Cost effectiveness analysis for implementation of smoking cessation strategies at primary health care settings in Tamil Nadu

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Abbreviation

COPD	Chronic obstructive pulmonary disease
COTPA	Cigarettes and Other Tobacco Products Act
CVD	Cardiovascular disease
DALY	Disability Adjusted Life Years
FCTC	Framework Convention on Tobacco Control
GATS	Global Adult Tobacco Survey
ICER	Incremental Cost-Effectiveness Ratio
IEC	Information, Education, and Communication
NCD	Non communicable Disease
NFHS	National Family Health Survey
NRT	Nicotine replacement therapy
NTCP	National Tobacco Control Programme
PHC	Primary Health Centre
PSA	Probabilistic Sensitivity Analysis
QALY	Quality Adjusted Life Year
RNTCP	Revised National TB Control Program
SLT	Smokeless tobacco
SHS	Second hand smoke
TCC	Tobacco Cessation Clinics
THS	Third Hand Smoke
WHO	World Health Organization

Introduction

Tobacco consumption is currently the single leading preventable cause of death globally.[1] Tobacco kills over 7 million people every year,[2] which means that, every day, more than 19 000 people die from tobacco use or second hand smoke exposure. Most tobacco-related deaths occur in low and middle-income countries. Tobacco use is a major risk factor for Chronic Obstructive Pulmonary Disease (COPD), Cardio Vascular Disease (CVD), cancer and stroke. Tobacco can be deadly even for non-smokers: Second-Hand Smoke (SHS) contributes to heart disease, cancer and other diseases causing around 890 000 premature deaths annually. India is the second largest consumer of tobacco (IIPS, 2009-2010) and is a home to 267 million tobacco users.

In India, tobacco is used in two forms: smoking form and smokeless forms. The most prevalent form of tobacco use in India is smokeless tobacco and commonly used products are khaini, gutkha, betel quid with tobacco and zarda. Smoking forms of tobacco used are bidi, cigarette and hookah.[3] Smoke Less tobacco (SLT) is a form of tobacco that need not be ignited for use but just applied orally and nasally. Smoking leads to faster and more severe progression of TB. Also it has been shown that mortality from tuberculosis was four times greater among smokers than non-smokers.[4] TB patients who smoked developed more pulmonary diseases and were more likely to require hospitalization than those who did not smoke. Hence it is important that smoking cessation has to be promoted among TB patients, especially in country like India with high TB burden.

Tobacco control in India

India is one of the 29 countries of the globe that completely banned all forms of tobacco advertising, promotion and sponsorship. Recognizing the significance of tobacco cessation, 13 Tobacco Cessation Clinics (TCCs) were started in 2002 by the Ministry of Health and Family Welfare (MoHFW), Government of India (GOI), with the support of World Health Organization (WHO) India, and were gradually increased to 19 in order to provide tobacco cessation interventions. They were set-up in diverse settings such as cancer treatment hospitals, psychiatric hospitals, medical colleges, NGOs and community settings to help users to quit tobacco use. The objectives of these clinics were to develop cessation strategies for smokers and smokeless tobacco users. According to Cigarettes and Other Tobacco Products Act (COTPA) established in 2003, direct and indirect advertisements of tobacco products,

smoking in public places, sale of tobacco to minors and smoking within a radius of 100 yards of educational institutions are all prohibited; it also included mandatory display of pictorial warning and mandated testing of tar and nicotine content of all tobacco products.[5] Currently, the Programme is being implemented in all 36 States/Union Territories covering over 600 districts across the country (NTCP, 2021). NTCP is implemented through a three-tier structure, i.e. (i) National Tobacco Control Cell (NTCC) at Central level (ii) State Tobacco Control Cell (STCC) at State level & (iii) District Tobacco Control Cell (DTCC) at District level. There is also a provision of setting up Tobacco Cessation Services at District level. Moreover TCCs are established at all dental colleges in India.

Prevalence of smokers in India

GATS-2 reports that the prevalence of tobacco use is 28.6 among adults in any form, 10.7% smoke, and 21.4% use SLT (GATS, 2016-2017). Khaini (a form of SLT) and beedis are the dominant forms of tobacco consumed in India, at 11% and 8%, respectively (GATS, 2016-2017). Compared with GATS 2010, there has been a 6% decrease in the tobacco consumption recorded in GATS 2017 and also the NFHS-4 has shown decrease in the prevalence rate compared with NFHS-3.[6]

About 23% of adults have reported SHS exposure at public places (GATS 2016-17). In NFHS-3, 25% women reported SHS exposure at home.[7] The GATS 2, released by MoHFW, reveals that Tamil Nadu is the only South Indian state to report a higher prevalence of tobacco usage across different age groups when compared to GATS 1. According to GATS 2, overall use of tobacco went up from 16.2% in 2009-10 to 20.0% in 2016-17 in Tamil Nadu.

Disease Burden

Tobacco is an important risk factor for Non-Communicable Diseases (NCD); the total burden of NCDs is expected to rise from 40% in 1990 to 75% by 2030.[8] In India, the burden of CVD, respiratory diseases, tuberculosis and cancers is very high. Noteworthy of mentioning here is oral cancer; India has highest oral cancer rates in the world.[9] Tobacco is responsible for 90% of oral cancer cases and 52% caused using SLT consumption.[4] Exposure to tobacco smoke both active and passive increase the risk of developing TB disease.[10]

Economic Burden

The total economic costs attributed to tobacco use from all diseases in India in the year 2011 for persons aged 35-39 years amounted to ₹ 104 500 crores (US$ 22.4 billion), of which 16% was direct and 84% was indirect cost.[4] Direct medical costs of hospital care and treatment of tobacco attributable diseases amounted to ₹ 16,800 crores (US $ 3.6 billion) and associated indirect morbidity cost amounted to ₹14,700 crores (US$ 3.1 billion). The cost from premature mortality was ₹ 73,000 crores (US$ 15.6 billion), CVDs shared the highest burden (₹ 3,600 crores) of direct medical and indirect morbidity costs on account of tobacco use, followed by respiratory disease (₹ 2,800 cores), tuberculosis (₹ 2,300 crores) and cancers (₹1,400 crores). In Tamil Nadu, the average monthly expenditure on cigarette (for cigarette daily smoker) is ₹ 1343.8 and on bidi (for daily bidi smokers) is ₹ 522.7 (GATS 2, 2016-17).[6]

