ORIGINAL ARTICLE

Malaysia Abridged SimSmoke Model - Towards Achieving 2025 and 2045 Smoking Prevalence Targets

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ABSTRACT

Introduction: In respond to the World Health Assembly global NCD target of 30% reduction in the prevalence of adult tobacco use by 2025, Malaysian government called for lowering its smoking prevalence to 15% by 2025. In addition, moving towards the endgame target of less than 5% smoking prevalence in 2045. **Methods:** Malaysia Abridged SimSmoke model, a simulation model uses specific policy parameters, the most recent smoking prevalence, and population size for Malaysia is developed to estimates and access the impact of MPOWER policies in achieving the targets. **Results:** The 15% prevalence rate in 2025 can be achieved if the Malaysian government increase tobacco excise tax to 72% of the retail price, implement and enforce comprehensive smoke-free air policies, ban all forms of advertising/promotions and run intensive mass media campaigns. Such approach would reduce the number of smokers by about 2.6 million, averting almost 1.3 million premature deaths in the long term. The tobacco endgame target of less than 5% smoking prevalence by 2045 is achievable if the excise tax is further increased to 86.5% of the retail price while all other tobacco control policies are kept at the enhanced level. **Conclusions:** Both the targeted smoking prevalence are a realistic proposition if the proposed measures are fully implemented. It requires a whole government approach with the MOH as a leading agency driving the process. It is important to monitor both the compliance with the new measures and smoking prevalence to make sure that Malaysia is on track in achieving its targets.

Keywords: Tobacco excise tax, Smoking prevalence, Endgame target, MPOWER policies

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INTRODUCTION

To address the rising premature mortality burden due to non-communicable diseases (NCDs), the 2013 World Health Assembly set a global NCD target of 30% reduction in the prevalence of adult tobacco use by 2025 (1). Responding to this, the Malaysian government called for lowering its smoking prevalence to 15% by 2025, a 34% reduction compared to the 2011 prevalence. In addition, Malaysia has joined the other countries such as Hong Kong, New Zealand, Finland and Uruguay in setting up national tobacco use endgame target. Malaysia aims to achieve the endgame target with smoking prevalence of less than 5% by 2045 (2).

Malaysia has nearly five million adult smokers and tobacco use is responsible for 20,000 premature deaths each year (3). In 2015, the overall smoking prevalence was 22.8%, with 43% of male and 1.4% of female consuming cigarettes at least once in the last 30 days.

The government of Malaysia is committed to implement national tobacco control policies based on the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC). The WHO FCTC provides an evidence based guidance for countries to improve their national tobacco control and reach their smoking prevalence targets. The set of recommended policies are outlined in the 2008 WHO MPOWER report which include Monitoring tobacco use and prevention policies, Protecting people from tobacco smoke, Offering help to quit tobacco use, Warning about the dangers of

tobacco, Enforcing bans on advertising, promotion and sponsorship and Raising tobacco taxes.

Malaysia has an active monitoring system for assessing tobacco use via its National Health Morbidity surveys (NHMS). The first NHMS was in 1986, then conducted every 10 years with the second one in 1996 and the third NHMS was in 2006 and subsequently, it is more frequent, with different themes and focus areas. Other surveys are also conducted such as the Global Adult Tobacco Survey in 2011 and Global Youth Tobacco Survey in 2003, 2009 and 2016.

Tobacco use in public places has been regulated since 1993. As of 2016, smoking is prohibited in all public indoor spaces, in air-conditioned eating venues, in public transport, in places of worship, educational facilities, health care facilities and in government institutions.

In conjunction with "Offering help to quit tobacco use," the government offers smoking cessation programs via both private and public clinics where tobacco use disorder are treated through counseling services and pharmacotherapy, which include nicotine replacement therapy (NRT). The Ministry of Health (MOH) also subsidizes NRT and smoking cessation medication such as Varenicline in public health facilities (4).

On top of that, the MOH also run mass media campaign, which was preceeded by the "Tak Nak" (Say No) 2004 grand scale national anti-smoking campaign. Besides the mass media campaign, pictorial healthwarning on tobacco packaging introduced in January 2009 to disseminate information about the danger of tobacco use. The size of these warnings was increased in 2014 to 50% of the front and 60% of the back of all cigarette packages.

Malaysia has banned all forms tobacco advertising, which includes any advertisement on national TV, radio, printed media, internet, publics placesas well as banning some (but not all) other forms of direct and/or indirect advertising.

