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MODELING THE POTENTIAL PUBLIC HEALTH IMPACT OF E-CIGARETTE LEGALIZATION IN THAILAND

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INTRODUCTION

Over the last two decades, the landscape of tobacco products has changed with the introduction of electronic cigarettes (e-cigarettes), and most recently heat and not burn devices. In part, the impetus for the development of these products was to offer alternatives to combustible cigarettes that mitigate the health consequences of smoking. In fact, a review from Public Health England estimated that e-cigarettes are 95 percent less harmful than combustible cigarettes.¹ Likewise, the U.S. Food and Drug Administration (FDA) recently designated the Philip Morris International (PMI) heat and not burn product IQOS as a modified risk tobacco product, thus acknowledging IQOS

1. Public Health England, “E-Cigarettes around 95% less harmful than tobacco estimates hallmark review,” Press Release, Aug. 19, 2015. <https://www.gov.uk/government/news/e-cigarettes-around-95-less-harmful-than-tobacco-estimates-landmark-review>.

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to be less harmful than combustible cigarettes.²

This spectrum of harm among tobacco products, anchored by combustible cigarettes as most harmful and new Alternative Nicotine Delivery Systems (ANDS)—such as e-cigarettes and heat not burn devices—as less harmful, suggests that converting cigarette smokers who otherwise are unable or unwilling to quit to these less-harmful products would, in the long run, yield benefits to the overall population health. Modeling the impact of switching to e-cigarettes on cigarette smokers in the United States, one study concluded that over a 10-year period, replacing cigarettes with e-cigarettes would prevent over 1.6 million premature deaths.³ Similar research reported that smokers who switch to e-cigarettes potentially gain an extra two years of life, and vaping is likely to decrease the overall mortality associated with cigarettes.⁴

While these studies were based on the analysis of U.S. public health data, the analysis presented in this paper models the potential impact of smokers in Thailand switching to e-cigarettes. Unlike the United States, Thailand is one of 44

2. FDA “FDA authorizes marketing of IQOS tobacco heating system with reduced exposure information,” Press Release, July 7, 2020. <https://www.fda.gov/news-events/press-announcements/fda-authorizes-marketing-iqos-tobacco-heating-system-reduced-exposure-information>.

3. David Levy et al., “Potential deaths averted in the USA by replacing cigarettes with e-cigarettes,” *Tobacco Control* 27:1 (2018), pp. 18-25. https://tobaccocontrol.bmj.com/content/27/1/18?hottPostID=7d20180aacfab6d7ff810e2733726e12&utm_source=trendmd&utm_medium=cpc&utm_campaign=bmjopen&trendmd-shared=1&utm_content=Journalcontent&utm_term=TrendMDPhase4.

4. David Mendez, et al. “A Magic Bullet? The Potential Impact of E-Cigarettes on the Toll of Cigarette Smoking,” *Nicotine & Tobacco Research*, 2020. <https://academic.oup.com/ntr/advance-article-abstract/doi/10.1093/ntr/ntaa160/5895499>.

countries that currently ban the sale of e-cigarettes and other vaping products.⁵ Therefore, this paper models the potential public health impacts of introduction and legalization of e-cigarettes in Thailand based upon secondary data analysis and a review of the existing, relevant literature.

TOBACCO HARM REDUCTION

There is evidence that switching from combustible cigarettes to e-cigarettes results in positive clinical outcomes, which potentially explains the population-level gains reported by the studies cited above. For instance, one study reported improvements in cardiovascular health among smokers who switched to e-cigarettes.⁶ Other studies have shown a decrease in the exposure to known carcinogens or improvements in chronic obstructive pulmonary disease (COPD) indicators among former smokers who switched to e-cigarettes.⁷ Similarly, there is evidence that switching from combustible cigarettes to e-cigarettes leads to improvements in asthma outcomes.⁸

Moreover, there is an emerging body of literature which indicates that e-cigarettes are a more effective cessation tool than other cessation methods.⁹ The authors of one particular review analyzed findings from 50 studies in 13 countries involving 12,340 participants that compared cessation rates of using e-cigarettes with other types of tobacco cessation methods including varenicline (i.e., Chantix), nicotine replacement therapies and counseling.¹⁰ Based on the combined results across these studies, the six months cessation rate was 10 percent for e-cigarettes versus 6 percent for nicotine replacement therapies and only 4 percent for those having no support or only behavioral intervention.¹¹ One likely explanation of greater efficacy of e-cigarettes as a

cessation aid is because the psychological costs of switching to e-cigarettes such as personal or social enjoyment of smoking are minimal but there is the perceived gain of reducing personal harm.

