

Cost-Effectiveness Analysis Of Text Messaging To Support Health Advice For Smoking Cessation

Raquel Cobos-Campos

Health Research Institute Bioaraba

Javier Mar

OSI Guipuzkoa

Antxon Apiñaniz

OSI Araba

Arantza Sáez de Lafuente

Health Research Institute Bioaraba

Naiara Parraza

Health Research Institute Bioaraba

Felipe Aizpuru

OSAKIDETZA

Gorka Orive (✉ gorka.orive@ehu.eus)

Universidad del Pais Vasco

Research

Keywords: Smoking cessation, MeSH Unique ID: D016540, Costs and cost analysis, MeSH Unique ID: D003365, Cost of Illness, MeSH Unique ID: D017281, Quality-Adjusted Life Years, MeSH Unique ID: D019057, Text messaging, MeSH Unique ID: D060145,

Posted Date: February 18th, 2020

DOI: <https://doi.org/10.21203/rs.2.23843/v1>

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Version of Record: A version of this preprint was published on February 15th, 2021. See the published version at <https://doi.org/10.1186/s12962-021-00262-y>.

Abstract

Background: Smoking is one of the most serious public health problems. It is well known that it constitutes a major risk factor for chronic diseases and the leading cause of preventable death worldwide. Due to high prevalence of smokers, new cost-effective strategies seeking to increase smoking cessation rates are needed.

Methods: We performed a cost-effectiveness analysis comparing two treatments: health advice provided by general practitioners and nurses in primary care, and health advice reinforced by sending motivational text messages to patients' mobile phones. A Markov model was used in which patients transitioned between three mutually exclusive health states (smoker, former smoker and dead) after 6-month cycles. We calculated the cost-effectiveness ratio associated with the sending of motivational messages throughout a patient's life. Health care and societal perspectives (separately) were adopted. Costs taken into account were direct health care costs and direct health care cost and costs for lost productivity, respectively. Additionally, deterministic sensitivity analysis was performed modifying the probability of smoking cessation with each option.

Results: Sending of text messages as a tool to support health advice was found to be cost-effective as it was associated with increases in costs of €7.4 and €1,327 per QALY gained for men and women respectively from a healthcare perspective, significantly far from the published cost-effectiveness threshold. From a societal perspective, the combined program was dominant.

Conclusions: Sending text messages is a cost-effective approach. These findings support the implantation of the combined program across primary care health centres.

Background

Smoking is one of the most serious public health problems (1). It is well known that it constitutes a major risk factor for chronic diseases and the leading cause of preventable death worldwide (2). In Spain, according to the 12th Survey on Alcohol and other Drugs (EDADES), 34% of people between 15 and 64 years old admit to smoking on a daily basis in the past month, which represents an increased rate compared with rates (30 and 31%) from previous surveys (2011, 2013 and 2015) (3). Smoking is associated with higher healthcare costs, with an estimation of €864.64/year in smokers versus €474.71/year in non-smokers according to a study by the Spanish Society of Pulmonology and Thoracic Surgery (4).

Currently, there are various different treatments for smoking cessation, including more or less intensive interventions based on motivational advice, pharmacological therapy and group-based programs, with variable success rates depending on the therapy used (5). Interestingly, some patients decide to quit smoking without any support, with success rates varying from 3 to 8% after 6 months (6,7). The provision of health advice is considered one of the most cost-effective interventions for the treatment of smoking (8). However, changes stimulated by such advice do not last over time (9) and hence, there is a need to establish approaches for reinforcement, including the use of information and communication technologies, and specifically m-health (health through mobile technologies) for which there is evidence in the treatment of smoking. Whitaker et al (10) calculated a pooled risk ratio of text messaging reinforcement for smoking cessation of 1.83 (94% CI 1.54–2.19) as a measure of effectiveness based on six clinical trials, being their results similar to those reported by other research groups (11, 12).

We carried out a randomized clinical trial to assess the effectiveness of a combined program SMSalud® that included sending motivational messages by mobile phone to smoker people who sought help from primary health professionals. This intervention sought to provide reinforcement health advice provided in the primary care health professional consultation room. Our results showed a rate of smoking cessation similar to that obtained by other research groups (smoking cessation rate of 24% versus 12% with usual practice- only health advice -at 6 months and 16.25% [versus 5.6% at 12 months) (13). Further, with the deployment of mobile networks in the nineteen-eighties, the use of mobile phones has grown exponentially. The International Telecommunications Union estimated that by the end of 2015 there would be 7 billion mobile phones across the world, corresponding to a penetrance of 97% (14), and their increasingly widespread use makes these devices ever more useful tools in healthcare.