Tobacco excise tax has been increased annually since 2006, with the exception of 2012 and 2016. Malaysia used to have a mixed tobacco excise tax system consisting of both advalorem and specific tax, but this was changed in November 2015 when the advalorem tax was abolished. At the same time, the specific component of the tax was increased by 43% resulting in higher proportion of excise tax in the average cigarette retail price (an increased from 42.03% to 49.4%). Even with these increments, Malaysia is yet to reach the suggested WHO benchmark of 70% tobacco tax over the retail price (5). Cigarettes are also subjected to 6% Goods and Service Tax (GST).
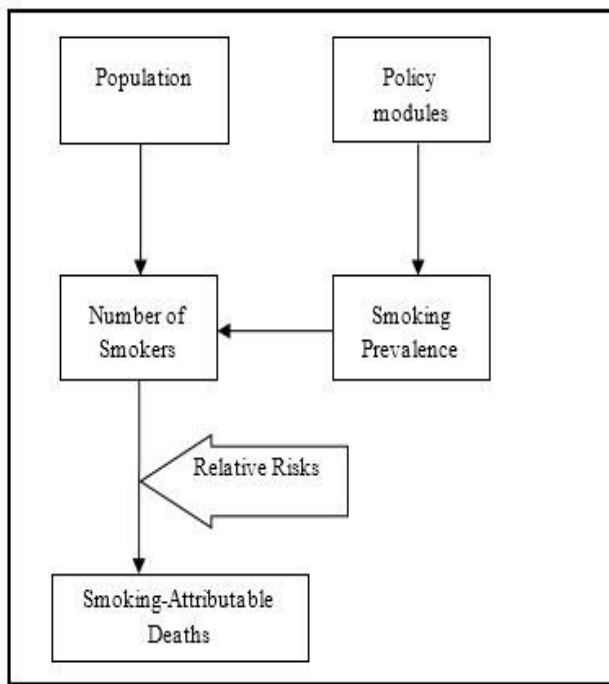
Understanding the impact of each MPOWER policy individually and in various combination on smoking prevalence and smoking attributable deaths is important for policy making, because it allows designing the right policy mix to achieve the targeted reduction in smoking prevalence. In this study, a previously validated Abridged SimSmoke model was applied to Malaysian tobacco control context to estimate the effect of national MPOWER policies and to assess their potentials for meeting the MOH's target of achieving 15% and <5% smoking prevalence by 2025 and 2045, respectively.

METHODS

SimSmoke model is a dynamic simulation approach that requires a large-scale survey of tobacco use to monitor and measure the smoking prevalence rate by age and gender in a country. Besides that it requires the application of smoking initiation and cessation rates, together with the validation of the model by experts. Although the SimSmoke model has proven its success, many countries especially low-income and middle-income countries including Malaysia do not have all the necessary data such as the relapse rate among former quitters by age. Therefore this study employed the Abridge SimSoke model which is a simplified form of SimSmoke model with the data requirements are less than for original SimSmoke and parallel to the data collected and prepared binneially for the WHO MPOWER/WHO Report on the Global Tobacco Epidemic by all WHO Member States.

Levy et al. developed the Abridged SimSmoke model in Microsoft Excel on a set of assumption and effect size which are derived from empirical evidence and scholarly. Alike the original SimSmoke, Abridged SimSmoke projects changes in smoking prevalence and smoking-attributable deaths due to the implementation of MPOWER policies (individually and in combination). The model can also be used to develop a strategy for reducing smoking prevalence to achieve a specific target. More importantly, even without the dynamic aspects of policy, the results from the Abridged SimSmoke model were close to the original SimSmoke model and has been succesfully implemented in few countries. Moreover in this study we used the Abridged SimSmoke model and filled in with inputs from Malaysia's own tobacco control policies. Therefore, the output is unique for Malaysia's tobacco objectives and potential outcomes. That is why this nation specific tobacco control approach and predicted outcome model is called 'the Malaysia Abridged SimSmoke model'.

Abridged SimSmoke model relies on three central components consist of population, policy and smoking prevalence modules (6). The structure of the model is depicted in Figure 1.

Source: Levy, DT (2014)

Fig 1: Structure of the Abridged SimSmoke Model

Population Module and Numbers of Smokers Module
The main difference between the original and the Abridged SimSmoke is in the population module. The original model takes into account the dynamic nature of the population over time considering the birth rates and death rates, while the Abridged model captures a static population cohort of fixed size and age/gender composition. However, the Abridged SimSmoke has separate modules for males and females taking into account the vast differences in male and female smoking prevalence in Malaysia. The 2015 population data used in the Malaysia Abridged SimSmoke model was provided by the Department of Statistics Malaysia.