The evidence supporting the population and individual health benefits of switching from combustible cigarettes to e-cigarettes, as well as the evidence showing that e-cigarettes are effective cessation aids provides an empirical foundation for the Tobacco Harm Reduction (THR) approach.¹² Acknowledging the continuum of harm among tobacco products, THR endorses conversion of current adult cigarette smokers to less harmful products as part of the overall tobacco control strategy. For example, in the United Kingdom e-cigarettes are considered a cessation aid and health messaging acknowledges health risks associated with electronic nicotine delivery systems (ENDS) products, but clearly articulates that they are significantly safer than combustible tobacco products.¹³ In fact, the integration of THR into the overall tobacco control efforts may potentially amplify the effects of other strategies. For example, the increase in cigarette excise tax may cue a smoker to switch to a less harmful alternative rather than seek a lower price combustible product—such as roll-your-own cigarettes—or simply ignore the price increase.

TOBACCO CONTROL AND USE IN THAILAND

Currently, possession of e-cigarettes in Thailand can lead to large fines and even jail time.¹⁴ At the same time, Thailand has aggressively implemented tobacco control policies under the World Health Organization (WHO) MPOWER framework, which includes counter marketing, raising excise taxes, provision of cessation services and restrictions on tobacco product marketing.¹⁵ To date, Thailand has received a favorable rating from the WHO, with investment in cessation programs and advertising restrictions as the only noted weaknesses.¹⁶

Currently, 2 percent of the tax revenue received from the sale of tobacco products is earmarked for the Thai Health Promotion Foundation (ThaiFund), which spends 6 percent (0.24 billion Thai Baht or approximately \$120 million)

5. "E-Cigarette Ban & Regulation: Global Status as of February 2020," Global Center for Good Governance in Tobacco Control, Feb. 24, 2020. <https://ggtc.world/2020/02/24/e-cigarette-ban-regulation-global-status-as-of-february-2020>.

6. Jacob George et al., "Cardiovascular Effects of Switching from Tobacco Cigarettes to Electronic Cigarettes," *Journal of American College of Cardiology* 74:25 (November 2019), pp. 3112–3120. <https://www.jacc.org/doi/full/10.1016/j.jacc.2019.09.067>.

7. See, e.g., Lion Shahab et al., "Nicotine, carcinogen, and toxin exposure in long-term e-cigarette and nicotine replacement therapy users: a cross-sectional study," *Annals of internal medicine* 166:6 (2017), pp. 390–400. <https://www.acpjournals.org/doi/abs/10.7326/M16-1107>; Michael Goniewicz, et al., "Exposure to Nicotine and Selected Toxicants in Cigarette Smokers Who Switched to Electronic Cigarettes: A Longitudinal Within-Subjects Observational Study," *Nicotine and Tobacco Research* 19:2 (2017) pp. 160–167. <https://academic.oup.com/ntr/article/19/2/160/2631650?login=true>; Ricardo Polosa et al., "COPD smokers who switched to e-cigarettes: health outcomes at 5-year follow up," *Therapeutic Advances in Chronic Disease* 11 (2020). <https://journals.sagepub.com/doi/full/10.1177/2040622320961617>.

8. Ricardo Polosa, et al. "Effect of smoking abstinence and reduction in asthmatic smokers switching to electronic cigarettes: evidence for harm reversal," *International journal of environmental research and public health* 11:5 (2014), pp. 4965–4977. <https://www.mdpi.com/1660-4601/11/5/4965>.

9. Jamie Hartmann-Boyce et al., "Electronic cigarettes for smoking cessation," *BMJ* 360 (2018). <https://www.bmj.com/content/360/bmj.j5543>.

10. Ibid.

11. Ibid.

12. MA Russell, "Low-tar medium-nicotine cigarettes: a new approach to safer smoking," *Br Med Journal* 1:6023 (1976), pp. 1430–1433. <https://www.bmj.com/content/1/6023/1430.short>.

