Estimating the Long-term Population Health Impacts from Marketing a Heated Tobacco Product

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Modeling estimates that authorization of Ploom® System heated tobacco product and MRTP claims potentially results in prevention of 1.6 million tobacco attributable deaths.
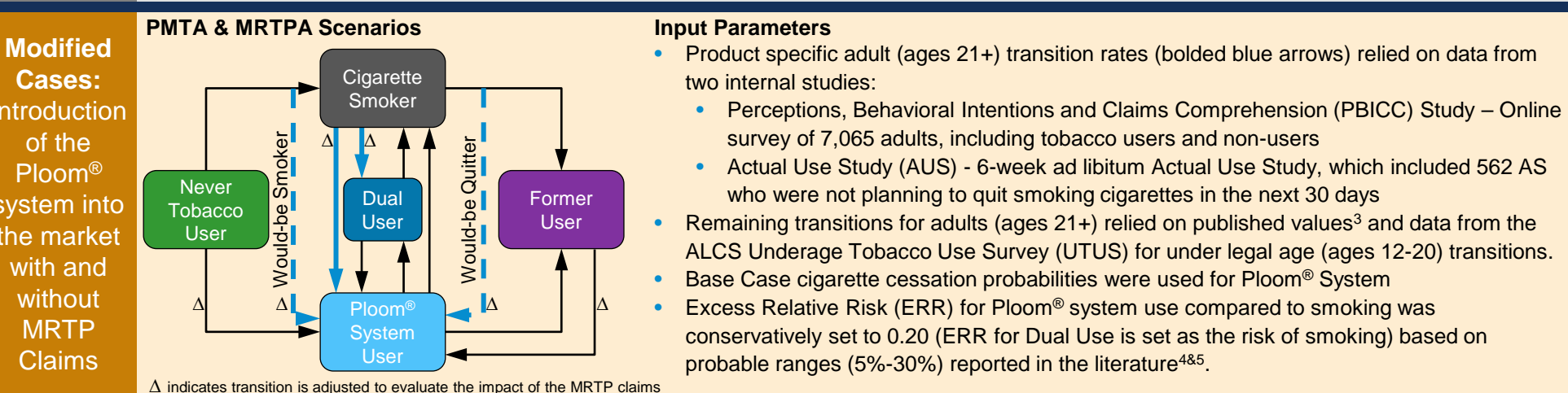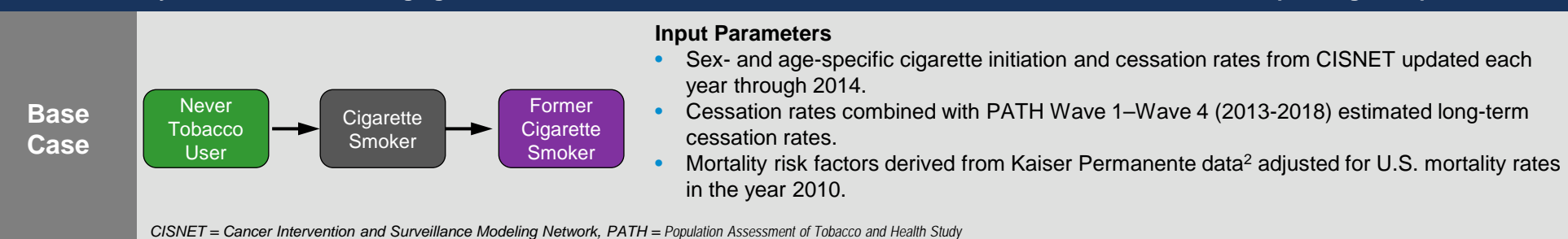
INTRODUCTION