The smoking prevalence module combines the population statistics with the gender-specific prevalence estimates in order to calculate the total number of male and female smokers. We used the 2015 smoking prevalence from the NHMS 2015 for Malaysian population age 15 years and over. Our model subjects this cohort of smokers to a new set of tobacco control policies described in the policy module to estimate the reaction to the given new set of policies.

The baseline for the policy module was the tobacco control policies already in place in 2015. We then introduce a set of new tobacco control policies that could achieve the reduced smoking prevalence target. The magnitude of the policy effects was based on Malaysia-specific estimate of the price elasticity of cigarette demand and international literature review for non-price tobacco control policies. Price elasticity of demand

measures the magnitude of change in consumption due to the increase in the price of cigarettes. The policy module calculates the relative (percentage) reductions in smoking prevalence as well as the absolute reduction in the number of smokers as the result of a policy being implemented. The model distinguishes between the short-term (within 5 years after implementing a policy),mid-term (within15 years after implementing a policy) and long-term (after the policy has been in place for over 40 years) policy effects. The mid-term and the long-term effects are calculated using a multiplier, which is a ratio of the relative change in prevalence after 15/40 years to the relative change in prevalence within a year after implementing a policy. Description of the policies and their effect sizes listed in Table I, with upper and lower bound ranges provided in terms of percentage increases and reductions in effect size.

Policy Module
We developed a separate policy modules for different types of tobacco control policies including price interventions (taxes), ban on smoking in workplaces, restaurants, and other public places, mass media/comprehensive campaigns addressing the harm of tobacco use (e.g. warning labels), advertising/promotion restrictions, and cessation services. The level of the compliance and enforcement with these policies was assessed via objective measures where available, or via a body of expert advisors to the project familiar with the tobacco control policies in Malaysia. The body of expert advisors consists of three senior public health physicians from the Malaysia Ministry of Health. Two of them were from the Tobacco Control Unit and one is a leading public health physician in Non-Communicable Diseases (NCD).

The 2015 policy data came from the MPOWER country report generated by the Malaysian MOH (7). The tax policy was evaluated according to the share of excise tax in the average cigarette price. In Malaysia, this share was 42.03% in 2015. To assess the impact of tax policy, the model employed the most recent estimate of the price elasticity of cigarette demand in Malaysia of -0.59 (8). The research evidence suggested that for cigarettes, half of the impact of higher price comes from a reduction in smoking prevalence while the rest of the impact is due to cutting down on the number of cigarettes consumed (9). Therefore, the prevalence price elasticity of -0.297 was used to calibrate our Malaysia Abridged SimSmoke model.

Only the government buildings/offices in Malaysia are smoke-freewhile the level of the information media campaign was considered medium. Malaysia complied fully with the WHO FCTC pictorial health warning requirement, but there is only a partial marketing ban since there is no regulation for point of sale product display. The offer of smoking cessation services is via the public and private health centers. At the time of

Table I: Policies, Specifications and Effect Sizes Used in Malaysia Abridged SimSmoke

