cummings et al. (1989) faultlessly identified program costs, and further identified future health care costs related to smoking and

health care costs during additional years of life[12]. Productivity changes were excluded. Parrot et al. (1998) identified program costs and patient costs correctly, but did not include future health care costs and productivity changes[7].

Perspective of the Organization

When the analysis is performed from the perspective of the organization, program costs should be assessed. All five studies performing the study from an organizational perspective included program costs only[15,20,27,28,30]. However program costs were not defined correctly. Development and implementation costs were included in intervention costs in one study[28]. Another study incorporated development and research costs into the analysis, while ignoring overhead costs[20]. The other three studies that performed cost-effectiveness analysis from the perspective of the organization did not take account of overhead costs[15,27,30].

When the organization is a medical one, which is the case in the study by Meenan et al. (1998), future medical costs related to the organization should have been measured also[15].

Perspective of the National Health Service

Some studies have been performed from the viewpoint of the National Health Service (NHS). Direct and indirect health care costs are relevant costs to consider. One study considered both cost aspects[13]. Unfortunately, overhead costs were not incorporated into the analysis. The other study reported program costs only[21].

Perspective of the Medical Payer

The perspective of the medical payer was used by one study. In line with the perspective used, non-medical costs were not included[23]. Consistent with the above-mentioned aim of economic evaluations, intervention costs were taken to include performance costs and overhead costs only.

Perspective of the Health Authority

Parrot et al. (1998) used the perspective of a health authority. Only program costs were included, and these were correctly identified.

Perspective of the Program Participants

One study calculated cost-effectiveness from the viewpoint of the participants[28]. In this study, telephone costs for participants were identified, as were charges for the program, time required for participants, transportation costs, and savings arising from not smoking or reduced smoking. These costs appear to cover fully the costs incurred by the program consumers.

Perspective Not Mentioned

Seven of the 11 studies that did not explicitly report the study perspective identified intervention costs only[11,18,19,22,25,26,29]. Three of these studies included relevant components of intervention costs, and excluded irrelevant components[11,18,22.] Calculation of intervention costs in the other four studies was unsatisfactory. Altman et al. (1987) identified program costs and patient costs[24]. Program costs were not appropriate to the decision-making process: research costs and implementation costs were included in the analysis. Akehurst and Piercy (1994) rightly identified intervention costs, and they also used smoking-related disease costs in their analysis[10]. Intervention costs (unfortunately lacking overhead costs) and changes in costs due to changes in lifetime health care costs were identified by Krumholz et al. (1993)[14]. Finally, Oster et al. (1988) used adequate program costs in the analysis together with future smoking-related and non-smoking-related disease costs[16].

In short, when focusing on the internal validity of cost estimation, it is observed that costs included are more likely to be consistent with the perspective used when a narrower perspective is adopted. However, intervention costs often did not include the recommended cost components. Therefore, it can be concluded that there is only one study[23] that identifies costs according to the perspective adopted, and that identifies intervention costs in an accurate way.

Measurement and Valuation of Costs

In the reviewed studies there was a tendency to make use of service units (eg provider visits) when possible. An input-oriented approach was used more often when interventions were complex or could not be defined as services.

Counseling and nicotine replacement therapy are interventions that can easily be defined in terms of multidimensional units. As a result, they were often identified, measured, and valued this way in the studies. Nicotine replacement therapy was measured in terms of doses and duration of nicotine replacement intervention[7,11,16,17,21-23]. Valuation was based on retail prices in four cases[7,16,17,22,23]. Stapleton (1999) valued costs of nicotine patches in terms of manufacturers' wholesale prices[21].