13. "Health matters: stopping smoking—what works?," Public Health England, last accessed Sept. 17, 2020. <https://www.gov.uk/government/publications/health-matters-stopping-smoking-what-works/health-matters-stopping-smoking-what-works>.

14. Royal Thai Embassy, London, "Prohibition of e-cigarettes," Press Release, Aug. 28, 2019. <https://london.thailembassy.org/en/publicservice/86207-prohibition-of-e-cigarettes?page=5d6636ce15e39c3bd000734d&menu=5d6636cd15e39c3bd00072e2>.

15. "MPower: A Policy Package to Reverse the Tobacco Epidemic," World Health Organization, 2008. https://www.who.int/tobacco/mpower/mpower_english.pdf.

16. "Country Profile: Thailand," in *WHO report on the global tobacco epidemic, 2019*, World Health Organization, July 26, 2019. https://www.who.int/tobacco/surveillance/policy/country_profile/tha.pdf?ua=1.

of its annual budget on tobacco control.¹⁷ In an effort to further control tobacco use, the Thai government has raised taxes on commercially made combustible cigarettes numerous times; however, tax increases were mostly limited to cigarettes rather than other types of combustible tobacco products.¹⁸ Despite consistent tobacco control efforts, the smoking rate for combustible cigarettes has stalled. Based on survey data from 2011 to 2017, Thailand has seen only a 2 percent decrease (from 21 percent to 19 percent) in the smoking rate.¹⁹ This plateau may be due in part to the limited cessation tools and options available to Thai citizens.

Given the ban on ENDS products in Thailand, a smoker who wants to quit has a limited selection of effective nicotine replacement therapies or products. Without a viable, affordable cessation alternative, the effect of the excise tax increases may be moving established smokers to lower-cost brands or roll-your-own cigarettes that are not taxed at the same rate as manufactured cigarettes.²⁰

However, the introduction and legalization of ENDS products to the Thai market will offer an alternative to Thai smokers, especially those who either gave up trying to quit using traditional methods or do not want to do so. Based on secondary data analysis of the existing body of literature, it is fair to assume some combustible cigarette smokers would switch to e-cigarettes if they were introduced to the Thai market. This would lead to the overall gains in population health. The results of the modelling study, which addresses the various potential outcomes of the introduction and legalization of ENDS products to the Thai market, are detailed in the following section.

MODELS

The results presented here are based on a model that estimates the increases or decreases in the number of deaths among smokers in Thailand if e-cigarettes are introduced to Thai markets. The final estimates are for 10-year cumulative gain or loss of life after e-cigarettes become legal. The analytical approach closely followed the analysis of one U.S. model, with several modifications to account for Thai-specific data sources and patterns of tobacco use. The model provides three estimates of mortality: the status quo model, the optimistic model and the pessimistic model.

17. Ibid.

18. "Tax policies on Tobacco products in Thailand: The way forward," World Health Organization, 2011. <https://apps.who.int/iris/bitstream/handle/10665/205961/B4732.pdf?sequence=1&isAllowed=y#:text=In%201992%2C%20the%20rate%20of.The%20way%20forward%206%20respectively>.

19. "Thailand Smoking Rate 2000-2021," Macrotrends, last accessed Feb. 21, 2021. <https://www.macrotrends.net/countries/THA/thailand/smoking-rate-statistics>.

20. List of Statistical Tables (Smoking Behaviour)," National Statistical Office of Thailand, last accessed Sept. 29, 2020. http://web.nso.go.th/en/survey/health/data/Cigarette_Ful_14.pdf.

Status Quo Model

The status quo model assumes that e-cigarettes are not introduced to Thailand during the 10-year period in question. This model further assumes that the cessation rates and mortality rates due to smoking cigarettes are constant throughout the 10 years. The status quo model thus provides a comparison estimate for the models that assume introduction of e-cigarettes to Thailand.

Optimistic Model

The optimistic model assumes that e-cigarettes will be introduced to Thai market. It makes two key assumptions: that the transition rate—meaning the rate at which cigarette smokers transition to e-cigarettes—will lead to complete cessation of combustible cigarettes by 2030 and that e-cigarettes are 5 percent as dangerous as combustible cigarettes. The transition rate for the optimistic model is set at 10 percent initially. This means that 10 percent of combustible cigarette smokers will initially switch to e-cigarettes when they are introduced to the market. The estimates of e-cigarette risk are based on an assessment by the Royal College of Physicians and National Academies of Science, Engineering and Medicine.²¹

Pessimistic Model

The pessimistic model assumes that by 2030, the rate of combustible cigarette smoking will be 5 percent and the rate of e-cigarette use will also be 5 percent. The initial transition rate of 7.1 percent set in this model is similar to the transition rate reported in the United Kingdom²². Furthermore, the model assumes that e-cigarettes are 40 percent as harmful as combustible cigarettes. The 40 percent figure was used as an acknowledgment that the long-term health consequences of e-cigarette use are not well known.