POLICY	SPECIFICATION	Description	EFFECT SIZE (% Effect)*	Long term multiplier	Lower and Upper Bounds around the effect size	Awareness Parameter	Rural/Adjust
Tax Policy							
Retail price of cigarettes	Tax as a percent of Price	Excise tax in MPOWER, uses arc elasticity formula	Based on nation-specific price elasticities, generally -0..15 for HICs and-0.2 for LMICs	2	(-25%, +25%)	no	no
Smoke-Free Policies							
Smoke-free ban in all indoor workplaces	MPOWER by Type	Ban in all indoor private workplaces	6%	1.4	(-50%, +50%)	1.5	yes
Ban in indoor offices only	MPOWER by Type	Ban , except ventillated workplaces	4%	1.4	(-50%, +50%)	1.5	yes
Ban in health facilities, universities, govt. facilities (2 of 3)	MPOWER by Type	Ban in work areas only	2%	1.4	(-50%, +50%)	1.5	yes
Restaurants: Smoke free in all indoor areas	MPOWER by Type	Same, except also specified partial restaurant ban	2%	1.4	(-50%, +50%)	1.5	yes
Pubs and bars: smoke free	MPOWER by Type		1%	1.4	(-50%, +50%)	1.5	yes
Enforcement	MPOWER: 0-10		25% of above effect depends on % enforcement (out of 10)				
Publicity	Based on level of tobacco control funding		25% of above effect depends on publicity from tobacco control campaigns				
Marketing Bans							
Ban on direct and indirect marketing	MPOWER: score = 4	Ban on all direct and indirect advertising	5%	1.3	(-50%, +50%)	2	no
Ban on advertising	MPOWER: score = 3	Ban on all direct advertising	3%	1.3	(-50%, +50%)	2	no
Partial ban on advertising	MPOWER: score = 2	Ban on some direct or indirect advertsing	1%	1.3	(-50%, +50%)	2	no
No restrictions	MPOWER: score = 1		no effect				
Enforcement	MPOWER: 0-10	0-1.0	50% of the above effects depends on % enforcement (out of 10)		Same, except no moderate enforcement		
Health Warnings							
Very strong health warnings	MPOWER: score = 4	Bold and graphic, and covers at least one fourth of the front of the package	1%	3	(-50%, +50%)	2	no
Strong health warnings	MPOWER: score = 3	Warning, but does not qualify for strong warning	0.75%	3	(-50%, +50%)	2	no
Mild health warnings	MPOWER: score = 2	Small, non-graphic warning	0.50%	3	(-50%, +50%)	2	no
No warnings	MPOWER: score = 1		no effect				
Cessation Treatment Policies							
Availability of Pharmacotherapy: NRT	MPOWER: 1 if NRT is provided by either general store or pharmacy w/ Rx, 2 if NRT is provided by general store or pharmacy (no Rx). Otherwise 0.	Designates if sold by pharmacy or general store and if prescription is required	Prev. reduced 0.667% if available at general store and half that amount if prescription only	2.5	(-50%, +100%)	1.5	yes
Availability of Pharmacotherapy: Buproprion	MPOWER: 1 if Buproprion is provided by either general store or pharmacy with Rx, otherwise 0.	Designates if sold by pharmacy with prescrption	Prev. reduced 0.334%, available at general store and half that amount if prescription only	2.5	(-50%, +100%)	1.5	yes
Provision of treatments	Types of facilities distinguished, specified as primary care facilities, hospitals, offices of health professionals. Community and other	MPOWER: 0 = None, Yes in some= 0.125, Yes in most= 2	If indicator >= 1 and program is well publicized, prev. reduced 2.25%	2.5	(-50%, +100%)	1.5	yes
Quitline type	MPOWER: 0 = None, 1 = Yes	Operating active quitline	Prev. reduced 0.5%	2.5	(-50%, +100%)	1.5	yes
Publicity	Based on level of tobacco control funding	Campaign publicized heavily on TV (at least two months of the year) and at least some other media, with a social marketing approach	W/ the policies, prev. reduced 4.75%, 25% of above effect depends on publicity from tobacco control campaigns	2.5	(-50%, +100%)	1.5	yes

Note:* Unless otherwise indicated, the prevalence and initiation rate are increased and the cessation rate. Prev= smoking prevalence rate, Cess.= first year cessation rate, Init. = initiation rate

In addition to cessation clinics, quitline and infoline services are offered nationally by the University Sains Malaysia and the MOH. Nicotine replacement therapy and non-nicotine replacement therapy such as varenicline, is also available via smoking cessation services through retail pharmacies. In 2016, the MOH launched the mQuit program in collaboration with Universiti Malaya, Universiti Sains Malaysia, Malaysia Academy of Pharmacy and Johnson &Johnson Sdn. Bhd., offering a more comprehensive smoking cessation services through public-private partnership. Overall, the effect of the smoking cessation services was considered to be moderate.

We calibrated the impact of non-price tobacco control policies based on the law enforcement and other factors related to their effectiveness. Non-price tobacco control policies include legislation on smokefree places, regulations on packaging, contents and labelling of tobacco products, health education and ban on tobacco advertising, sponsorhip and promotion. If a certain regulation was considered to be fully enforced, the model used a parameter with the value of 1; if it was not enforced at all, the model used a parameter with the value of 0. Following consultations with the Malaysian tobacco control experts, we assigned the value of 0.5 and 0.7 for the enforcement of smoke-free air policies and marketing/promotional restrictions, respectively.