Physician counselling was often measured in number of minutes of physician time needed, and valuation was based on charges for physician visits[10,12,17,21,23]. When counseling was not provided by physicians, but by nurses or other qualified persons, input data were used to estimate costs[14,18,25,30]. The amount of time input was registered and valuation was based either on actual wages[18,25] or on an estimation of the average wage rate[14,30]. Although counseling was assumed to be provided by general practitioners, Parrot et al. (1998) used the method of cost measurement and cost valuation described above[7]. Because of failures in the identification phase, only personnel costs but no overhead costs were measured and valued in three of the four input-oriented counseling based studies[14,25,30]. Prathiba (1998) included overhead costs, but the methods for measuring and valuing these costs are not clear[18].

If interventions become more complicated or more complex, measurement and valuation of costs become less straightforward. A variety of quit-smoking interventions other than counseling and nicotine replacement therapy were economically evaluated.

Altman (1987) evaluated three interventions: a self-help kit, a contest, and a smoking-cessation class[24]. The only cost aspect for which measurement was explicitly mentioned was participants' time input. It was valued at $10, but the reason for assigning this value was not explained. Measurement and valuation of other aspects is not clear. Reading between the lines, it seems that actual costs incurred during the program were used, including staff and staff benefits, overhead, rents, supplies and materials, travel, and data analysis.

More or less the same procedure seems to have been followed by Mudde et al. (1996)[28]. Costs of the program were primarily based on financial records. Hourly wages of trainers were based on the national average wage, time input of participants was valued based on figures in literature, and transportation costs were measured and valued separately. Costs of the community health educational program by Secker-Walker et al. (1997) were estimated from project records only[20].

In another community health education project, all aspects of the campaign were measured separately[19]. Time input was measured and valued as a proportion of individual gross salaries. Overhead was assumed to involve the same proportion. Media cost was divided into buying and

advertising time. These units were valued using recorded data. Costs of self-help booklets were also measured and valued using recorded data.

In the study by Croghan et al. (1997) quit-smoking therapies provided by the Mayo Clinic to all of their clients were evaluated[11]. Costs of this large variety of interventions were determined from the total operating costs of the Mayo Clinic over one year. These costs were projected over the total study period.

Miller et al. (1996) combined behavioral modification with nicotine replacement therapy and provided educational material to subjects[27]. Costs of behavioral modification were estimated by measuring the time input of trainers, valuing time input as the average wage. Nicotine replacement therapy was measured in duration and dosage of therapy. It was valued using the costs at which the products were acquired by the pharmacy. The costs of educational materials were estimated as the actual costs per pamphlet, multiplied by the number of pamphlets.

Recruitment strategy for a quit-smoking contest was the main intervention in the study by Nelson et al. (1989)[29]. Costs were measured as time input of persons involved, valued at the average wage. Volunteer time was not valued. Costs for promotional and educational materials were taken from project records.

Two studies were very inaccurate in measuring and valuing costs of the intervention program. Haycox (1994) used a hypothetical community intervention[13]. Determination of intervention costs was not explained at all. Korhonen gave only rough estimates of costs made by the organization. Costs incurred by other partners were not included at all[26].

Reductions in costs due to decreases in smoking-related disease together with an increase in costs due to increases in routine medical costs during additional life years were referred to by four studies[12,13,16,23]. Three studies decided not to measure these costs because the literature suggests that the benefits of quitting smoking that arise from reductions in smoking related diseases are of the same magnitude as the increase in health care costs during the additional life years[12,16,23]. Haycox (1994) used current figures on smoking-related health care and health care costs together with modeling to estimate the effects on total health care costs[13]. The results was a net cost saving in health care expenditures. Only one study included a reduction in costs due to fewer smoking-related diseases[17]. Costs were determined by gaining advice from an expert panel. Finally, one study examined the effects of an increase in lifetime medical care costs in sensitivity analysis[14]. Costs were based on published data.

General Quality Aspects

Incremental Analysis

For a meaningful comparison of alternatives, additional costs and effects of one program over another program need to be explored[8]. All studies reviewed were full economic evaluations, which means that a comparison between alternatives was made when estimating cost-effectiveness. A cost-effectiveness ratio is most informative when relevant alternatives are compared. Appropriate alternatives to a new program are prevailing interventions or best care. Studies are reviewed with respect to the incremental analysis in this section. Information about incremental analysis is summarized in Table 3.