- The Ploom® System (Marlboro® heated tobacco sticks used with the Ploom® device) produces an aerosol with substantially lower levels of HPHCs overall than combustible cigarette smoke and is a potential viable alternative for many adults who smoke (AS).
- Switching completely to noncombustible tobacco products with low or non-quantifiable levels of HPHCs presents the potential to reduce harm among AS.
- The FDA requires applicants to demonstrate that new tobacco products protect public health (through a PMTA) or reduce risks compared to existing products (through an MRTPA) to gain marketing authorization.
- Modeling incorporates evidence on the potential health risks and behavior among users and nonusers to assess the risks and benefits to the population as a whole.
- Modeling is particularly useful for testing extreme scenarios, such as assessing how underage initiation to a new product might offset the benefits of adults switching or evaluating uncertainties in the excess mortality risk of the new product compared to continued smoking.
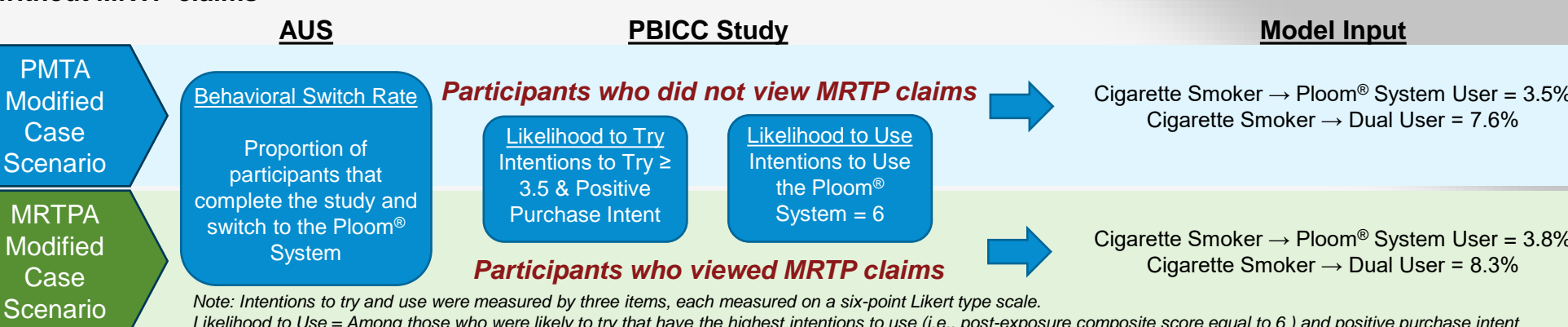
METHODS

We used an updated version of our previously validated Agent-based Model (ABM) [1]

- The model is initialized with a hypothetical population of 3.09MM agents (1/100th of the U.S. population in the year 2010 by age, gender, & tobacco use status)
- Tobacco attributable deaths (TAD), life-years lost (LYL), and tobacco use prevalence are projected in 1-year increments through 2100
- At each 1-year increment surviving agents can maintain their current status or transition to a new tobacco use state depending on input transition rates

Base Case

Input Parameters
- Sex- and age-specific cigarette initiation and cessation rates from CISNET updated each year through 2014.
- Cessation rates combined with PATH Wave 1–Wave 4 (2013-2018) estimated long-term cessation rates.
- Mortality risk factors derived from Kaiser Permanente data[2] adjusted for U.S. mortality rates in the year 2010.

CISNET = Cancer Intervention and Surveillance Modeling Network, PATH = Population Assessment of Tobacco and Health Study

Modified Cases: Introduction of the Ploom® system into the market with and without MRTP Claims

PMTA & MRTPA Scenarios

Δ indicates transition used to evaluate the impact of the MRTPA claims

Input Parameters
- Product specific adult (ages 21+) transition rates (bolded blue arrows) relied on data from two internal studies:
  - Perceptions, Behavioral Intentions and Claims Comprehension (PBICC) Study – Online survey of 7,065 adults, including tobacco users and non-users
  - Actual Use Study (AUS) - 6-week ad libitum Actual Use Study, which included 562 AS who were not planning to quit smoking cigarettes in the next 30 days
- Remaining transitions for adults (ages 21+) relied on published values[3] and data from the ALCS Underage Tobacco Use Survey (UTUS) for under legal age (ages 12-20) transitions.
- Base Case cigarette cessation probabilities were used for Ploom® System
- Excess Relative Risk (ERR) for Ploom® system use compared to smoking was conservatively set to 0.20 (ERR for Dual Use is set as the risk of smoking) based on probable ranges (5%-30%) reported in the literature[4,5].