The impact of smoking cessation services and/or limits on smoking in public places was adjusted by an urban factor measured by (1 - the share of labor force employed in the agriculture) and by labor participation. It reflects the ability of these policies to reach and influence the population that might be working outdoors, not working at all or living far from urban centers where cessation services are available. Based on the data from the Malaysia Department of Statistic, about 12% of Malaysian worked in the agricultural sector while the unemployment rate was 3.2% in 2015.

This model also take into account the population level knowledge about the risks of smoking, because it affects the impact of disseminating warnings about the dangers of tobacco use. The countries with highest level of knowledge will be given a parameter value of 1 (no additional impact), while countries with lower level of knowledge will get a parameter greater than one. After consulting with tobacco control experts in Malaysia, we assigned a parameter value 2 to advertising/promotional ban and health warnings, which doubles the impact of these policies on our outcome measures. Following the same approach, we assigned a parameter value 1.5 to smoke-free policies and a parameter value of 1.25 to cessation services.

Smoking Attributable Deaths
The reduction in the number of deaths attributable to smoking as result of new set of policies was derived from the reduction in the number of smokers and a relative risk of smoking (10). It is estimated that about 50% of all regular cigarette smokers in countries with advanced stage of smoking epidemic will die due to smoking. The relative mortality risk from smoking may be lower in LMICs, because smokers in these countries, on average, started smoking at a later age, and their background risk is higher. However, recent studies argued on these lower estimates and demonstrated much larger mortality risks associated with smoking even in LMIC. Given the relatively advanced stage of smoking epidemic in Malaysia and the mean age of daily smoking initiation of 18.3 years (11), we decided to use the high-income country relative mortality risk. This means that the number of cigarette quitters/non-initiators after the implementation of new policies was multiplied by 0.5 in the calculation of the number of averted smoking-attributable deaths.

RESULTS

In November 2015 Malaysian government increased its tobacco excise tax by 34.5%. As a result, the excise tax represents about 49.4% of the average retail cigarette price, compared to 42.03% before the tax increase. In order to recommend policies to achieve the MOH smoking prevalence targets, the Abridged SimSmoke model first calculated the impact of the 2015 tax increase with other non-price policies at their 2015 level to establish a new baseline in terms of prevalence and the number of smokers in Malaysia. The model predicted that in the short term, the 2015 tax increase will reduce smoking prevalence by about 4.5% (about 473,000 fewer smokers) and prevent about 237,000 smoking attributable deaths.

Using these estimates as the baseline, we studied the impact of two possible policy scenarios. The first scenario relied only on raising excise tax while the second scenario used higher tobacco excise tax in combination with other non-price policies. The proposed ehnancement in the non-price policies include imposing a complete ban on both direct and indirect cigarette marketing, a fully funded mass media campaign, an expansion of smokefree areas with enforcement increased from 50% to 70%.

Table II shows the results of the Abridged SimSmoke with respect to the 15% smoking prevalence target considering the two policy scenarios. Using the tax policy alone, the smoking prevalence would reduce by 27.5% by 2020 and 54.9% by 2055. In particular, the decline of 34.2% of smoking prevalence to achieve the 15% target is projected to occur between 2020 and 2030. During this 10 year period of time, the smoking prevalence is estimated to decline on average by 1.4% annually. Hence, an additional 6.7% point reduction will take about 5 years to achieve the decline of 34.2%, bringing the smoking prevalence to 15% target. Therefore

Table II: Policies to achieve smoking prevalence target of 15% by 2025

Policy	Adult smoking prevalence			Reduction in the number of smokers in the long-term			Reduction in smoking attributable death in the long term		
	Short Term (or by 2020)	Medium Term (or by 2030)	Long Term (or by 2055)	Male	Female	Total	Male	Female	Total
Only raising the excise tax rate from 49.4% to 78%	-27.5%	-41.2%	-54.9%	2,821,887	83,395	2,905,282	1,410,943	41,698	1,452,641
Raising tax to 72% in combination with other policies	-29.1%	-39.2%	-48.3%	2,481,925	73,348	2,555, 273	1,240,963	36,674	1,277,637

raising the excise tax to 78% of retail price alone would be able to meet the 15% of MOH's smoking prevalence target by 2025. If the tax policy is combined with other non-price tobacco control policies, the rate of decline was initially bigger (by about 29% by 2020), but then continue to decline at a slower pace, by 1% till 2030, nonetheless still achieving the MOH prevalence target of 15% prevalence by 2025.