Role of primary Health Care

World Health Organization has called for tobacco cessation to be integrated into primary care.[11] In India, the role of primary healthcare providers is immense in tobacco cessations. Primary Health Centre (PHC) is the most common setting for the provision of tobacco cessation advice.[12] Health Service Providers (HSPs) at this level of health care are well placed to use patient's visit as an opportunity for providing screening and brief interventions in tobacco cessation. Provision of advice and support to tobacco users by health service providers in primary care settings improves cessation rates.[13] The indicators number and percentage of tobacco users who were successfully quit tobacco use at the end of 6 months and one year of receiving tobacco cessations services, number and percentage of doctors and health workers at PHCs who have been formally trained in tobacco control and cessations treatment will be monitored and evaluated .[14]

Effectiveness of different smoking cessation strategies

In Tamil Nadu, 73.8% of smokers were advised by a health care provider to quit smoking and 59.1 of smokeless tobacco users were advised by a health care provider to quit smokeless tobacco use.[6] Smoking cessation messages delivered by a physician, even when brief, are known to be effective as a strategy to promote smoking cessation.[15,16] All the commercially available forms of Nicotine Replacement Therapy (NRT) are effective as part of a strategy to promote smoking cessation.[17] An ICMR-NIRT study on physician's advice on quitting smoking among TB patients had shown a success rate of 35-40% with or without counsellor's counselling.[18] Studies assessing *Bupropion SR* (Sustained Release) intervention in smoking

cessation in general population done in India, had been doing well.[19] The report based on this cluster randomised trial concluded that enhanced counselling including giving one to one counselling using flip charts by the RNTCP health care workers to the TB patients attending the RNTCP centres for TB treatment as well as drug therapy using *Bupropion SR* with standard counselling were effective strategies for smoking cessation for TB patients treated in TB program.[20]

Research Question

1. Is Enhanced Counselling or promotion of Bupropion Sustained Release is cost-effective than that of the current strategy for smoking cessations among general population aged ≥15 years old attending Primary Health Care (PHC) centres in Tamil Nadu?

Objectives

1. To compare the cost-effectiveness of the 'Enhanced counselling' strategy with the current strategy for smoking cessations in population aged ≥15 years attending the PHC centres in Tamil Nadu.
2. To compare the cost-effectiveness of the 'promotion of Bupropion Sustained Release prescription' strategy with the current strategy for smoking cessations in population aged ≥15 years attending the PHC centres in Tamil Nadu.
3. To estimate the quit smoking through enhanced counselling strategy or Bupropion Sustained Release promotion as compared to current strategy for population aged ≥15 years for smoking cessation implemented at PHC centres in Tamil Nadu.

Methodology

Study Setting

ICMR-NIRT conducted cluster randomised trial on smoking cessation for TB patients and shown it was effective for quit-smoking[20]. The current study is modeling analysis to project the cost and effectiveness of implementing this intervention. This study is based on only secondary data analysis. The comparison is done for smoking cessation through enhanced counselling strategy and Bupropion Sustained Release promotion as compared to current practice for population attending PHC in Tamil Nadu.

Study Population

General population aged ≥15 years who visits PHC who are treated under NTEP in Tamil Nadu.

Study Perspective

The cost-effectiveness modelling is conducted primarily from health system perspective, which includes cost incurred by the health system.

Comparator and time horizon

The present model compares the costs and outcomes of implementing smoking cessation at PHC facilities with the current practice. This model characterizes the health state of the population and the population was followed till they quit smoking.

Table 1. Strategy for smoking cessation implemented at PHC centres in Tamil Nadu

Strategies	Level of implementation	Smoking cessation steps	Population
Proposed Strategy-1	Primary Health Care Centres	**1. Enhanced counselling:** Motivational Package includes Brochures, Flip charts, Posters, Movie/video presentations, Family counselling + NRT (nicotine patches, gums, spray, inhaler, sublingual tablets and lozenges) + Pharmacological Therapy - Bupropion tablet	General Population aged ≥ 15 years old
Proposed Strategy-2	Primary Health Care Centres	**2. Enhanced counselling + NRT + Promotion of Bupropion Sustained Release prescription:** Training of Medical Officers and adequate stocking of Bupropion Sustained Release	General Population aged ≥ 15 years old
Proposed Strategy-3	Primary Health Care Centres	3. **Standard counselling + NRT + Promotion of Bupropion Sustained Release prescription**	General Population aged ≥ 15 years old
Current Strategy	Primary Health Care Centres	Standard Counselling (or)	General Population aged

Strategies	Level of implementation	Smoking cessation steps	Population
		NRT (nicotine patches, gums, spray, inhaler, sublingual tablets and lozenges) (or) Pharmacological Therapy - Bupropion tablet	≥ 15 years old

Economic model overview

A decision tree model is used to estimate cost-effectiveness of introducing enhanced counselling to general population in addition to current strategy at PHC level in Tamil Nadu. This present model is developed based on the prevalence rate of smoking among general and TB populations, acceptance of tobacco smoking cessation, quit rate to calculate the ICER. The present study is developed economic model to calculate ICER for the intervention and comparator. The ICER is calculated from the cost and quit from smoking by different interventions.

Decision Tree

Decision tree model planned for this study is constructed based on the three strategies. The proposed strategy of enhanced counselling and promotion of bupropion sustained release with the current strategy of standard counselling and NRT under National Tobacco Control Programme were modelled as two parallel trees using probabilities associated with smoking cessation and outcome which are provided in the Figure-1. Microsoft excel spread sheet and Tree Age software (Licensed version 2020 R 1.0) will be used for analysis.