MODEL PARAMETERS

The models presented here use data points and data point estimates to derive the impact of introducing e-cigarettes to Thai markets. These are termed as model parameters. Most parameters are iteratively adjusted for each year in the model. For example, the number of cigarette smokers for each year is based on the cessation rate, estimated population rate and transition rate to e-cigarettes. The estimates for one year are then used to calculate the estimates for the next year. The first key parameter is the number of smokers in

21. Tobacco Advisory Group, "Nicotine without smoke: Tobacco harm reduction," Royal College of Physicians, April 28, 2016. <https://www.rcplondon.ac.uk/projects/outputs/nicotine-without-smoke-tobacco-harm-reduction>; Judith J. Prochaska, "The Public Health Consequences of E-cigarettes: a review by the National Academies of Sciences. A call for more research, a need for regulatory action," *Addiction* 114:4 (2018), pp. 587-589. <https://onlinelibrary.wiley.com/doi/full/10.1111/add.14478>.

22. "Use of e-cigarettes (vapourisers) among adults in Great Britain," Action on Smoking and Health, September 2018. <https://frvapingpost.com/wp-content/uploads/2018/10/ASH-Adult-e-cig-factsheet-2018-1.pdf>.

Thailand. For the start of the first year of analyses, the number of smokers is estimated based on available data and WHO projections.²³ The smoking prevalence was estimated at 20.5 percent. To project the number of smokers in the status quo model, the annual smoking prevalence was adjusted by “true cessation rate” which considers the number of smokers quitting and smoking initiation rates. The prevalence rate was then multiplied by the projected population of Thailand to estimate the annual number of smokers. In the status quo models, the total number of projected smokers are combustible cigarette smokers.²⁴

Both the optimistic and pessimistic models further adjust the number of combustible cigarette smokers by the transition rate to e-cigarettes. As noted previously, the optimistic model sets the initial transition rate at 10 percent and pessimistic model sets it at 7.1 percent; the transition rate is escalated annually. Since the transition rate is defined as the percentage of current combustible smokers switching to e-cigarettes, the transition rate is adjusted by the number of remaining smokers each year. Thus, both optimistic and pessimistic models also yield the estimated number of e-cigarette users. The estimated number of e-cigarette users are adjusted by the postulated cessation rate as well as the estimated number of naive cigarette users (i.e., individuals who did not smoke combustible cigarettes but took up e-cigarettes).

The second parameter is the combustible smoker mortality rate in Thailand. Based on WHO estimates, the smoker mortality rate in Thailand is 0.71 percent.²⁵ The mortality rate is assumed to be constant throughout the 10 years. The number of premature deaths among smokers is thus calculated by multiplying the estimated number of smokers for each year by 0.71. The mortality rate for cigarette users under the optimistic model is assumed to be 0.5 percent of the combustible smokers’ mortality rate (0.04). Under the pessimistic model, the mortality rate among e-cigarette users is assumed to be 40 percent of the combustible smokers’ mortality rate (0.3). Thus, the number of premature deaths due to e-cigarette use is calculated by multiplying the estimated number of e-cigarette users by the assumed mortality.

The third parameter in the model is the decrease in life expectancy due to smoking cigarettes. Thai-specific reduction in longevity due to smoking combustible cigarettes was not available. Therefore, a U.S. figure reported by the Centers

for Disease Control and Prevention (CDC) of 13.5 years was used.²⁶

RESULTS

Under the status quo model, the smoking rate would be 17.2 percent by 2030. During the 10 years, Thailand would lose 782,445 of its citizens due to smoking combustible cigarettes. Cumulatively, this represents the loss of 10,563,012 years of life.

Under the optimistic model, 369,223 smokers would die over the 10-year period. This includes mortality among e-cigarette users. This represents 4,948,512 years of life lost. In all, under the assumptions of the optimistic model, there would be 413,222 (or 52 percent) fewer deaths and a gain of 5,578,499 life years.