Half of the studies performed a precise incremental analysis that was well described in the article[7,12,14-18,20-23]. Most of these studies analyzed the additional cost-effectiveness of nicotine replacement plus counseling versus the relevant alternative of counselling alone[16,17,21-23]. Three studies assessed the incremental cost-effectiveness of counseling compared to routine physicians' advice[14,15,18], which is also an adequate comparison. One study was looked at the additional value of follow-up visits as an extra service to counseling[12]. Again, the interventions compared are relevant in determining reliable cost effectiveness ratios. Parrott et al. (1998) compared brief advice with usual care, and brief advice plus a self-help kit was compared with brief advice alone. Nicotine replacement therapy in addition to brief physicians' advice and self-help material was compared with brief advice and self-help material. Finally, an intervention using specialist smoking cessation services in addition to brief advice, self-help and nicotine replacement was compared with the same packet of care, excluding specialist smoking cessation services[7]. All these comparisons are useful.

In another study, the incremental cost-effectiveness of a mass media campaign in addition to a school program was the subject of research[20]. Two studies compared the smoking cessation rate at the end of the intervention with the estimated smoking cessation rate in the general population[11,12]. Only seven studies compared the smoking rate at the end of the program with the smoking rate at the start of the program[20,24,25,26,28-30]. By using this kind of comparison, the authors implicitly suggest that usual care or "doing nothing" is the best alternative available. Although in principle this is often a good choice for an alternative comparator intervention, the authors of these articles wrongly assumed that there would be no quitters if the intervention under research were not performed. In short, there are differences observed in the quality of incremental analysis performed.

Discounting

The process of discounting is strongly related to the concept of time preference. People prefer incurring costs in the future rather than today, and they favor benefits today rather than in the future. This means that they prefer to spend money in the future rather than in the short term. Drummond et al. (1997) gave some explanations for this phenomenon[8]: it can be explained partly because the value of an amount of money will decrease over time and partly because it provides people with more flexibility; giving them more options.

Time preference is not restricted to monetary values. People also favor health benefits today rather than tomorrow. Reasons for this were provided by Drummond et al. (1997) too[8]. One reason might be that the future is uncertain. Therefore, when the health benefits of a specific intervention will only be felt after 20 years, people give less value to it because many other bad things could happen to them during that time period. Furthermore, people simply may have a short-term view of life. Because of the importance of time preferences -- especially in preventive interventions -- it is incorporated in the analysis via the process of discounting of costs and effects.

Time preferences will play a role only when the costs or the health effects occur in the future. Seven of the reviewed studies in the field of cost-effectiveness of non-smoking interventions defined cost-effectiveness in terms of costs per quitter[24-30]. In most cases, the costs involved are short-term program costs only. This makes discounting unnecessary. In two studies, the intervention lasted more than one year and costs were discounted [4,29]. Effects expressed in number of quitters did not include future health benefits. Therefore, there was no need for discounting either (Table 3).

The remaining studies expressed cost-effectiveness in terms of costs per years of life saved[7,10-15,18-23,31,33]. Cost-utility was estimated by Fiscella and Franks (1996)[23]. These studies expanded outcomes to future health benefits and should therefore have discounted the effects. All but one study did indeed discount effects (Table 3). The most commonly used discount rate was 5%[11,12,14-17,22]. Discount rates of 1.5%[7], 1.75%[21,] 3%[20, 23], and 6%[10,13,19] were used also.

Discounting of costs was necessary only when future costs were incorporated (Table 3). Future costs were identified in seven studies and were included in the analysis in three of them[13,16,17]. In concordance with the guidelines, these three studies indeed discounted future costs at a rate of 5% or 6%. When future costs were identified but not measured, based on literature, the assumption of a zero net effect was made.

