EPH102

Modeling the Population Health Impact of Nicotine Misperceptions

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Abstract

Objectives: Although evidence demonstrates that inhaling the smoke from combustion of cigarettes is responsible for the harm caused by smoking, the majority of U.S. adults who smoke inaccurately believe that nicotine causes the harm. These misperceptions may be a significant obstacle to adult smokers' motivations to switch to potentially reduced-harm, smoke-free products. This research quantified the population health impact associated with varying nicotine perceptions. **Methods:** We applied a previously validated agent-based model to the U.S. population. We developed a Base Case model using estimates of cigarette smoking initiation, cessation, and switching to exclusive smoke-free product use (i.e., use of e-cigarettes, smokeless tobacco and/or snus). We analyzed nationally representative data from the Population Assessment of Tobacco and Health (PATH) Study to estimate the overall rate of switching from smoking to smoke-free product use. We then stratified this rate based on responses to the question "Do you believe nicotine is the chemical that causes most of the cancer caused by smoking cigarettes?" (Four-item scale from "Definitely not" to "Definitely yes"). Nicotine perception scenarios were based on these stratified rates. The public health impact of nicotine perceptions was estimated as the difference in all-cause mortality between the Base Case and nicotine perception scenarios. **Results:** Switch rates aligned with those who responded "Definitely not" result in a net benefit of preventing nearly 800,000 premature deaths over an 85-year period. Conversely switch rates reflective of those who responded "Definitely yes" result in a net harm of nearly 300,000 additional premature deaths over the same period. **Conclusions:** Accurate knowledge regarding the role of nicotine is associated with higher switching rates, translating into prevention of premature deaths. Limitations of predictive models must be considered when drawing inferences. Our findings suggest that promoting public education to correct nicotine misperceptions has potential to benefit population health.

Introduction

Cigarette smoking causes serious diseases, which contribute to more than 400,000 premature deaths in the U.S. each year[1]. Despite the acknowledgement by many in public health and FDA that a continuum of risk exists among tobacco products, there are more than 30 million adults who continue to smoke. Nicotine misperceptions may discourage adults who smoke (AS), who are otherwise unable or unwilling to quit, from transitioning to lower harm sources of nicotine[2]. Scientific evidence clearly indicates that nicotine is addictive, but it is not directly responsible for serious smoking-related disease and mortality[3]. However, a majority of AS believe that nicotine is the chemical in cigarettes that causes cancer[4-6]. The purpose of this research was to quantify the public health impact of AS misperceptions that nicotine causes most of the cancer caused by smoking cigarettes.

Methods

- We used a validated Agent-based Model (ABM)[7]
  - The model is initialized with a hypothetical population of 2.81MM agents, (1/100th of U.S. population in the year 2000 by age, gender, & tobacco use status)
  - All-cause mortality and tobacco use prevalence are projected in 1-year increments through 2100
  - At each 1-year increment surviving agents can maintain current status or transition to a new tobacco use state depending on input transition rates
  - New population members are added each year via Birth & Immigration based on U.S. Census data
- Population health impact is estimated as the difference between **1)** Base Case scenario simulation in which AS switch to Smoke-Free Product (SFP) use at rates representative of varying levels of nicotine harm perceptions and **2)** each of four different Nicotine Perception Scenarios in which the Base Case rate of switching to SFP use is adjusted beginning in 2014 based on stratified transition probabilities associated with the responses to the question "Do you believe nicotine is the chemical that causes most of the cancer caused by smoking cigarettes?" from the Population Assessment of Tobacco and Health (PATH) Study[8] (R04_AC9120, Four-item scale from "Definitely not" to "Definitely yes").

Model Transition Inputs & Sources

Base Case
- CISNET estimated cigarette initiation and cessation rates updated each year through 2014
  - Cessation rates reflect successful cessation for at least two years therefore relapse from FS to CS is set to zero.
- Analysis of PATH Wave 1 (W1) to Wave 5 (W5) to estimate recent successful cessation and switching rates:
  - Switching: CS in W1 identified as SFP in W2 and remain SFP through W5
  - Cessation: CS in W1 identified as FS in W2 who does not use SFP and remain FS and no SFP use through W5

Nicotine Perception Scenarios
- Analysis of PATH W4 to W5 was conducted to estimate relative adjustment factors associated with nicotine perception responses
- Relative adjustment factors were calculated as the ratio of the transition rate associated with one level of the nicotine harm perception over the overall W4 to W5 CS to SFP switch rate
  - Overall rate of switching between CS (W4) and SFP use (W5) was 3.9%
  - The rate of switching stratified by nicotine perceptions ranged between 2.6% ("Definitely yes") to 8.4% ("Definitely not")
  - Relative adjustment factors shown in Table 1 were applied to the Base Case successful SFP switch rate