Assuming that mobile phones are useful tools in healthcare, it seems reasonable to explore strategies focused on using mobile technology to improve smoking cessation. Although the combined program SMSalud® has shown to be effective as a tool to reinforce health advice provided in primary care health professionals, and the results of Guerriero et al. (15) suggest that it would be a cost-effective tool, there is a need for specific economic assessment prior its implementation in the primary care setting. Taking all this into consideration, the main objective of the present article was to assess whether the use of text messages as a support tool for health advice is a cost-effective strategy in smoking cessation programs in primary care. To address this hypothesis, a Markov model in which patients transitioned between three mutually exclusive health states (smoker, non-smoker and dead) after 6-month cycles was used with the aim of estimating the costs and clinical outcomes from the start of the intervention until patient death.

Methods

We carried out a cost-effectiveness study comparing two treatment options: a) Usual clinical practice carried out in primary care health centers- health advice provided by general practitioners or nurses responsible for smoking cessation management (verbal and written information on the benefits of not smoking and recommended changes in eating habits) (13), and b) the same health advice complemented by the sending of motivational and supportive messages to the patient's mobile phone during the 6 months the program lasted (combined program). Health advice was provided repeatedly (at 7 days, 4, 12 weeks and at 6 months since the quitting day). In both cases, the treatment lasted 6 months.

Patients on the combined program received two automatically-generated text messages a day (one in the morning and one in the evening) for the first 5 weeks and three messages a week from weeks 6 to 26. At 26 weeks, the program finished. The messages were motivational in intent, to encourage patients in their

efforts to stop smoking, and also provided information about the health-related risks of smoking. Patients could also request supportive messages from the system in moments of crisis or anxiety. For this, they had to send a message free of charge with the word “anxiety” or “relapse” to a given phone number (13).

Model

We performed a cost-effectiveness analysis to calculate the incremental cost-effectiveness ratio (ICER), which is a measure that compares differences in costs and differences in effectiveness between the options considered. The study was based on the aforementioned clinical trial in which we assessed the effectiveness of the combined program, SMSalud®, comparing it with health advice alone. Patients were randomly allocated to receive one of the two interventions for 26 weeks (13).

To estimate the costs and clinical outcomes from the start of the intervention until patient death, we used a Markov model that has been used previously in economic assessments (16, 15). This Markov model consists of three mutually exclusive health states (smoker, former smoker and dead), to simulate the process of smoking cessation in a hypothetical cohort of 1000 smokers aged 16 years old or above. Specifically, we opted for a model with cycles of 6 months, in which patients' transition between the three health states, with transition probabilities differing as a function of time, age and sex (Fig. 1). All patients started the model in the smoker state, and in the first cycle, could then stop smoking, continue smoking or die. From the second cycle onwards, patients could continue to not smoke, continue to smoke, start smoking again or die. Additionally, both smokers and former smokers could develop smoking-related diseases (myocardial infarction, stroke, heart disease, chronic obstructive pulmonary disease or lung cancer), with different probabilities as a function of age and gender. For calculating the incremental cost associated with the reinforcement provided through mobile text messaging, life years gained (LYGs) and quality-adjusted life years (QALYs), the time horizon was set to be the patient's entire life. This time frame allowed us to include both the health impact and all the costs associated with smoking over a patient's life and thus explore the reduction in costs due to the use of reinforcing text messaging.

A discount rate of 3% was used for updating future costs and effectiveness. This discount rate is widely used in long-term cost-effectiveness studies (17–19). The analysis was conducted from a health system perspective including all the costs related to the intervention provided and a societal perspective including the costs due to loss of productivity caused by sick leave associated with the five diseases most strongly associated with smoking.

Probabilities

The probabilities of smoking cessation and relapse used in this cost-effectiveness study are taken from our previous clinical trial (13) in 320 smoking patients. In this clinical trial, 24% (95% CI 17.72-31%) of patients who received reinforcement messages stopped smoking after 6 months, compared to 12% (95% CI 6.86%-16.88%) of patients assigned to health advice alone, not founding statistically significant differences in success rates between men and women. The rates of relapse were 33% and 53% in the groups receiving health advice plus reinforcement messages and health advice alone respectively (Table 1).