Under the pessimistic model, which makes more conservative assumptions about transition rates and assumes higher health risks associated with e-cigarette use, smoking related mortality in 10 years is predicted to be 574,461 and total life years lost would be 7,775,219. This represents a 26 percent decrease in smoking-related mortality in comparison to the status quo model, with 207,865 fewer Thai citizens dying due to smoking and a gain of 2,807,793 life years.

Even under the pessimistic scenario, which assumes lower transition rates from cigarettes to e-cigarettes and higher health risk associated with e-cigarette use, the introduction of e-cigarettes to Thailand would result in 26 percent fewer smoking-related deaths over a 10-year period. The more optimistic scenario showed a 52 percent decrease in smoking related mortality. Since many parameters in the model are estimated and projected into the future, the findings presented here should be considered more descriptive than predictive. As with any model of this type, the findings here describe what is likely to happen based on available data. But the findings are consistent with evidence for the THR approach, namely that e-cigarettes pose lower health risks than combustible cigarettes and in fact facilitate cessation. The bottom line is that the introduction of e-cigarettes to Thai markets will reduce smoking-related mortality and likely significantly so.

In comparison, a model that looked at hypothetical implementation of comprehensive tobacco control strategies that included raising cigarette taxes in Thailand annually by 15 percent, expansion of quit lines and youth prevention efforts predicted a 4.5 percent reduction in mortality over 10 years

23. “WHO global report on trends in prevalence of tobacco use 2000-2025,” World Health Organization, 2019. <https://www.who.int/publications/i/item/who-global-report-on-trends-in-prevalence-of-tobacco-use-2000-2025-third-edition>.

24. Regional Office for South-East Asia, “Factsheet 2018: Thailand,” World Health Organization, 2018. https://apps.who.int/iris/bitstream/handle/10665/272690/wntd_2018_thailand_fs.pdf?sequence=1.

25. Jeffrey Drope and Neil W. Schluger, eds., *The Tobacco Atlas, Sixth Edition*, (American Cancer Society and Vital Strategies, 2018).

26. Surgeon General, “The health consequences of smoking—50 years of progress: a report of the Surgeon General,” U.S. Department of Health and Human Services, 2014. <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.653.9865>.

among male smokers.²⁷ The modest effect presented by this model could be because the net effectiveness of more traditional tobacco control approaches has reached its limit as the overall prevalence declined.²⁸ Adopting the THR approach and legalizing e-cigarettes may provide a new opportunity to advance the public health agenda of reducing the burden of smoking and improve the overall health of Thai citizens.

Of course, the analyses presented here are not without limitations. For example, the model assumes a consistent cessation rate throughout the 10 years, an assumption that can be challenged if Thailand does implement more strict tobacco control policies. Moreover, the model does not account for the potential positive effect of e-cigarettes on cessation, thus potentially underestimating the smoking prevalence rates and hence smoking mortality. It also assumes that the tobacco-related mortality rate will remain constant, an assumption that is reasonable unless there is a significant expansion of access to care or unprecedented medical breakthroughs.

Perhaps a more serious limitation of the model is that it does not account for dual use: using combustible cigarettes and e-cigarettes concurrently. Dual use is likely to lower the estimates of decreases in mortality. However, by setting the risk of health consequences of e-cigarette use significantly above the evidence-based 5 percent, the pessimistic model potentially accounts for the negative effects of dual use.

Furthermore, since e-cigarettes are illegal in Thailand, the model first assumes that there is no current e-cigarette use. Moreover, the actual rate of transition is not known. However, there is evidence that despite the product being illegal, 3.3 percent of Thai youth are e-cigarette users.²⁹ Although this figure is at least five years old, it does signal that there is an interest in e-cigarettes in Thailand.

The success of the introduction of e-cigarettes in Thailand will depend on the regulatory policies to a large extent. For example, excise taxes on e-cigarettes result in a decrease in e-cigarette sales, but a simultaneous increase in combustible cigarette sales.³⁰ This is likely because the price elasticity is more likely to affect a newer product on the market than

the more established brands. Therefore, a pragmatic policy seeking to promote public health would tax e-cigarettes at a lower rate than combustible cigarettes.