The impact on the population as a whole is estimated based on the difference in tobacco use prevalence, tobacco-attributable deaths, and life-years lost between a Base and Modified Case scenario
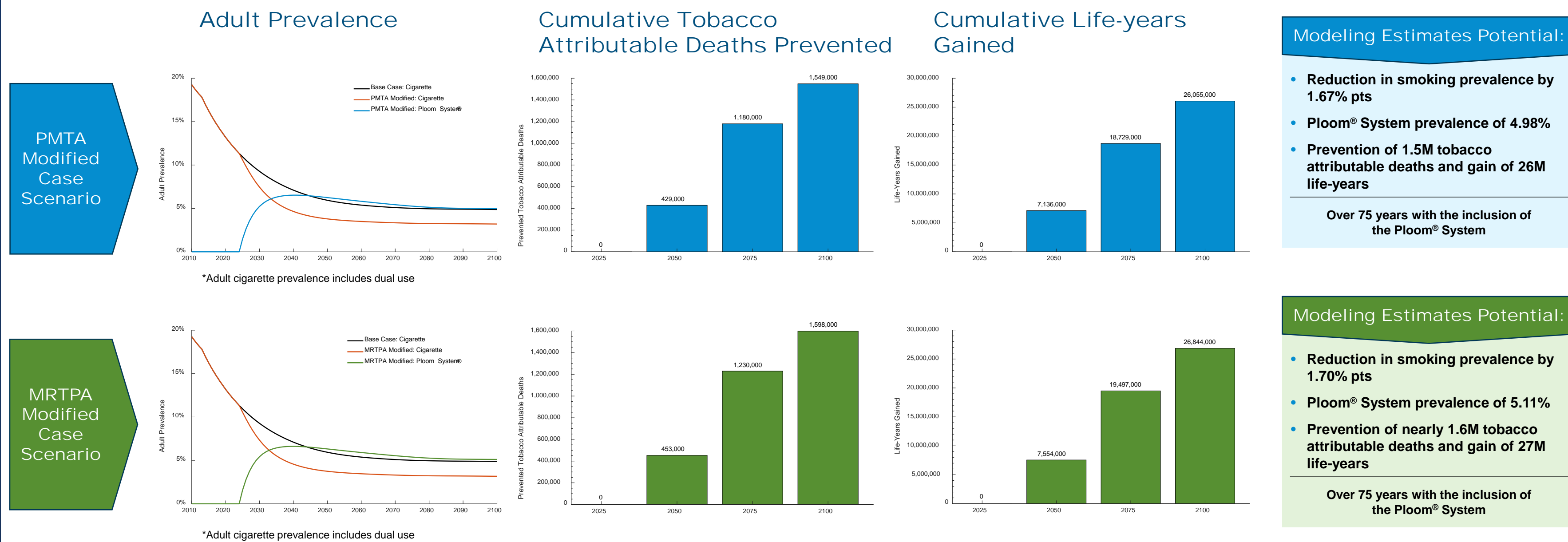
Estimated transition rates from smoking to use of the Ploom® System to evaluate the impact of market authorization with and without MRTP claims

	AUS	PBICC Study		Model Input
PMTA Modified Case Scenario	Behavioral Switch Rate — Proportion of participants that complete the study and switch to the Ploom® System	*Participants who did not view MRTP claims* Likelihood to Try Intentions to Try ≥ 3.5 & Positive Purchase Intent	Likelihood to Use Intentions to Use the Ploom® System = 6	Cigarette Smoker → Ploom® System User = 3.5% Cigarette Smoker → Dual User = 7.6%
MRTPA Modified Case Scenario		*Participants who viewed MRTP claims*		Cigarette Smoker → Ploom® System User = 3.8% Cigarette Smoker → Dual User = 8.3%

Note: Intentions to try and use were measured by three items, each measured on a six-point Likert type scale.
Likelihood to Use = Among those who were likely to try that have the highest intentions to use (i.e., post-exposure composite score equal to 6) and positive purchase intent

RESULTS

Adult Prevalence

PMTA Modified Case Scenario

*Adult cigarette prevalence includes dual use

MRTPA Modified Case Scenario

*Adult cigarette prevalence includes dual use

Cumulative Tobacco Attributable Deaths Prevented

Cumulative Life-years Gained

Modeling Estimates Potential:
- Reduction in smoking prevalence by 1.67% pts
- Ploom® System prevalence of 4.98%
- Prevention of 1.5M tobacco attributable deaths and gain of 26M life-years

Over 75 years with the inclusion of the Ploom® System

Modeling Estimates Potential:
- Reduction in smoking prevalence by 1.70% pts
- Ploom® System prevalence of 5.11%
- Prevention of nearly 1.6M tobacco attributable deaths and gain of 27M life-years

Over 75 years with the inclusion of the Ploom® System

Underage Tipping Point Sensitivity

Smokeless Tobacco = 0.1% Cigarettes = 0.5% ENDS = 3.3% — Youth tobacco product initiation rates †

PMTA Modified Case Scenario Underage initiation = 0.21%

25x Increase in PMTA initiation rate

50x Increase in PMTA initiation rate

Population benefit observed under extreme 50x increase in underage initiation

Underage initiation would have to increase to highly unrealistic rates before the benefit tips to risk

960,000 Tobacco Attributable Deaths Prevented

1.2M Tobacco Attributable Deaths Prevented

1.5M Tobacco Attributable Deaths Prevented

Excess Relative Risk (ERR) Sensitivity

- While no youth should use any tobacco product, tipping point scenarios illustrate that Ploom® System specific initiation rates for underage never user populations would have to rise well beyond those currently observed for the entire cigarette, smokeless tobacco, and electronic nicotine delivery system (ENDS) categories to result in a net risk to the population as a whole.
- Product specific initiation rates for the underage never user population would have to rise to levels resulting in subsequent product specific underage prevalence well above that observed from National Youth Tobacco Survey (NYTS) data for current use of all tobacco products.