Table 1
Data on effectiveness

Age, years	Cycles	Smoking cessation		Relapse	
		Combined program	Health advice alone	Combined program	Health advice alone
16	1	0.2438	0.1188	0	0
16.5	2	0.02	0.02	0.333	0.5264
17	>3	0.02	0.02	0.05	0.05

We assumed an annual rate of relapse of 10% from the first year (21), based on a meta-analysis of clinical trials and prospective studies, and an annual rate of smoking cessation of 2%, regardless of the therapy used, age and gender, from the second cessation attempt onwards, this figure also having been used in previous studies (15). We also assumed that each patient could make two attempts at quitting smoking each year, in line with data from the Spanish National Health Survey (23) (Table 1).

In the absence of valid data from the Spanish population on mortality rates by age and smoking habits, we used figures for the British population by age and smoking habits (smoker, former smoker), calculated in 1994 by Doll et al. (24). However, before their inclusion in the model, we calibrated these rates seeking to reproduce mortality rates in men and women in the Spanish population.

To calculate the number of smokers and former smokers who might develop a smoking-related disease in each cycle, we multiplied the number of smokers/former smokers in each cycle by the incidence of each disease by age and gender (when such disaggregated data were available) (Table 2) (25–28) and the excess risk of developing each disease in the case of smokers and former smokers (supplementary table 1) (29–31).

Disease incidence = (Disease incidence in former smokers * Number of former smokers) + (Disease incidence in smokers * Number of smokers)

Similarly, we calculated the prevalence of each disease as a function of smoking status:

Disease prevalence = (Disease prevalence in smokers * Prevalence of smokers) + (Disease prevalence in former smokers * Prevalence of former smokers)

The data on prevalence (Table 2) of the different diseases considered were taken from the study by Flack et al. on interventions for smoking cessation (16). According to this study, the prevalence rates increased with age and differed as a function of gender.

Table 2
Data entered into the model

Inputs			Source
Mortality	By smoking status (smoker, former smoker)		24
Prevalence of smoking-related diseases:	Myocardial infarction Heart disease Chronic obstructive pulmonary disease Lung cancer Stroke		16
Incidence of smoking-related diseases:	Myocardial infarction Heart disease Chronic obstructive pulmonary disease Lung cancer Stroke		28 28 25, 26 27 28
Risk ratio of developing smoking-related diseases	Lung cancer Smokers Former smokers Myocardial infarction Smokers Former smokers Chronic obstructive pulmonary disease Smokers Former smokers Heart disease Smokers Former smokers Stroke Smokers Former smokers	Male 8.78/ Female 7.48 Male 3.01/ Female 2.82 4.21 1.47 3.51 2.35 4.22 1.51 2.58 1.34	29 29 31 31 30 30 29 29 30 30
Smoking cessation At first cycle After the first cycle	Combined program Health advice alone Combined program Health advice alone	0.24375 0.11875 0.02 0.02	13 13 22
Relapse After the first cycle	Combined program Health advice alone	0.333 0.5264	13 13
After the second cycle	Combined program Health advice alone	0.10 0.10	21 21
Number of attempts at smoking cessation		2	23
Utilities	Smoker with no comorbidities Former smoker with no comorbidities Smoking-related diseases	0.75 0.78 Calculated for different age ranges from	34 34 32, 33
Days of sick leave due to smoking -related diseases	Days of sick leave in smokers (per year) Days of sick in former smokers (per year)	11 7	4
Percentage in employment	Men 16–24 years 25–34 years 35–44 years 45–54 years ≥ 55 years Women 16–24 years 25–34 years 35–44 years 45–54 years ≥ 55 years	41.06% 91.63% 94.05% 90.41% 28.01% 37.23% 86.64% 84.38% 75.65% 18.07%	45 45
Hourly earnings	Men Women	€15.90 €13.60	45
Monthly agreed working hours by type of contract	Men Women	155 h 155 h	45

Utilities

The values for health-related quality of life (Table 2) of the five smoking-related diseases in healthy population and the corresponding decrease associated with myocardial infarction, stroke, chronic obstructive pulmonary disease, and heart disease were taken from the 2011–2012 Spanish National Health Survey, disaggregated by age and sex, and assessed using the EuroQol 5D-5L (32). In the case of lung cancer, the decrease of health-related quality of life was assessed using the results of Trippoli et al (33). Further, the data on the quality of life of smokers and former smokers with no comorbidities were obtained from a study by Tillmann et al, conducted in 1997 (34). As in previous studies, when patients had more than one comorbidity, we applied the lowest utility value (15).