Table 1. Base & Nicotine Perception Scenario Inputs

"Do you believe nicotine is the chemical that causes most of the cancer caused by smoking cigarettes?"	Base Case Switching Rate	Relative Adjustment Factors	Nicotine Perception Scenario Switch Rate
Definitely Not	0.92%	113%	1.96%
Probably Not		28%	1.18%
Probably Yes		-21%	0.73%
Definitely Yes		-34%	0.61%

Switching rates used in the model were stratified by gender

CISNET = Cancer Intervention and Surveillance Modeling Network, CS = Current smoking status, FS = Former smoking status

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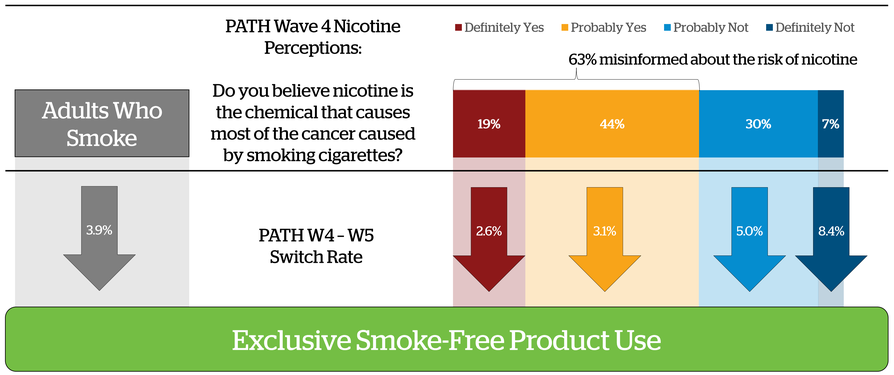
Promoting public education to correct nicotine misperceptions among AS has potential to reduce cigarette prevalence and prevent premature death due to smoking related diseases

Switch Rate Overall and Stratified by Nicotine Perception



Exclusive Smoke-free product use defined as AS in Wave 4 (W4) who no longer smoked but also indicated every day or someday use of electronic nicotine products (ENPs, which includes products such as e-cigarettes, e-hookahs, e-cigars, e-pipes, personal vaporizers, vape pens, and hookah pens), Smokeless Tobacco or snus in W5.

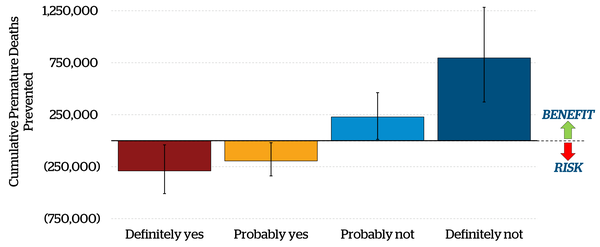
Conclusion

- We conclude, based on our findings, that providing accurate information regarding the risk of nicotine to AS has the potential to accelerate harm reduction by removing a barrier to switching from cigarettes to smoke-free products. This can result in substantial public health benefit by reducing the amount of smoking-related morbidity and mortality.

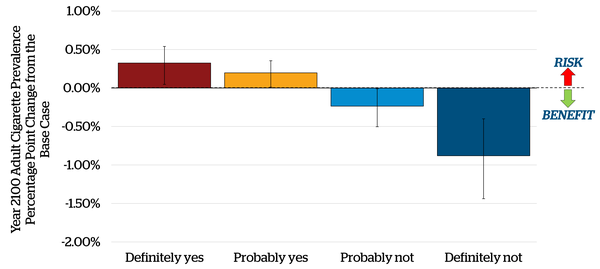
Strengths & Limitations

- Strengths
  - PATH is a nationally-representative longitudinal cohort study which allows for calculations of generalizable transition rates
  - Population Modeling allows for assessing the long-term tobacco-related public health impacts resulting from policy changes, new products or modified risk claims
- Limitations
  - Premature deaths prevented is dependent on the relative risk of SFP use, which was set to the highest risk of the products included in the combined category
  - To reduce complexity the model results were based only on changes in AS switching rates

Results



Error bars represent results from additional scenarios in which the Base Case CS to SFP switch rate shown in Table 1 is adjusted based on relative adjustment factors estimated from the 95% confidence limits (not shown) of the W4 to W5 stratified nicotine perception response group rates. Results are cumulative over an 85-year period.



Decreasing cigarette prevalence results in an increase in premature deaths prevented

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