- Increasing the ERR to 30% results in a decrease in the population health benefit to 1,217,000 tobacco attributable deaths prevented by year 2100.
- ERR would need to increase quite substantially (>0.6) before the net benefit could potentially turn into net risk.

†ALCS analysis of PATH W5-W6 current use of tobacco products among youth never users of ENDS, cigarettes and smokeless tobacco Note: Only initiation is increased, all other transitions remain the same as in the Modified Case
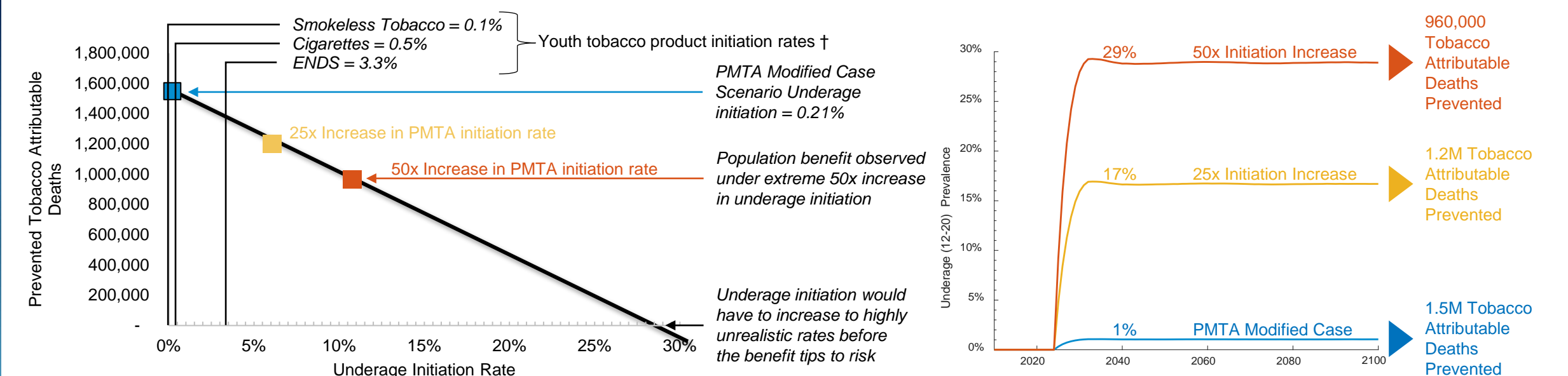
CONCLUSIONS

- Modeling estimates a potential net benefit of authorization with 1.5 million TADs prevented, 26.1 million LYG, and an additional reduction in smoking prevalence by 1.67 percentage points over a period of 75 years
- Modeling estimates a potential additional 49,000 deaths prevented and gain of 789,000 life-years with the inclusion of MRTP claims
- Potential population benefit is retained under a variety of sensitivity scenarios
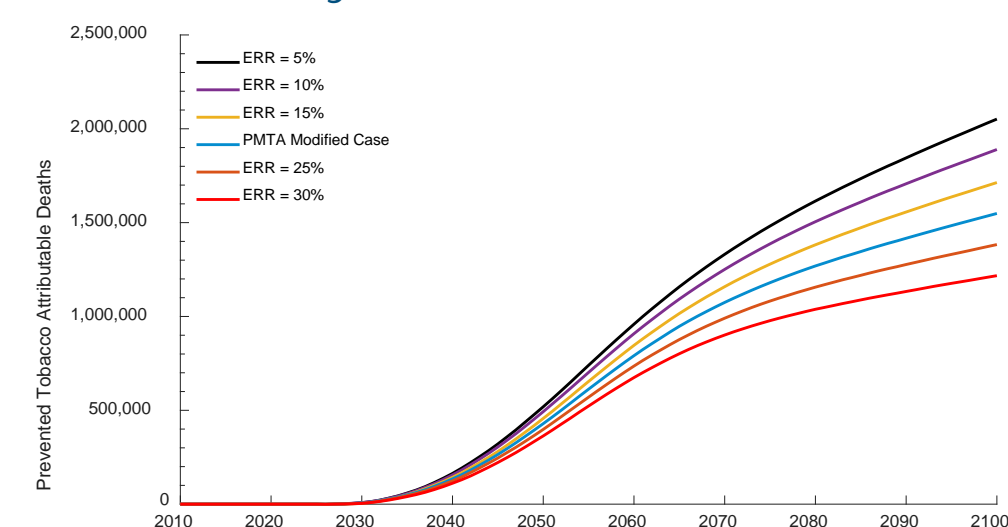- Tipping point sensitivity analyses estimates low risk of initiation among underage populations

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