Figure 1: Decision tree for implementing smoking cessation strategies
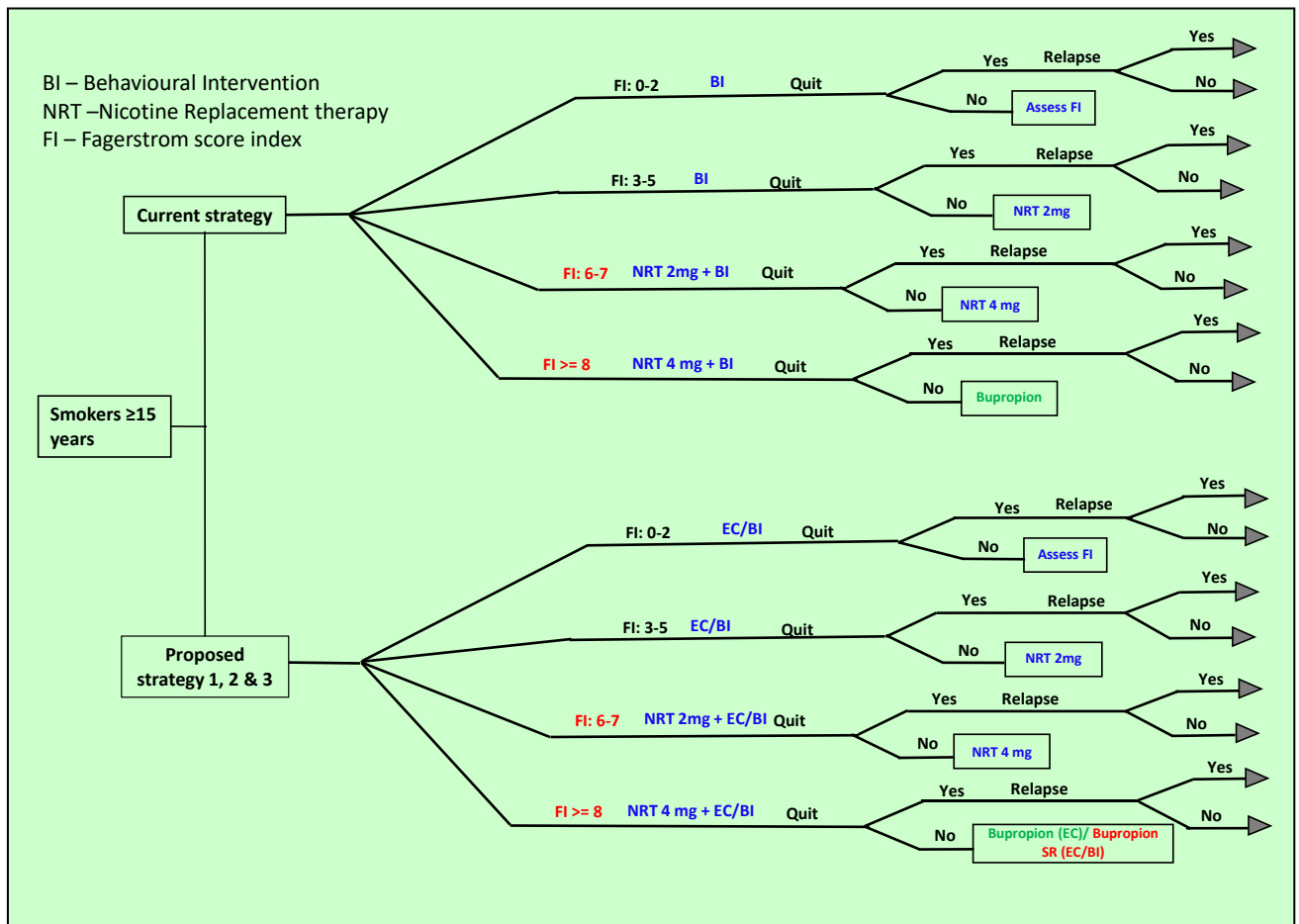
Current strategy

For smokers who are willing to quit smoking having FI score from 0-2 go for behavioural intervention alone; FI score from 3-5 will undergo behavioural intervention and NRT 2mg treatment; FI score from 6-7 will undergo behavioural intervention and NRT 2mg + NRT 4mg treatment; and FI score more than 7 will undergo behavioural intervention and NRT 4mg + Bupropion treatment.

Model Assumptions

This study is a model-based estimation of incremental costs and quit rate of smoking tobacco by introduction of implementing smoking cessations strategies at PHC for general population. We modelled this study using decision tree analysis.

Proposed strategy

1. Enhanced Counselling

For smokers who are willing to quit smoking having FI score from 0-10 will undergo for enhanced counselling (including physician's advice) using the following tools.

1. **Brochures on smoking cessation provision:** Education material with information containing harms of smoking and information how to quit smoking.

2. **Flip charts:** An extensive counselling by one to one sitting with the patient, using a flip chart prepared exclusively for the study purpose, explaining the hazards of smoking, association of TB & smoking, how to quit smoking, withdrawal symptoms and family benefits on quitting smoking were shown.

3. **Posters:** Three posters with two with details of harms of smoking, and one with TB - Smoking associations pasted in the study centres were shown.

4. **Movie/video presentations:** Movie clips on smoking and its harms - a video by Sai creation's 'Sathamilla maranangal' directed and produced by R.Venkatramanan, which tells about harms of smoking were shown in the study centres wherever DVD players were available.

5. **Family counselling:** Family members were also counselled and were sorted to extend their support in helping the subjects to quit smoking wherever possible.

II. Promotion of Bupropion Sustained Release

People who are willing to quit smoking those who have FI score 0-10 will undergo for Bupropion Sustained Release treatment.

Model Input Parameters

The key input parameters for the model includes: demographic, prevalence of smoking, all-cause mortality, probability of quitting smoking and health system cost incurred for smoking cessation. All these information is extracted from the published literature.

Cost Data

The cost data for enhanced counselling is collected from the cluster randomized trial conducted by ICMR-NIRT on smoking cessation in TB that had included all the related trainings, IEC materials and others details and costs details. The various cost for implementing smoking cessation strategies included such as training the staff for delivering

the counselling, cost of the related IEC materials, human resource cost, management cost, training cost, providers cost, drug cost, cost of NRT and consultancy cost.

Effectiveness Data

Quit rate through enhanced counselling strategy/ promotion of Bupropion SR as compared to current strategies for general population aged ≥15 years old is estimated. Quit rates are self-reported. The incremental cost per person quit from tobacco smoking by enhanced counselling strategy/ promotion of Bupropion SR is also estimated. Due to non-availability of relapse rate we have used different rate and estimated ICERs.

Data on epidemiological parameters

All epidemiological parameters such as prevalence of smokers in general population, quit rate among smokers in general population is obtained from published literatures.

Table 1. Input parameters used for cost-effectiveness analysis of the enhanced counselling for smoking cessation as compared to behavioural intervention

Variable		Base case	Lower	Upper	Distribution	Source
Demographic	Average age of smokers	18.2	14.56	21.84	Normal	21
	Cohort Population	100,000	100,000	100,000	NA	Expert opinion
	Life expectancy	55	44	66	NA	
Prevalence	Smokers in general population	0.2	0.16	0.24	Beta	22
	Smokers with FI:0-2	0.02	0.016	0.024	Beta	
	Smokers with FI:3-5	0.11	0.088	0.132	Beta	
	Smokers with FI:6-7	0.62	0.496	0.744	Beta	23
	Smokers with FI:≥8	0.23	0.184	0.276	Beta	
	Smokers given BI	0.143	0.1144	0.1716	Beta	
	Smokers given NRT/Bupropion	0.034	0.0272	0.0408	Beta	24
BI-HR Cost	Doctor cost	150	120	180	Gamma	Expert opinion
	Social/Health Care Worker	94	75.2	112.8	Gamma	Expert opinion
Drug Cost	NRT 2mg	6	4.8	7.2	Gamma	25
	NRT 4mg	7	5.6	8.4	Gamma	26
	Bupropion	8	6.4	9.6	Gamma	27

