

TCORS 2.0

University of
Michigan &
Georgetown
University

Center for the
**Assessment of Tobacco
Regulations**
[CAStoR]



The CISNET Smoking History Generator and CAStoR microsimulation models. Past applications, current developments, and future directions

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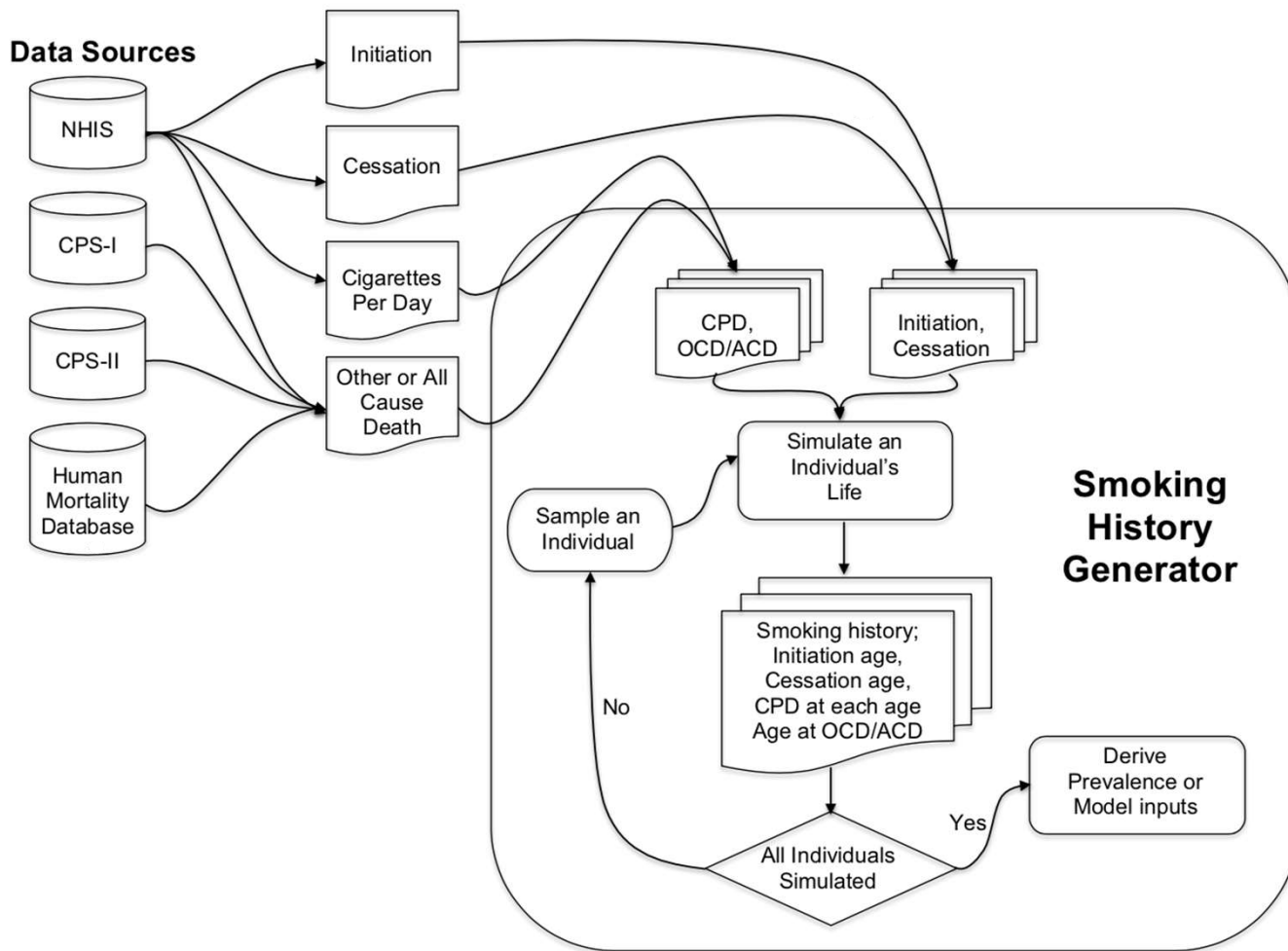
University of Michigan