Costs

In the cost analysis from a healthcare perspective, we only include direct healthcare costs related to the intervention administered (cost of the text messaging, cost of the messages sent, and costs associated with the visits to health professionals) and related to the smoking related diseases-SRD) (35). All the costs (Tables 2 and 3) are expressed in euro for 2018, corresponding inflation rates being applied for each year.

Table 3
Costs included in the model

Costs of each option/patient	€187.90	€166.95
Cost of general practitioner appointment (2018 portfolio of services of the Basque Health Service)	€58 × 4	€58 × 4
Cost of nurse appointment (2018 portfolio of services of the Basque Health Service)	€24 × 1	€24 × 1
Cost of nurse phone consultation (2018 portfolio of services of the Basque Health Service)	€12 × 4	€12 × 4
Cost of the text messaging program	€17,385.27*	
Cost of the messages sent	€3,127.85*	
Cost of two CO monitors and mouthpiece	€1,891.5**	
Program logo	€431.5*	
Annual costs of the treatments of smoking-related diseases	€13,206	38
Incidence-related costs	€5,759.50	39
Lung cancer	€12,987	29
Stroke	€1,672	37
Myocardial infarction	€8,578	38
Chronic obstructive pulmonary disease	€13,206	38
Heart disease	€3,596.60	39
Prevalence-related costs	€3,046	29
Lung cancer	€1,672	37
Stroke	€685	38
Myocardial infarction		
Chronic obstructive pulmonary disease		
Heart disease		
Training costs for the combined program	€1,900	
* For calculating the costs per patient, the total amount for each item was divided by the total number of patients in each group (1000).		
** For calculating the costs per patient, the total amount for each item was divided by the total number of patients in each group (2000).		

Regarding the analysis from the social perspective, we assumed the direct healthcare costs specified in the previous paragraph and also losses of productivity due to SRD (Tables 2 and 3) (36–41). We estimated the disease-related loss of productivity as the reduction in productivity of a worker who is ill or unable to work. Further, for calculating the loss of productivity due to sick leave, we considered the percentage of male and female smokers and former smokers in work, the hourly earnings for men and women, and the mean number of monthly agreed working hours for men and women, all these data being obtained from the Spanish National Statistics Institute (42).

In order to estimate indirect costs and transform them into monetary units, we used the human capital approach (43–45). This approach converts life years into monetary equivalents considering the mean gross income of each worker. The method is based on the hypothesis that the value of the lost production is equivalent to the wage associated with obtaining the aforementioned production. That is, a day off work represents a loss of production equal to the wage for that same day worked (46). With this methodology, a single wage, often the mean or the minimum, is applied to all analyzed patients. Interestingly, a study published by Suarez-Bonel et al. (4), demonstrated that smokers and non-smokers were on sick leave for an average of 11 days and 7 days a year, respectively. All the parameters entered into the model are listed in supplementary table 1.

Model validation

The model was validated internally and externally. For the former, we followed all the recommendations of Halpern et al (46) and Nuijten et al (47). In addition, according to McCabe et al (48), the results of the model can only be properly validated in one way, that is, by comparing the modelled estimates with the values obtained in real life, which could be called predictive validity. To address this, we calculated the life expectancy of men and women at different ages based on our model and compared it with the figures provided by the Spanish National Statistics Institute (real data). For the external validation, we used the LYGs thanks to smoking cessation at different ages and the life years lost due to smoking at 40 years of age, comparing the results with those of Ozasa et al. (49). In this particular case we considered a utility of 1 and a discount of 0.

The life expectancy estimated from our model is very similar to the data provided by the Spanish National Statistics Institute for different ages (Table 4). The results of the external validation are shown in Tables 5 and 6. Smoking cessation at an age ≤ 40 or < 50 years old translates to 4.2 and 3.9 LYGs, respectively, being these results similar to those of Ozasa et al (49). At older ages, the differences between Ozasa et al, and our group increase slightly. In addition, the life expectancy values calculated from our model and from that of Ozasa et al (49) as a function of smoking status and gender (49) at the age of 40 years old are very similar, finding the largest difference in the case of smoking men (2.7 years) whereas the smallest difference in non-smoking men (0.1 years).