Variable		Base case	Lower	Upper	Distribution	Source
Enhanced Counselling Cost	IEC material preparation	196	156.8	235.2	Gamma	Expert opinion
	DVD	50	40	60	Gamma	
	Flip Chart	295	236	354	Gamma	
Outcome General population	Quit rate by BI	0.52	0.416	0.624	Beta	28
	Quit rate by NRT	0.6	0.48	0.72	Beta	29
	Quit rate by Bupropion	0.67	0.536	0.804	Beta	28
	Quit rate by Promotion of Bupropion	0.67	0.536	0.804	Beta	
	Quit rate by Enhanced counselling	0.83	0.664	0.996	Beta	
Mortality	All-cause mortality	0.076	0.0608	0.0912	Beta	30
Quality of life	Smokers	0.85	0.68	1.02	Beta	31

FI=Fagerstorm Index Score; BI=Behavioural Intervention; NRT=Nicotine Replacement Therapy

Cost-effectiveness Analysis

After the estimation of cost and consequences for smoking cessation strategies versus comparator scenario, the ICER is calculated.

Base case analysis

Cohort size of 1000 individuals entered the decision analytic model for the estimation of incremental costs and incremental quit rate from tobacco smoking by introduction of enhanced counselling and promotion of Bupropion treatment for smoking cessation. Model results are expressed in terms of ICER value for the proposed strategy.

Calibration and sensitivity analysis

The robustness of model results is tested through a sensitivity analysis by varying input parameters between 20% above or below the estimated values. The sources of uncertainty especially parameter uncertainties which would influence cost-effectiveness outcome is evaluated by one-way sensitivity analysis (OWSA). Uncertainty in outcome variables and their effect on ICER is tested by Tornado diagram.

Results

Base case analysis

Table 3. Incremental cost-effectiveness ratio

		Total cost (₹) Crores	Persons quit form smoking	Cost (₹) Crores	Effect	ICER
Comparator	Standard Counselling + NRT + Bupropion	40.22	56264	-	-	-
S1	Enhanced Counselling + NRT + Bupropion	39.07	72337	-1.15	16073	-714
S2	Standard Counselling + NRT + Bupropion SR	39.73	53059	-0.49	-3205	1531
S3	Enhanced Counselling + NRT + Bupropion SR	38.80	68779	-1.44	12515	-1131

The ICER value for strategy-1 (Enhanced Counselling + NRT + Bupropion) is -714 which indicates that compared to the current strategy (Standard Counselling + NRT + Bupropion), strategy-1 is saving ₹714 per person for quitting smoking. The ICER value for strategy-3 (Enhanced Counselling + NRT + Bupropion SR) is -1131 which indicates that compared to the current strategy (Standard Counselling + NRT + Bupropion SR), strategy-3 is saving ₹1131 per person for quitting smoking. Whereas the strategy-2 (Standard Counselling + NRT + Bupropion SR) had an ICER value of ₹1531, indicating ₹1531 need to spend additional to get one per person for quitting smoking compared to current strategy.

Figure 2. Cost effectiveness plane
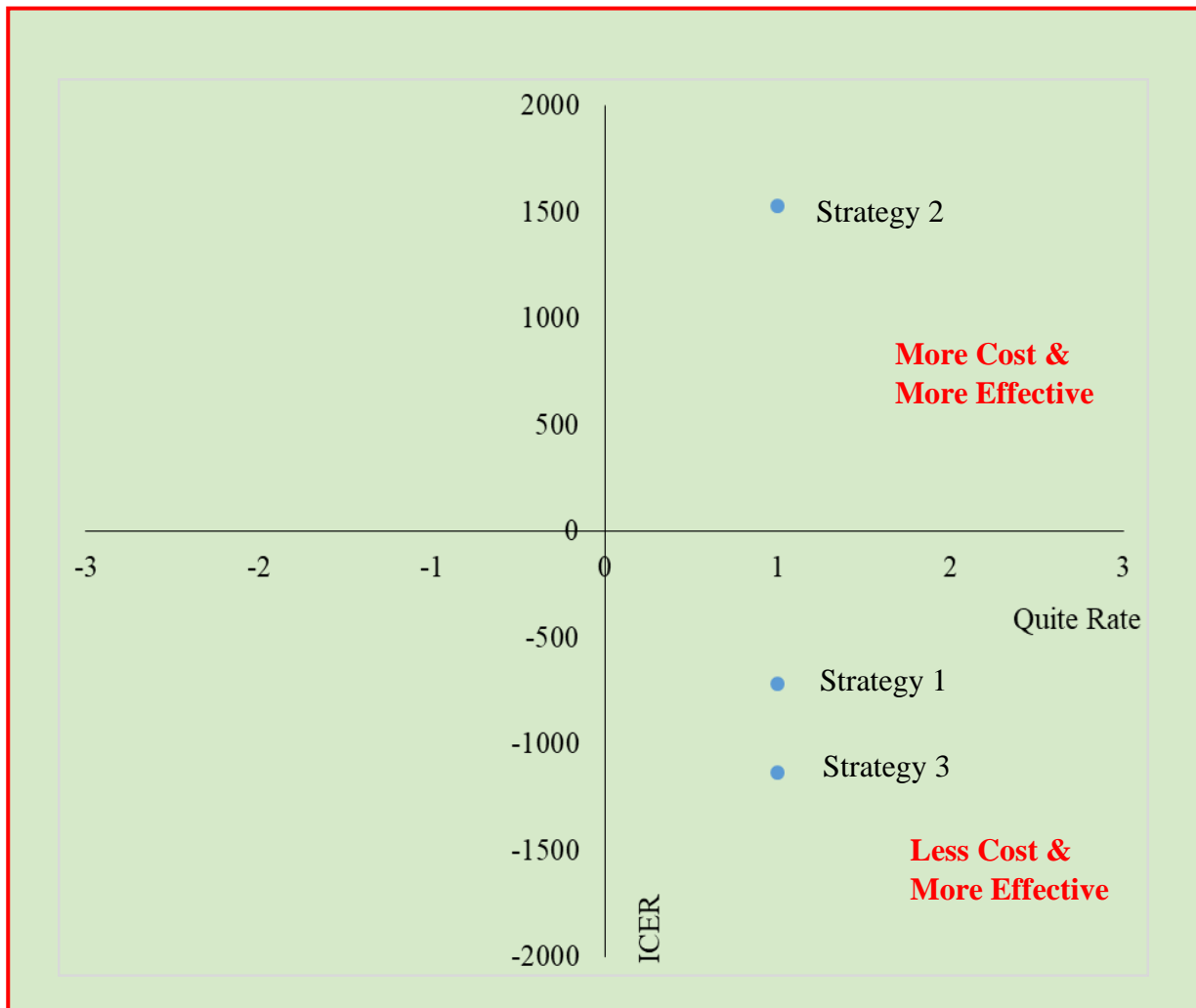

The ICER value of 2 proposed strategies are falling in the second quadrant which shows that the proposed strategies are acquiring less cost and yielding more effectiveness in comparison with the current strategy. The strategy 2 is falling in the first quadrant which indicates that strategy 2 is requiring more cost and more effective compared to the current strategy (Figure-2).