Sensitivity Analysis

Every economic evaluation contains some degree of uncertainty. Because of the long-term scope, this is especially true for economic evaluations of preventive interventions. The effect data used in the study may not accurately represent the actual quit rates that result from the interventions. Based on one or more effectiveness or even efficacy studies, assumptions are made about quit rates, relapse rates, compliance, and other factors that determine the effect of the intervention. It might be clear that elimination of uncertainty in effect data can never be fully achieved. This is also true for costs used in economic evaluation. The degree of uncertainty of the data will influence the reliability of the established cost-effectiveness ratio. It is important for authors and reviewers of cost-effectiveness studies to be aware of this. The guidelines recommend that researchers explore the possible variability in outcomes. Sensitivity analysis is the most frequently used tool for investigating the robustness of outcomes. Five studies did not perform sensitivity analysis or any other form of investigating variability in outcome at all[7,19,25,26,29]. The remaining 17 studies all performed sensitivity analysis (Table 3).

The results of sensitivity analysis have to be explored very well. Many researchers and policymakers consider only estimates of cost-effectiveness ratios that have high certainty to be of value. This may result in performing conservative sensitivity analysis by limiting the number of parameters varied or by defining unrealistically small sensitivity ranges. It is important to use realistic sensitivity ranges when performing sensitivity analysis and to explain explicitly the choice of the ranges.

In nine studies an explanation was given for the sensitivity range chosen[11,15,16,20-23,27,28.] Confidence intervals (90% or 95%) were most often used to define a sensitivity range[15,16,20,21,23,27,28]. Estimates of lower and higher bounds were based on literature in three studies[11,16,22]. Table 3 summarizes the use of sensitivity analysis in the studies.

Table 3: Characteristics from cost analysis and from general aspects of economic evaluations

first author, year	relevant intervention costs		non-relevant intervention costs			smoking related disease costs	health care costs in extra life years	productivity costs	patient costs	discounting costs	discounting effects	sensitivity analysis	range sensitivity analysis explained
	performance costs	overhead costs	development costs	research costs	implementation costs								
Altman, 1987 [25]	yes	yes	(yes)	yes	yes	no	no	no	yes	yes	n/a	yes	no
Bertera, 1990 [26]	yes	no	no	no	no	no	no	no	no	n/a	n/a	no	n/a
Korhonen, 1992 [27]	yes	no	no	no	no	no	no	no	no	n/a	n/a	no	n/a
Miller, 1996 [28]	yes	no	no	no	no	no	no	no	no	n/a	n/a	yes	yes
Mudde, 1996 [29]	yes	no?	yes	no	yes	no	no	no	yes	n/a	n/a	yes	yes
Nelson, 1989 [30]	yes	no	no	no	no	no	no	no	no	yes	n/a	no	n/a
Windsor, 1988 [31]	yes	no	no	no	no	no	no	no	(yes)	n/a	n/a	yes	no
Parrot, 1998 [7]	yes	yes	no	no	no	no	no	no	yes	n/a	yes	no	n/a
Akehurst, 1994 [11]	yes	yes*	no	yes	yes	yes	no	no	no	n/a	yes	yes	no
Croghan, 1997 [12]	yes	yes	no	no	no	no	no	no	no	n/a	yes	yes	yes
Cummings, 1989 [13]	yes	yes*	no	no	no	yes	yes	no	yes	n/a	yes	yes	no
Haycox, 1994 [14]	yes	no	no	no	no	yes	yes	no	no	yes	yes	yes	no
Krumholz, 1993 [15]	yes	no	no	no	no	no (?)	yes (sens)	no	no	n/a	yes	yes	no
Meenan, 1998 [16]	yes	no	no	no	no	no	no	no	no	n/a	yes	yes	yes
Oster, 1986 [17]	yes	yes*	no	no	no	yes (sens)	yes (sens)	no	no	yes	yes	yes	yes
Plans-Rubio, 1998 [18]	yes	yes*	no	no	no	yes	no	no	no	yes	yes	yes	no
Prathiba, 1998 [19]	yes	yes	no	no	no	no	no	no	no	n/a	no	yes	no
Ratcliffe, 1997 [20]	yes	yes	yes	yes	no	no	no	no	no	no	yes	no	n/a
Secker-Walker, 1997 [21]	yes	no	yes	yes	no	no	no	no	no	?	yes	yes	yes
Stapleton, 1999 [22]	yes	yes*	no	no	no	no	no	no	no	n/a	yes	yes	yes
Wasley, 1997 [23]	yes	yes*	no	no	no	no	no	no	no	n/a	yes	yes	yes
Fiscella, 1996 [24]	yes	yes*	no	no	no	yes	yes	no	no	n/a	yes	yes	yes