Table 4
INTERNAL validation of the model with the life expectancy for the Spanish population

PATIENT LIFE EXPECTANCY FOR 2018 (data from the Spanish National Statistics Institute)		MODEL
Men		
16 years	64.77	64.77
30 years	51.03	51.7
50 years	31.86	31.02
Women		
16 years	70.11	69.6
30 years	56.24	56.34
50 years	36.76	37.4

Table 5
EXTERNAL validation. Years of life gained after smoking cessation at different ages

Sex	Age at smoking cessation (years)	Years of life gained	
		according to our model (years)	according to Ozasa et al* (years)
Male	40	4.2	4.8
	50	3.9	3.9
	60	3.3	1.6

Table 6
EXTERNAL validation. Life expectancy as a function of smoking status at 40 years old

Smoking status	Age	Men		Women	
		Our model	Ozasa et al.	Our model	Ozasa et al.
Former smokers	40 years	40.03	40.8	44.2	42.4
Smokers		35.8	38.5	39.8	42.1
Non smokers		42.3	42.4	46.5	46.1

Deterministic sensitivity analysis

We performed a univariate deterministic sensitivity analysis to assess the change in ICER as a function of the changes in the effectiveness values of the combined program or the motivational advice alone. The effectiveness values for the combined program used to perform the sensitivity analysis lie within the 95% confidence Interval (17.71%-31%) as did the corresponding values for treatment effectiveness of motivational advice alone (6.86%-16.88%).

Results

The increase in costs associated with mobile phone messaging at 6 months for a cohort of 1000 smoking patients was €22,850. The latter was associated with a 52% increase in the number of people quitting smoking (244 versus 119), which translates to an additional cost of €183 per patient quitting. At the end of their lives, the mean LYG and QALYs were 0.08 and 0.22 years per male former smoker and 0.06 and 0.20 years per female former smoker respectively.

From a healthcare perspective, the increase in costs through the entire life of patients was €7.4 and €1,327 per QALY gained for men and women, respectively. From the social perspective, the alternative treatment was dominant, with savings of €5,398 and €3,290 per QALY gained for men and women respectively (Table 7).

Table 7
Results of the cost- effectiveness analysis. Base case

	Healthcare perspective							Societal perspective						
	Combined program		Health advice alone		Difference between the options			Combined program		Health advice alone		Difference between the options		
	Mean costs (€)	Mean QALYs	Mean costs (€)	Mean QALYs	ΔCost (€)	Δ QALYs	ICER €/QALY	Mean costs (€)	Mean QALYs	Mean costs (€)	Mean QALYs	ΔCost (€)	Δ QALYs	ICER €/QALY
Man	2,566	20.61	2,565.80	20.59	199.93*	27.07*	7.40	22,01	20.61	22,16	20.59	-146,178*	27.07*	-5,398 (DOMI)
Woman	1,888	20.98	1,855	20.96	33,333*	25.10*	1,327	16,829	20.98	16,912	20.96	-82,632.81*	25.12*	-3,290 (DOMI)

*Cost and QALYs increase for a hypothetical cohort of 1000 patients

A deterministic sensitivity analysis was performed to assess whether the results were maintained when certain variables were modified. Table 8 shows that as the difference in the probability of quitting smoking between the combined program and health advice alone increases, both QALYs gained and ICER increase. In the sensitivity analysis as a function of age (Table 3), it can be seen that when increasing the age at which patients started the smoking cessation program, more savings are generated for the system, for both men and women.

Table 8
Results of the cost-effectiveness analysis. Univariate sensitivity analysis. Changing the probability of smoking cessation

Assumption modified	COMBINED PROGRAMME						HEALTH ADVICE ALONE					
Probability of smoking cessation	0.1772		0.24375		0.3103		0.0686		0.11875		0.1688	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
	ICER (€/QALYs)											
Healthcare perspective	115	2,426	7	1,327	-36	888	-20	1,046	7	-1,327	51	1,782
Societal perspective	-5,312	-2,245	-5,398	-3,290	-5,432	-3,707	-5,409	-3,548	-5,398	-3,290	-5,404	-2,281

* Cost and QALYs increase for a hypothetical cohort of 1000 patients

Discussion

This economic assessment shows that the use of text messaging as a tool to support health advice is cost-effective, given that it leads to health benefits and reduces costs. From the healthcare perspective, the ICER is far below the threshold of €22,000 calculated for the Spanish health system (50). The ICER regarding the use of the combined program for smoking cessation compared to usual practice represents an increase in costs of €1,327 and €7.4 for each QALY gained for women and men, respectively.