Table 4. Association between different relapse rate and ICERs

	Relapse rate										
	0%	5%	10%	20%	30%	40%	50%	60%	70%	75%	80%
S1	-714	-551	-371	58	609	1343	2372	3915	6486	8543	11629
S2	1531	1810	2120	2856	3803	5066	6833	9485	13904	17439	22741
S3	-1131	-995	-843	-484	-21	596	1460	2756	4915	6642	9234

We have assessed the association between different relapse rate and ICERs. We have studied the change in the ICER value with respect to change in relapse rate. In strategy 1,2 and 3, the ICER is increasing as the relapse rate is increasing (Table-4).

Figure 3. Association between different relapse rate and ICERs
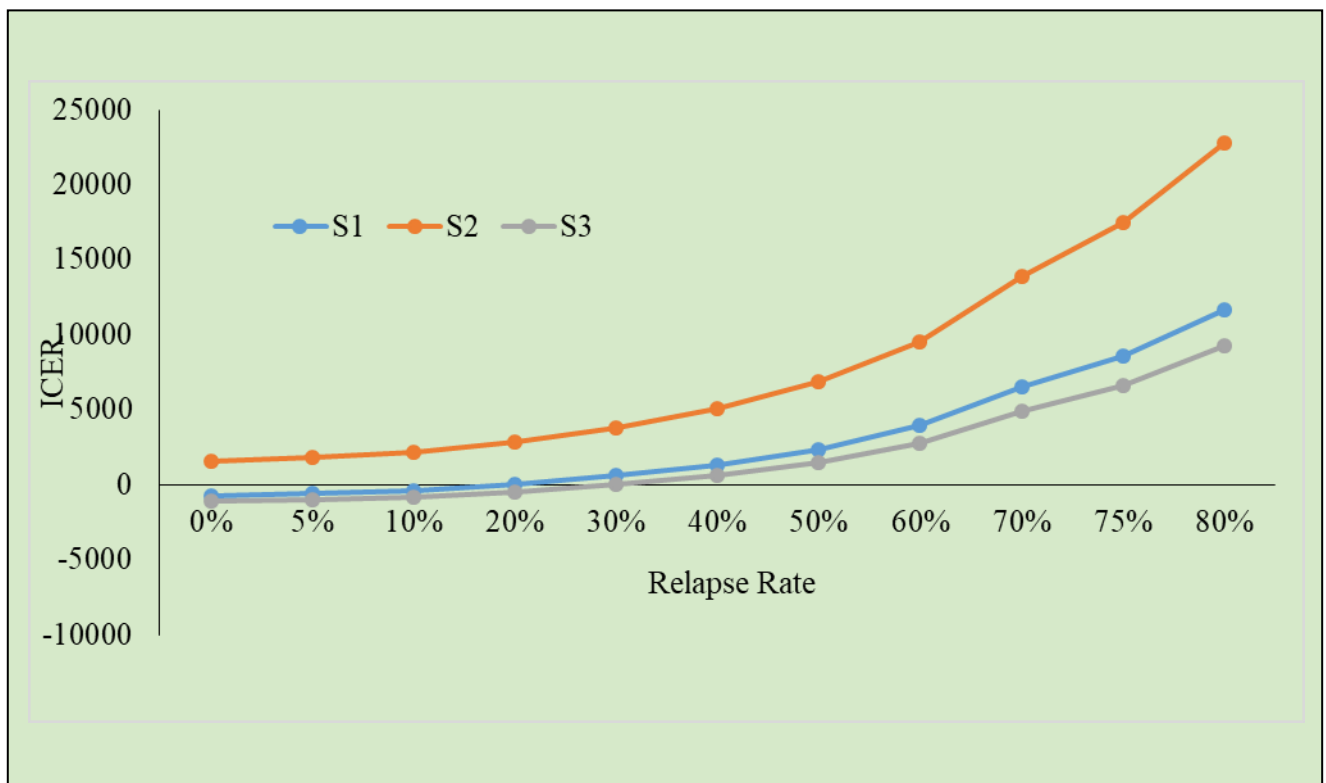
We have studied the association between different relapse rate and ICERs. In different scenarios of relapse rate, we have checked the ICER values. As the relapse rate is increasing, the ICER is also increasing. That is the cost to be spent for one person for quitting smoking is

increasing if the relapse rate of smokers is increasing. Strategy 1 is turning out to be cost effective when the relapse rate is 20% and strategy 3 is turning to be cost effective when the relapse rate is at 40%.