Table III reports results of the Abridged SimSmoke model simulating the MOH goal of less then 5% smoking prevalence by 2045 corresponding to the tobacco endgame scenario (12). This would require 17.8% point or 78% decline in the smoking prevalence in 30 years period starting in 2015. Using tax policy alone, the excise tax would need to represent 87.5% of the cigarette retail price. When the excise tax policy was applied together with other tobacco control policies, the excise tax would only need to reach 86.5% of the retail price.

DISCUSSION

The Malaysia Abridged SimSmoke model demonstrated that achieving the 15% and <5% smoking prevalence targets by 2025 and 2045, respectively, is achievable by adopting evidence based tobacco tax policy accompanied by other non-price tobacco control measures according to the WHO FCTC MPOWER recommendations. Higher tobacco excise taxes, comprehensive ban on marketing/promotion of cigarettes, a fully funded mass media campaign informing about the dangers of tobacco use and improving enforcement of no smoking in smoke free areas will allow the government of Malaysia to achieve its goal in reducing smoking prevalence and premature deaths due to smoking.

This model projected that Malaysia can reduce its smoking prevalence to 15% by 2025 and reduce the number of smokers by about 2.6 million by 2055 while averting almost 1.3 million premature tobacco-related deaths if the government increases its tobacco tax from the current level of 49.4% to 72% of the average retail cigarette price while enhancing the implementation and enforcement a set of non-price policies. This would require increasing the current tax by 163%. If this tax is fully passed on to consumers, the average cigarette price would increase from the current MYR16.2 to MYR29.4, or by 81%.

The end-game target of 5% smoking prevalence by 2045

Table III: Policies to achieve smoking prevalence target of 5% by 2045

Taxation policy	Effect size on smoking prevalence			Total reduction in the number of smokers in the long-term			Reduction in smoking attributable death in the long term		
	Short Term (by 2020)	Medium Term (by 2030)	Long Term (by2055)	Male	Female	Total	Male	Female	Total
Raising the excise tax rate from 49.4% to 87.5%	-43.2%	-64.8%	-86.4%	4,440,985	131,244	4,572,229	2,220,492	65,622	2,286,114
Combined policies effects at the tax rate of 86.5%	-48.1%	-67.1%	-85.1%	4,372,970	129,234	4,502,204	2,186,485	64,617	2,251,102

can be achieved by a 556% tax increase accompanied with the similar set of non-price interventions. In that case, Malaysia would have 4.5 million fewer smokers and avert almost 2.25 million premature tobacco-related deaths by 2055. Its cigarette prices would increase by at least 275% while the excise tax would represent 86.5% of the retail price.

Even though the proposed tax increase may appear substantial, they are not unprecedented. Ukraine, for example, increased its excise tax by 500% in just two years, from 2008 to 2010 (13). In 2013, the Philippines increased its excise tax rate by 341% on the low tier cigarettes (14). Both countries achieved a substantial reduction in smoking prevalence and substantial increase in excise tax revenue.

Our study has several limitations. First, we only studied the impact of tobacco control policies on cigarettes and did not consider their impact on possible substitution towards other forms of tobacco such as smokeless tobacco and electronic cigarettes. The prevalence of smokeless tobacco use among Malaysian has increased sharply from 0.7% in 2011 to 10.9% in 2015, and the current electronic cigarette use prevalence reached 3.2% in 2016. Secondly, our predictions were based on the assumption that the tobacco industry will fully pass the tax increases to cigarette prices. Thirdly, we had to base our prevalence predictions on estimates before the most recent tax increase. If the current prevalence is lower as the result of the November 2015 tax increase, the tax increase required to reach the prevalence target will be lower. Forthly, the Abridged SimSmoke does not account for future changes in the demographic profile. Finally, the issue of contraband or smuggled cigarettes in Malaysia was assume to remain constant.

Despite these limitations, we believe that our study provides a valuable insight into the policy mix needed to achieve both the WHO Global NCD target 2025 and the tobacco end game target set by the Government of Malaysia by 2045.

CONCLUSION

We conclude that tobacco endgame in Malaysia is a realistic proposition if the proposed measures are fully implemented. It will require a whole government approach with the MOH as a leading agency driving the process. The Ministry of Finance could play a key role in drafting a plan for tobacco tax increases that can be spread over several years while the Customs Department can support the process by enhancing its capacity to prevent tax avoidance and evasion. The newly generated tax revenue will be able to fund the government activities and the enforcement of tobacco control measures. It will be important to monitor both the compliance with the new measures and smoking prevalence to make sure that Malaysia is on track in achieving its targets.

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