Considering a social perspective, the combined program is an alternative that results in savings of €5,398 and €3,290 per QALY gained for men and women respectively. These saving costs are related to the fact that former smokers have less risk of suffering from SRD. This entails fewer work leaves, thus generates savings costs from society perspective.

It is more cost-effective in men as they are at greater risk of developing disorders related to smoking than women, and proportionally, the benefits of smoking cessation translate to a greater reduction in the risk of developing common smoking-related diseases in men. These benefits of the program are maintained when we modify the assumptions in the different sensitivity analyses carried out.

The design selected in the present study aimed to maximize the validity of the results. In particular, a Markov model was chosen as the nature of the process under study is chronic with health states changing over time and associated with events due to risk exposure (20). The recommendations of Halpern et al (46) and Nuijten et al (47) for selecting the data to input to the model in terms of costs, effectiveness and probability of smoking were followed. In addition, effectiveness data was selected from a clinical trial carried out by our research team (13). Last but not least, data on costs for smoking-related diseases for the Spanish population, when available, and utility data for these diseases were obtained from the Spanish population.

Nonetheless, there are several limitations when interpreting the results of this study. First, the mortality rates were taken from the data of Doll et al (24) for the British population corrected for smoking status, as we did not have access to adjusted rates for the Spanish population. On the other hand, we calibrated these rates to reproduce the mortality rates for men and women in the Spanish population, assuming a risk that is proportional to the baseline risk for former smokers and smokers. Second, as with previous economic assessments, this study may potentially underestimate the benefits of reinforcement through text messaging as a tool to support health advice for smoking cessation, since it does not assume the effects of passive smoking reduction or other less common

smoking-related diseases [12]. As a consequence, the study may also underestimate the potential savings associated with the intervention, as it does not take into account the costs of treatment of these smoking-related health problems. Third, our study was based on mean costs of the diseases most commonly associated with smoking, these figures varying with disease severity. Fourth, due to the lack of valid data on incidence of smoking related diseases (SRD) for Spanish smoker population, data on incidence of SRD come from different countries, but at least, all data on Incidence come from European Community Countries. Despite these limitations, results from the present study come along with those reported by others: 0.3 LYG and 0.5 QALYs for former smokers (15), 0.069 QALYs for former smokers (51) and 0.10 QALYs for former smokers (52). These results are also consistent with previous economic assessments showing that smoking cessation interventions using mobile phones are cost saving (15, 53) and cost effective (54).

Interestingly, the program studied herein becomes more cost effective as we increase the age at initiation of the intervention, given that it increases the probability of developing a smoking-related disease and the benefit of smoking cessation is greater, as found by Guerriero et al (15) with larger savings the older the age of the study subgroup. The numbers of YLG related to smoking cessation obtained in our model are very similar to those found by Ozasa et al (49), at the ages of 40 and 50 years old, with the difference being greater above 60 years of age. A potential explanation for this difference is that the non-smokers from the Ozasa cohort (49) were less healthy, that is, they may have had health problems that made them less likely to smoke, and hence, the number of YLG as a result of smoking cessation was smaller in this older age group.

The WHO Framework Convention on Tobacco Control (FCTC) (55) proposed a series of measures for the prevention and control of non-communicable disease. With the combined program our intention is to reinforce the measure (O) Offer-of-receer, to help to quit tobacco use. The 2018 International Conference on Tobacco Control, held in Madrid, 14–16 June 2018, concluded that the measures that should be adopted by public authorities in Spain with regards to Article 14 of the FCTC (Demand reduction measures concerning tobacco dependence and cessation) include facilitating access by smokers to health professionals trained in managing smoking treatments and fund clinical, behavioral and pharmacological interventions proven to be effective and safe in the treatment of smoking.