Figure 4. One Way Sensitivity Analysis (Strategy 1 vs Current Practice)
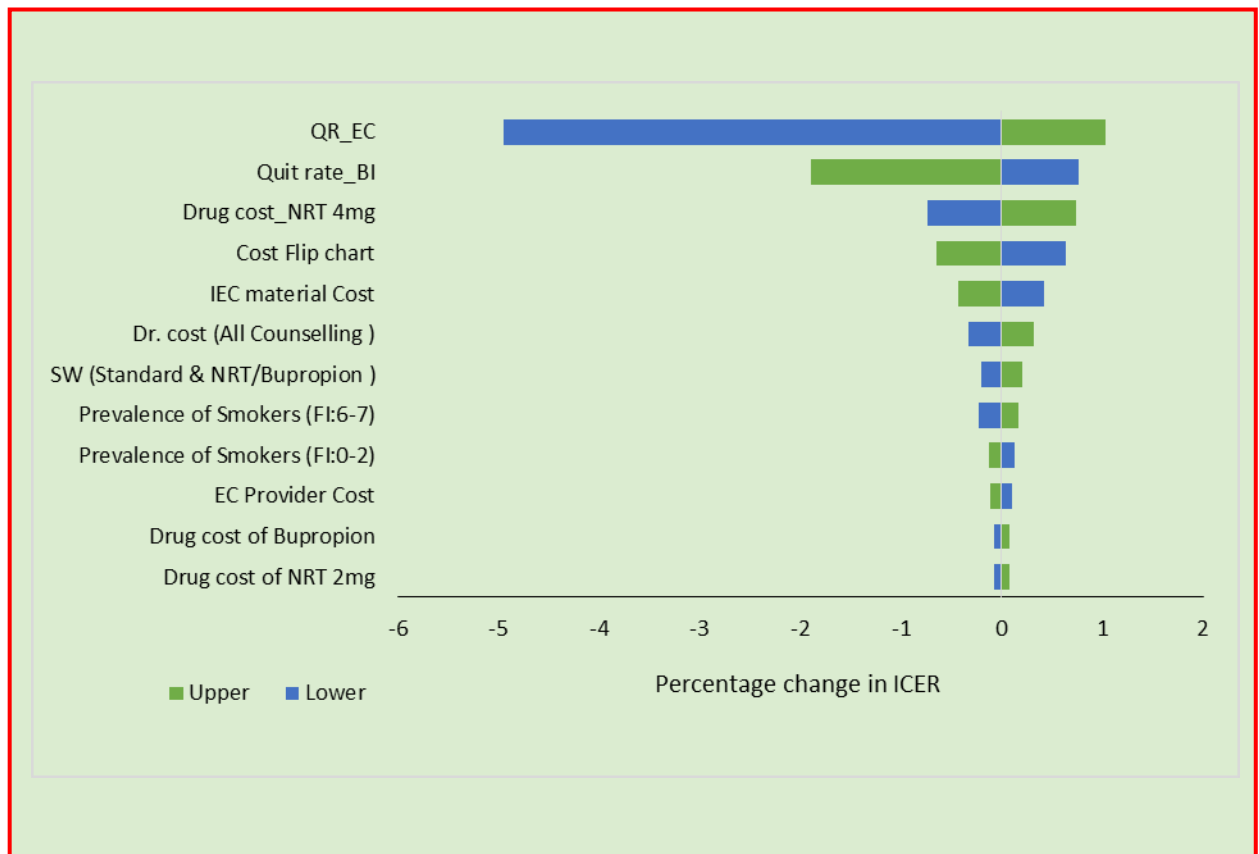
The OWSA showed that the (Figure 4) quit rate by enhanced counselling, quit rate by behavioural intervention, drug cost of NRT had the higher impact on ICER.

Figure 5. One Way Sensitivity Analysis (Strategy 2 vs Current Practice)
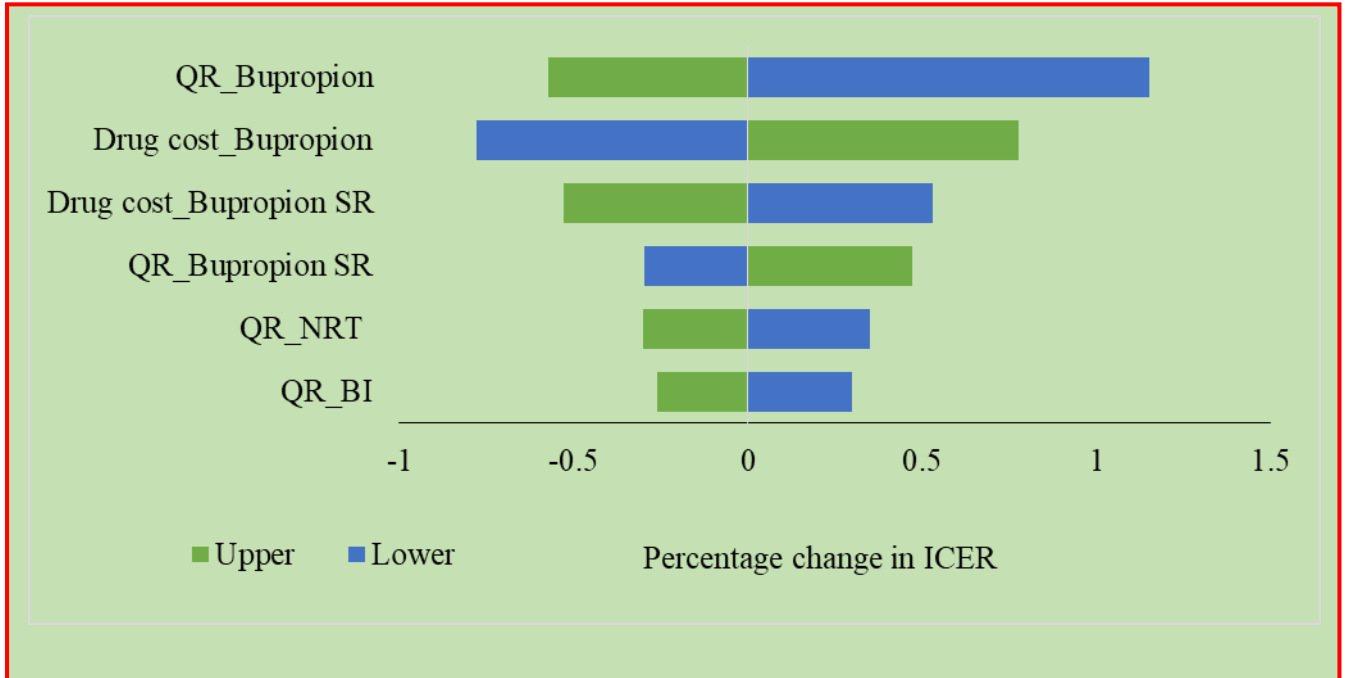
The OWSA showed that the quit rate by Bupropion, drug cost of Bupropion, drug cost of Bupropion SR and quit rate by Bupropion SR had the higher influence on ICER (Figure 5).

Figure 6. One Way Sensitivity Analysis (Strategy 3 vs Current Practice)