* = implicitly measured

SUMMARY

This article reports on a review of 22 economic evaluations in the field of treatment for tobacco-dependence. The articles were quite diverse in terms of interventions performed, alternative interventions considered, and study populations. This indicates that cost-effectiveness ratios and cost utility ratios of different studies could not be compared, but differences in the general features of studies were not problematic because our interest was in the quality of the economic evaluation of individual studies.

Since there is no scoring system available to evaluate the quality of individual studies, the checklist proposed by Drummond et al. (1997) was used as a guide to perform a quality assessment of economic evaluations in the field of treatment for tobacco dependence[8].

Scientific studies should start by providing a well-defined research question. In the case of economic evaluation, an important aspect of the research question is the perspective from which the analysis is performed. The perspective is mentioned in only 13 studies.

In terms of the economic evaluation itself, the first condition for providing reliable outcome data in economic evaluation is to make use of qualitatively good data on the effects of the intervention. There were only five published cost-effectiveness studies that used effectiveness data which were obtained through a randomized controlled trial and which also incorporated likely relapse rates when necessary. This indicates that many economic evaluation studies might not be based on qualitatively good effectiveness data. In other words, although there is evidence that stop-smoking interventions are effective in general, the estimates of the magnitude of the effect in specific studies might not be reliable.

When reviewing cost-analysis, there was only one study that adequately identified cost categories in concordance with the viewpoint taken by the study. Contrary to identification of costs, measurement of the identified cost categories was performed adequately by most of the studies.

In addition to the quality of the data on effects and the quality of the cost-analysis, there are some general aspects that influence the quality of economic evaluation studies. Discounting is one of these aspects. In most of the studies reviewed, discounting was performed when necessary, and many studies used the same discount rate.

Sensitivity analysis was performed by 17 of the 22 studies evaluated. An explanation for the width of the sensitivity ranges used was provided by only half of the studies. Sensitivity ranges were determined using confidence intervals and/or secondary literature. These methods seem to result in reasonable and appropriate sensitivity ranges.

In summary, it can be said that, in general, the guidelines were not followed very well. This conclusion raises the important question of whether the quality of the studies in general is low, or whether there are large differences in quality of economic evaluation between studies. There was no study that accurately handled effectiveness data and faultlessly identified relevant costs in concordance with the perspective stated. The study of Fiscella and Franks (1996)[23], performed from the perspective of the medical payer, was carried out most closely in accordance with the guidelines of Drummond et al. (1997)[8]. Fiscella and Franks (1996) identified costs in concordance with the perspective mentioned, and discounting and

sensitivity analysis were carried out, and the choices for sensitivity ranges were explained[23]. Effects were estimated on the basis of a review study. An important issue, however, is that this study was performed from the fairly narrow perspective of the medical payer. This perspective includes only a few cost categories, which means that the study was easier to perform than cost-effectiveness analyses performed from broader points of view. In addition, having not performed the study according to a societal perspective makes the study inadequate for decision-making at the macro level. This is discussed in the following section.