Bans on flavored e-cigarettes may also decrease the transition rates from combustible cigarettes to e-cigarettes as evidence suggests that combustible cigarette smokers switching to e-cigarettes prefer flavored products.³¹ In addition, smokers who switch to flavored e-cigarette products are less likely to resume smoking combustible cigarettes.³² Although there have been concerns about the role of flavored e-cigarette products in youth initiation, regulations that restrict access to youth through purchase age limits and strict enforcement of sales to minors have shown to be effective in curbing use by minors without affecting the adult smokers who want to switch.³³

Marketing of e-cigarettes should also be regulated based on available evidence. Undoubtedly, the manufacturers and distributors of e-cigarettes should not be allowed to make unsubstantiated health claims. Likewise, the government should not impose unsubstantiated health warnings. Given the preponderance of evidence that although not without risks, e-cigarettes are significantly less harmful than combustible cigarettes, the marketing of e-cigarettes should allow for modified risk claims—clearly articulating potential health risks while allowing for claims that the product is less harmful than combustible cigarettes. These changes would allow Thai consumers to make more informed decisions.

CONCLUSION

An abundance of evidence indicates that e-cigarettes are less harmful than combustible cigarettes. Moreover, e-cigarettes help with smoking cessation. ENDS products thus offer a viable alternative to smoking combustible cigarettes, potentially leading to an improvement in the overall population health.

To date, the tobacco control efforts in Thailand have stalled, showing only small annual decreases in smoking prevalence. The analyses presented here looked at the hypothetical scenario of introducing e-cigarettes to Thailand's market and what effect, if any, that would have on smoking cessation rates and public health. The results suggest that in the best-

27. Suchunya Aungkulanon et al., "Smoking prevalence and attributable deaths in Thailand: predicting outcomes of different tobacco control interventions," *BMC Public Health* 19:984 (2019), pp. 1-11. <https://doi.org/10.1186/s12889-019-7332-x>.

28. Alec Ulasevich and Chelsea Boyd, "Exploring the Differences in Tobacco Policy Between the United Kingdom and Thailand," *R Street Policy Study* No. 208. September 2020. <https://www.rstreet.org/2020/10/05/exploring-the-differences-in-tobacco-policy-between-the-united-kingdom-and-thailand>.

29. Pantip Chotbenjamaporn et al., "Tobacco use among Thai students: results from the 2015 global youth tobacco survey," *Indian Journal of Public Health*, 61:5 (2017), p. 40. <https://www.ijph.in/article.asp?issn=0019-557X;year=2017;volume=61;issue=5;spage=40;epage=46;aulast=Chotbenjamaporn>.

30. Chad Conti et al., "The Effects of E-Cigarette Taxes on E-Cigarette Prices and Tobacco Product Sales: Evidence from Retail Panel Data," *National Bureau of Economic Research Working Paper* No. 26724, August 2020. <https://www.nber.org/papers/w26724>.

31. Konstantinos E. Farsalinos et al., "Impact of flavour variability on electronic cigarette use experience: an internet survey," *International Journal of Environmental Research and Public Health* 10:12 (December 2013), pp. 7272-82. <https://www.mdpi.com/1660-4601/10/12/7272>.

32. Christopher Russell et al., "Changing patterns of first e-cigarette flavor used and current flavors used by 20,836 adult frequent e-cigarette users in the USA," *Harm Reduction Journal* 15:1 (2018), pp. 1-14. <https://link.springer.com/article/10.1186/s12954-018-0238-6>.

33. Teresa W. Wang et al., "E-cigarette Use Among Middle and High School Students—United States, 2020," *Morbidity and Mortality Weekly Report* 69:37 (2020), p. 1310. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7498174>.

case scenario, the introduction of e-cigarettes would lead to a 52 percent reduction in smoking-related mortality by both converting some current cigarette smokers to e-cigarettes, and accelerating overall cessation of tobacco use. A more conservative estimate shows a 28 percent reduction in smoking-related mortality. Both estimates outperform the estimated decrease in smoker mortality if more stringent tobacco control policies are implemented in Thailand. Thus, the findings suggest that the legalization of e-cigarettes in Thailand is likely to reduce the burden of tobacco use and help the nation achieve its public health goals. However, evidence-based policies regarding regulations of e-cigarette flavors, excise taxes and marketing should accompany the legalization of e-cigarettes to maximize public health benefits.

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