The OWSA showed that the quit rate by enhance counselling, quit rate by Bupropion and quit rate by behavioural intervention played major influence on ICER (Figure 6).
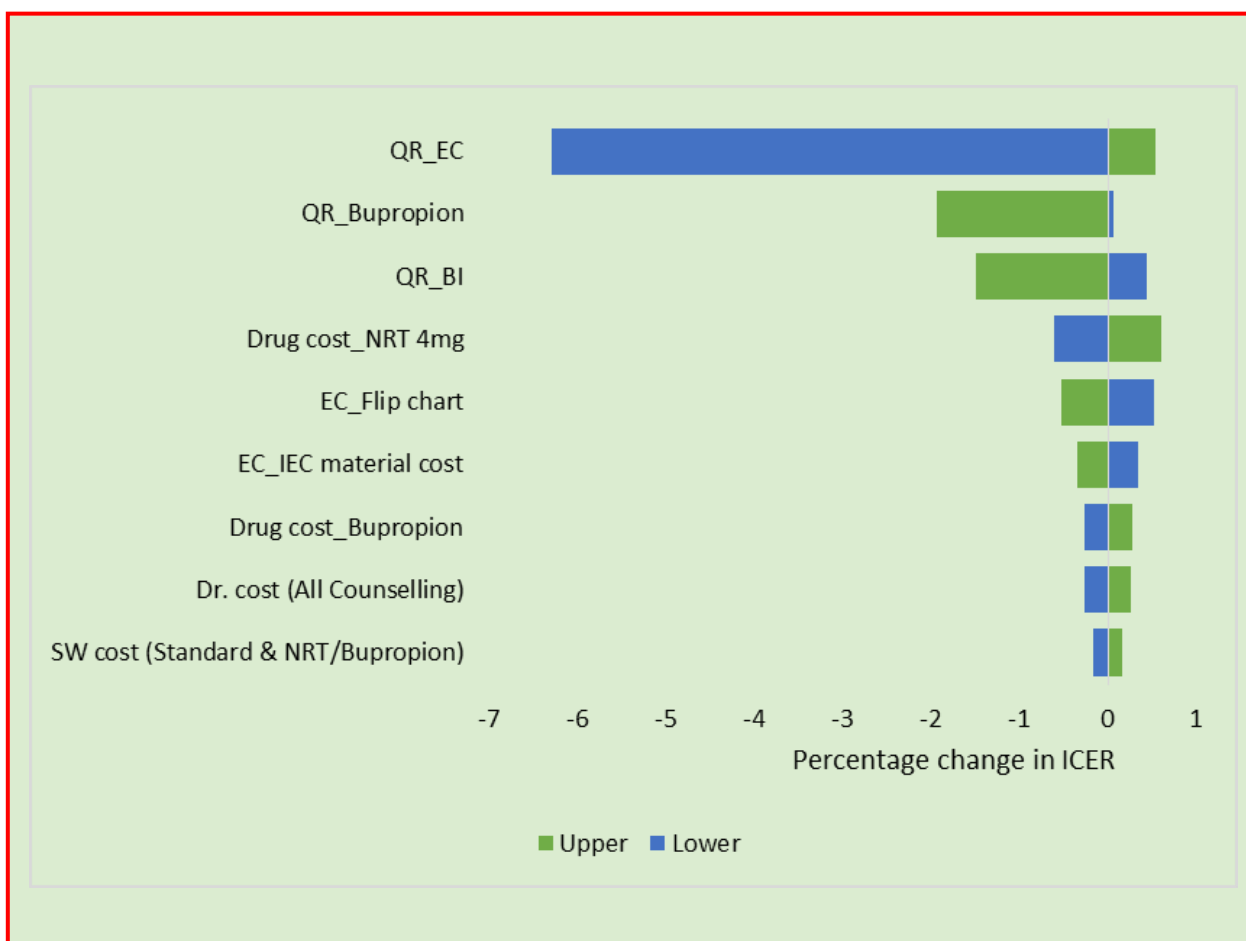
Limitation

In the current study, the relapse rate of smokers and adverse reactions of the drugs given are not included. This could have underestimated the results. The markov model consisting of different health states was not modelled in the study. Due to the non-availability of data for transition probabilities, disease transition states and the quit rates for dose specific drugs they are not included in the study. The different factors associated to BI such as close monitoring, type of communicators, influence of co morbidities in BI has not been taken in to account in

the cost and effectiveness data. This might have underestimated the results. We did not consider the relapse rates as they were not available specific to treatments for smoking cessation.

Summary and Conclusion

In summary, compared to the current strategy that is used for smoking cessation (Standard Counselling + NRT + Bupropion) the proposed strategy (Enhanced Counselling + NRT + Bupropion) saves a cost of ₹714 per person for quitting smoking. In the second proposed strategy (Standard Counselling + NRT + Bupropion SR), we have to spend ₹1531 more than the current strategy and in proposed strategy-3, we have to spend ₹1131 less per person for quitting smoking. Among the three proposed strategies, strategy-3 is the most cost saving strategy compared to the current strategy followed by strategy-1. This is due to the difference in total cost and quit rate among the three strategies. The drug cost of NRT 4mg is comparatively higher than the other drug costs. The quit rate by enhanced counselling is higher than the other interventions followed by bupropion which has a quit rate of 67%. In conclusion as smoking continues to be a major threat for developing heart diseases, cancer, and lung disease, it is the need of the hour to implement the most cost-effective smoking cessation strategy in order to reduce the prevalence of smoking in India. Our study findings indicate that the strategy that includes enhanced counselling and Bupropion SR is the most cost effective strategy compared to the current strategy. There is now consistent evidence for this strategy to be implemented in smoking cessation programmes.

Table 4: Review of literature on Prevalence of smoking

Ref	Population	n	Design	Study Area	% (smoking)
32	Adult patients seeking tuberculosis treatment	1926	Cross sectional study	South Africa	21.8
33	Pulmonary TB men + HIV	279	Case control study	South Africa	33
34	Pulmonary TB patients	200	Cross sectional study	Tehran	34
35	PTB patients relapsed within 12 months of treatment completion	220	Prospective nested case control study	Yemen	23
36	Patients with TB	472	Retrospective cohort study	Pakistan	14.4
37	MDRTB patients	193	Cross sectional study	Tanzania	41.5
38	Adults who initiated LTBI treatment	393	Retrospective cohort study	Washington	12.5
39	TB patients	16345	Prospective study	China	22.7
40	High tuberculosis incidence area	2401	Cross sectional study	South Africa	55
41	New sputum smear-positive TB patients	750	Intervention study	Indonesia	77.6
42	Discharged TB patients	877	Survey	Japan	32.3
43	PTB patients	235	Cross sectional study	Puducherry	35.3
44	PTB patients	424	Cross sectional study	South India	41.5
45	pulmonary TB patients	2350	Hospital based prospective study	Karnataka	32.2
46	Tribal population	1602	Case control study	Madhya Pradesh	46.8
47	MTB patients	741	Case control study	Madhya Pradesh	34.8
48	Adult patients with TB	413	Convergent parallel mixed methods	Karnataka	21
49	TB patients	2879	Intervention study	Gujarat	46.3
50	Pulmonary TB patients	101	Observational prospective study	New Delhi	41.6
51	Saharia tribal community	9538	Cross sectional study	Madhya Pradesh	34.3
52	TB patients	307	Cross sectional study	Karnataka	9.8
53	Young Adults	2016	Cross-sectional study	Mangalore	11.4
54	Young Adults	2016	Cross-sectional study	Kerala	6.9
55	Students	4820	Survey	Tamil Nadu	7.1
56	Men	714	Survey	Rural Tamil Nadu	36.9
57	General population	7510	Survey	Chennai	13.5
58	General population	797540	cross-sectional study	India	14.4
59	General population	100000	survey	China	54