CONCLUSIONS AND DISCUSSION

Overall it can be concluded that economic evaluation studies in the field of tobacco cessation – as in other fields of research – do not follow guidelines for economic evaluation very well. Authors often falsely assume that effectiveness studies are of high quality. This study indicates that more attention has to be paid to the quality of the *sources* of effectiveness data. Furthermore, it is shown that the first step in the economic evaluation of smoking cessation interventions, namely identifying costs, was performed according to guidelines only in a few cases. It is of great concern that the basis of the determination of costs is frequently subject to inaccuracies.

The observation that sensitivity analysis often is performed in a non-scientific way is also of concern. Sensitivity analysis is the only part of the study in which the assumptions used to generate the cost-effectiveness ratio or cost utility ratio can be varied to test the robustness of the outcome ratio. This part of the evaluation has to be carried out very carefully.

In addition to the poor scientific quality of the studies, there is another caveat worth mentioning. To achieve information about costs per life year saved resulting from preventive interventions within a limited time frame, it is necessary to make use of modelling. In economic evaluation of quit-smoking interventions, diverse models have been used to extrapolate from the number of quitters to the number of life years saved. Studies based on modelling techniques are subject to a number of frequently raised concerns. Some frequently mentioned concerns are an inappropriate use of clinical data, concerns about bias in observational data, concerns about the validity of models, and concerns about difficulties in extrapolation[34]. There are especially concerns with the validity of the models, and gaining insight into models is difficult because the models often are not transparent. As a result, the quality of the models cannot be judged.

Studies that did *not* make use of models presented the outcome in terms of cost per quitter. The main problem with these studies is that their cost-effectiveness ratio cannot be compared to health care interventions that present outcomes in terms of costs per year of life saved. This does not necessarily mean that studies that use costs per quitter as the only outcome measure are not useful. When more insight into modelling is gained, costs per quitter might be translated easily by economists into costs per life year saved and/or costs per quality adjusted life year. Retaining these studies in the analysis offers a broader view on costs and effects of smoking cessation interventions.

Because the studies are not of high quality scientifically, and because there is uncertainty about the validity of models, we are left with the question as to whether the economic evaluation studies in the field of smoking cessation are of practical use. The costs per life year saved presented in the studies are low ($220 to $19,000), but because of the poor quality of

the studies, no firm conclusions can be drawn about the cost-effectiveness of smoking cessation interventions. However, there is a very high consistency among the studies in concluding that stop-smoking interventions are cost-effective, and the results stay favorable after having performed sensitivity analyses. Furthermore, although there are many biases observed in most of the studies, it is highly unlikely that these modify the results in favor of the non-smoking interventions. Finally, cost-effectiveness ratios presented in studies about smoking cessation interventions are much lower than other already-accepted health care treatments. So, in spite of the generally low quality of economic evaluations in the field of smoking cessation, the conclusion from other reviewers[4, 6], namely that treatments to reduce the number of smokers are cost-effective at least in relative terms, is likely to be true.

This is important information for policymakers, who thus are advised to continue smoking cessation interventions, at least until better insight is gained into the cost-effectiveness of interventions to reduce tobacco consumption.

More robust scientific evidence can be gathered using a model that has the potential to modify all aspects relevant for estimating the cost-effectiveness of smoking cessation interventions. Developing such a model might be a challenge for researchers in order to solve the problem of cost-effectiveness of smoking cessation, and it may even be helpful in clarifying cost-effectiveness issues of other health care interventions.

Such a model might also solve another issue of importance, namely that of the external validity of the studies. Medical technology assessment is a research area that builds a bridge between science and policy. It is aimed at facilitating decision-making about implementation of health care interventions at a macro level. To be able to make these decisions, studies have to be performed from the societal perspective, which very few of the reviewed studies used. Development of a meta-model in which all aspects of economic analysis can be simulated would increase the usefulness of the large number of economic evaluations performed from a non-societal perspective.

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