Conclusions

The present study clearly shows that the use of motivational messaging as a tool to support health advice provided by primary health care professionals is a cost-effective strategy from the healthcare perspective, and a dominant strategy from the societal perspective, and hence, following the recommendations of this aforementioned conference, such a strategy should be adopted. Notably, the National Institute for Health and Care Excellence has recently included the use of text messaging as an effective tool for smoking cessation in its recommendations (56). The potential transfer of this program to primary care clinical practice is feasible given the low associated costs. It is estimated that at least 70% of the population seek medical attention through their general practitioner at least once a year, and smokers do so more often than non-smokers. Thus, primary care provides a great opportunity to introduce and promote our program (57). As we have mentioned above, our proposal seeks to address one of the measures cited in the WHO Framework Convention. Nonetheless, in the reduction of smoking, we should also address the other measures proposed in this convention, as well as the Spanish regulations regarding the sale, supply, consumption and advertising of tobacco products. On the other hand, our program can be easily converted into a mobile application which does not require any payment for messages. Furthermore, assuming the increasing use of mobile phones in the population, such a mobile app could have deep penetration in the society, however this would require an assessment of its effectiveness.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Material is available in Bioaraba health research institute for any request of scientific community

Competing interests

Authors declare not to have competing interest.

Funding

There is no funding for carrying out the study.

Authors' contributions

Raquel Cobos has carried out the economic evaluation. Javier Mar has reviewed the economic evaluation and the rest of authors have read and approved the article.

Acknowledgements

We thank all the patients who participated in the previous clinical trial and which has allowed us to carry out this economic evaluation.

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Figures

Figure 1

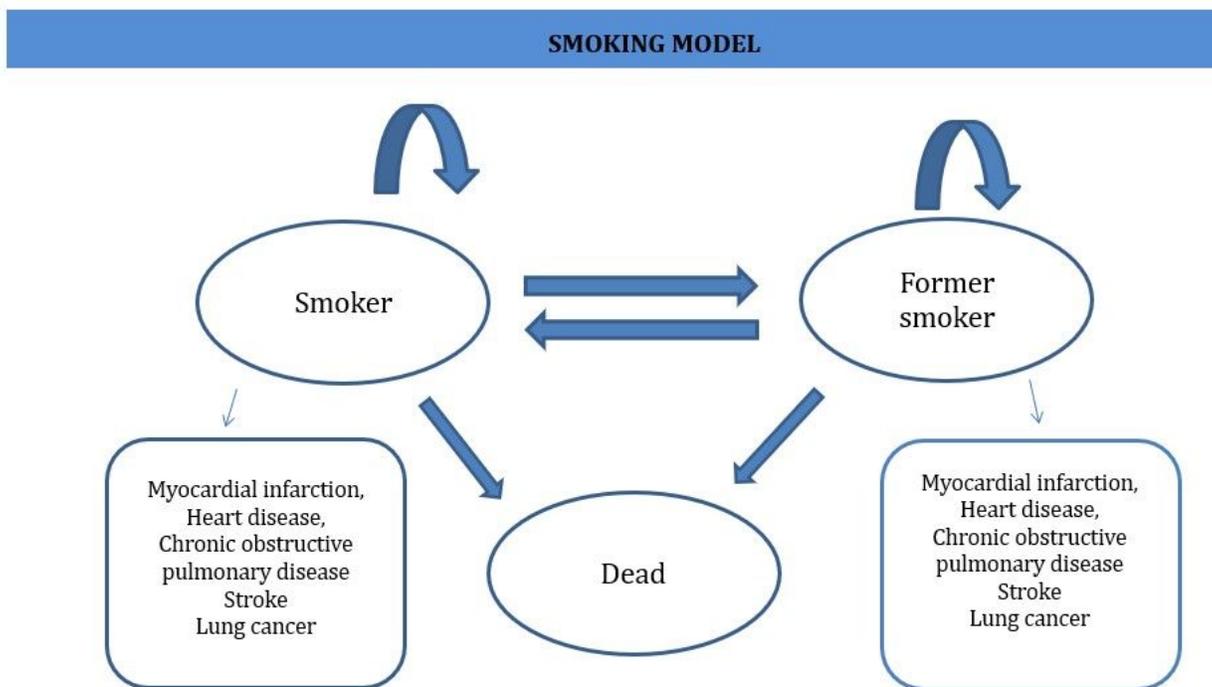


Figure 1

This Markov model consists of three mutually exclusive health states (smoker, former smoker and dead), to simulate the process of smoking cessation in a hypothetical cohort of 1000 smokers aged 16 years old or above. Specifically, we opted for a model with cycles of 6 months, in which patients' transition between the three health states, with transition probabilities differing as a function of time, age and sex