Table 5: Review of literature on Effectiveness of smoking interventions

Ref	Population	Sample	Intervention	Study Area	% of people quit smoking
60	Smokers registered for TB treatment	152	Ask Brief Cessation support package	Chandigarh	80.2
61	New csases of TB who currently smoke cigarettes	86	Smoking cessation intervention (SCI)+DOTS	Malaysia	77.5
62	Adult smokers with suspected tuberculosis	1955	Brief Behavioral Support sessions (BSS), BSS plus 7 weeks of bupropion therapy (BSS+)	Pakistan	41.0/45.4
63	TB patients	2879	Brief advice for tobacco cessation based on five A's	Gujarat	67.3
64	New sputum smear-positive TB patients	750	ABC (Ask Brief advice Cessation support)intervention	Indonesia	66.8
65	Pulmonary TB patients	246	Brief advice	Nepal	39
66	Smokers	1086	Nicotine patch, Varenicline, C-NRT	US	22.8/23.6/26.8
67	Adult daily smokers	1310	Cytisine , NRT	New Zealand	40/31
68	Adult smokers	205	bupropion therapy	Canada	21
69	Smokers	314	Nicotine inhaler or gum	Prague	20.1

Table 6: Review of literature on cost-effectiveness of smoking cessation strategies

Ref	Year	Population	Sample	Design	Study Area	Interventions	Cost Effectiveness
70	2018	Medicaid smokers	3186	Randomized Control Trial, July 2012 and May 2013	California, US		Adding both financial incentives and nicotine patches to usual quitline care would result in $15 million net savings with a benefit−cost ratio of 1.30 over 10 years compared with the usual care plus nicotine patches strategy. It would yield $44 million net savings, with a benefit−cost ratio of 1.90 over 10 years compared with usual care alone.
71	2017	Current smoking population (18+ years)	67 538 844	Markov-based state transition return on investment model (EQUIPTMOD).	Germany	Group-based behavioural support, financial incentive programmes and varenicline	1) The highest returns through reduction in smoking-related health-care costs were seen for the financial incentive programme (€2.71 per €1 invested), followed by that of group-based behavioural support (€1.63 per €1 invested), compared with no interventions. 2) Prospective scenario 1 led to 15 034 QALYs gained and €27 million cost-savings
72	2018	adult smokers	1,83,94,068	Clinical trial; Benefits of Smoking Cessation on Outcomes (BENESCO) Markov model	US	varenicline, bupropion, nicotine replacement therapy (NRT) patch, and placebo	1) For varenicline, there were an estimated 319,730 fewer smoking-related morbidities at the lifetime compared with placebo. 2) Smoking-related mortality decreased by 198,240 subjects when varenicline was compared with placebo.
73	2011	65-year-old male smokers with a small	Literature data	A Markov cohort simulation model		Adjuvant pharmacotherapy	1) The incremental cost/effectiveness ratio reached the willingness-to-pay threshold value of €25,000 per life-year gained

Ref	Year	Population	Sample	Design	Study Area	Interventions	Cost Effectiveness
		Abdominal Aortic Aneurysms (AAA)					when assuming an intervention cost of >€3250 or an effect of ≤1% difference in long-term smoking cessation between the intervention and nonintervention groups.
							2) Smoking cessation resulted in a relative risk reduction for elective AAA repair by 9% and for rupture by 38% over 10 years of follow-up
74	2018	65-year-old smokers with cancer	Literature + Ontario cancer careand reports	Markov model	Ontario,Canada	basic program (screening + advice + referral), basic program + pharmacological therapy (varenicline) + counseling +follow-up	1) The incremental cost-effectiveness ratio of the best practice smoking cessation program compared to the basic smoking cessation program was $3367 per QALY gained and $5050 per LY gained for males, and $2050 per QALY gained and $4100 per LY gained for females
75	2019	Canadian Inuit communities		Transmission model, Decision analysis modelling	Canada	Increased tobacco taxation, pharmacotherapy and counselling for smoking cessation, pharmacotherapy+ counselling + mass media campaign, the combination of all.	1) The combined strategy was projected to reduce active TB cases by 6.1% (95% uncertainty range 4.9–7.0%) and TB deaths by 10.4% (9.5–11.4%) over 20 years, relative to the status quo. 2) Increased taxation was the only cost-saving strategy

Table 7: Review of literature on economic impact due to smoking

Ref	Year	Population	Sample	Design	Study Area	Economic impact
76	2017	Smoking population in European countries	2000	EQUIPT ROI -Economic model uses Markov state transition cohort model to estimate life-time costs, quality-adjusted life years (QALYs) and life years associated with a current and former smoker.	European countries	1)Will reduce life expectancy by 0.66, 2) Reduce QALYs by 1.09 3) Result in £4961 higher disease-related health care costs than if the smoker ceased smoking in the next 12 months.
77	2017	Smoking population in 186 countries			186 countries	1)The global smoking-attributable burden was 251,160 disability-adjusted life years 2) On national level, it was highest in China (69,148 DALYs), India (29,362 DALYs) and the United States (12,714 DALYs)
78	2016	Smokers in Thailand		Prevalence-based, disease-specific cost of illness approach	Thailand	1) Total economic burden of smoking amounted to $2.18 billion 2) Total medical cost was US$0.37 billion 3) The total cost of smoking accounted for 0.78% of the national gross domestic product and about 18.19% of total health expenditure.
79	2015	Smokers		Number of major cancer deaths due to smoking by sex and age groups in 2012 was obtained from GLOBCAN database. The life expectancy and retirement age were used to estimate years of potential life lost (YPLL) and cost of	Iran	1) Smoking was responsible for 4,623 cancer deaths, 80808 YPLL and $US 83,019,583 cost of productivity loss 2) 22% of cost of productivity lost was attributable to

Ref	Year	Population	Sample	Design	Study Area	Economic impact
				productive lost attributable to smoking, respectively		smoking
80	2015	Smokers		Probabilistic microsimulation health economic model	Brazil	1) Smoking was accountable for 147,072 deaths, 2.69 million years of life lost, 157,126 acute myocardial infarctions, 75,663 strokes, and 63,753 cancer diagnoses. 2) The direct cost for the health system was of BRL 23.37 billion
81	2016	Smokers	23,738	Microsimulation model	Peru	1) Yearly total of 16,719 deaths, 6,926 cancer diagnoses, 7,936 strokes, and 7,548 hospital admissions due to cardiovascular disease can be attributed to smoking. 2) 396,069 years of life are lost each year from premature death and disability 3) Cost of treating smoking-attributable health issues rises to 2,500 million soles

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