CAStoR Simulation Modeling Symposium 2021

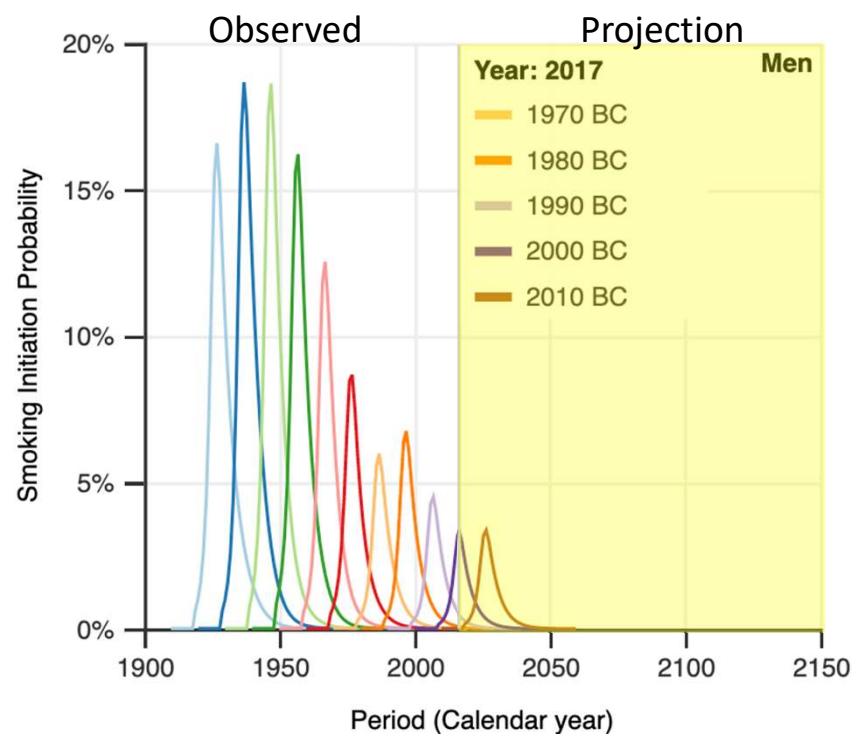


Smoking History Generator / CAsToR Miscrosimulation Models

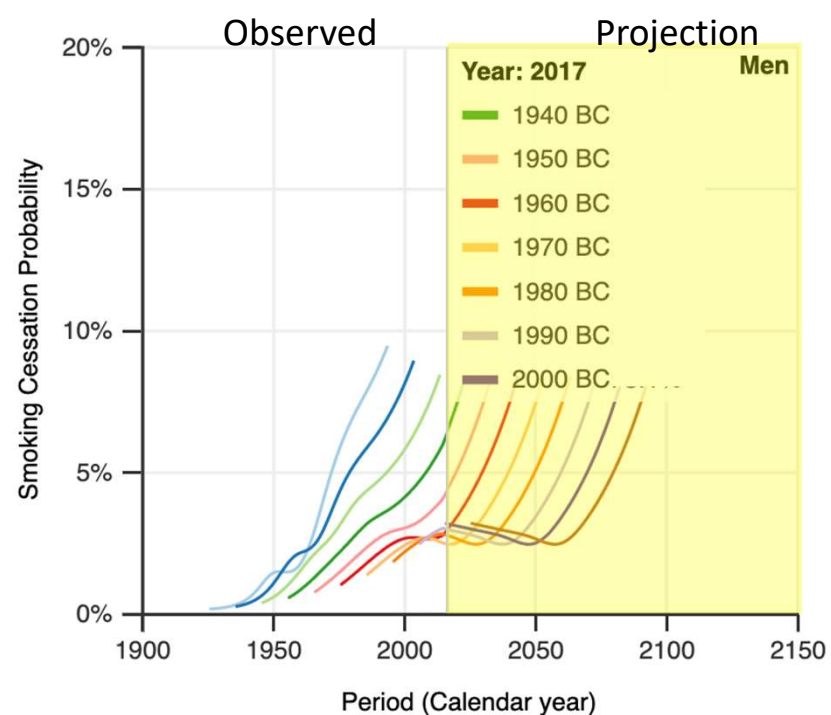
- Modeling of smoking patterns in the US by gender, age, calendar year and **birth-cohort**
- Detailed modeling of smoking initiation, cessation and intensity rates
- Policy effects are incorporated through changes in initiation and cessation rates (taxes, smokefree, expenditures, MLA)
- Projection of the impact of Tobacco Control in the US on overall mortality and lung cancer



Smoking Initiation

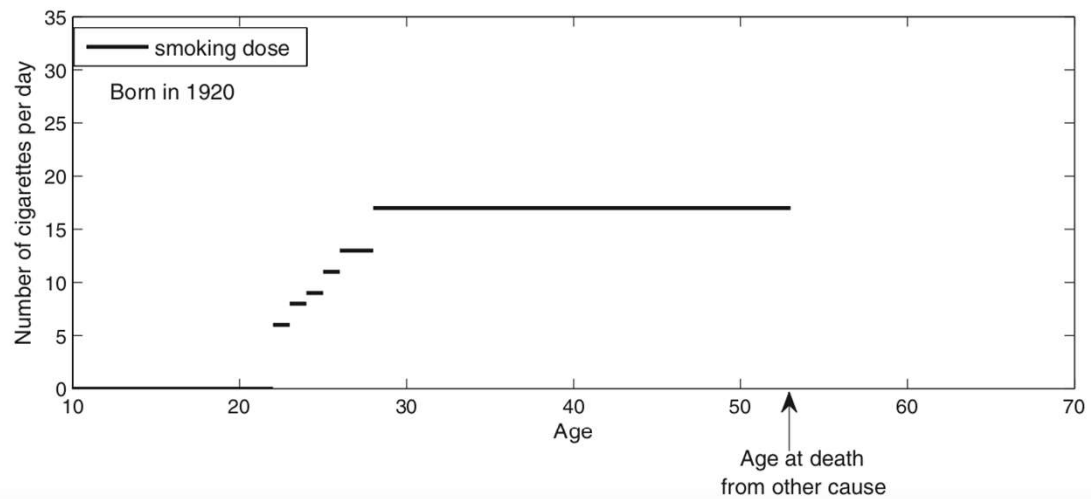
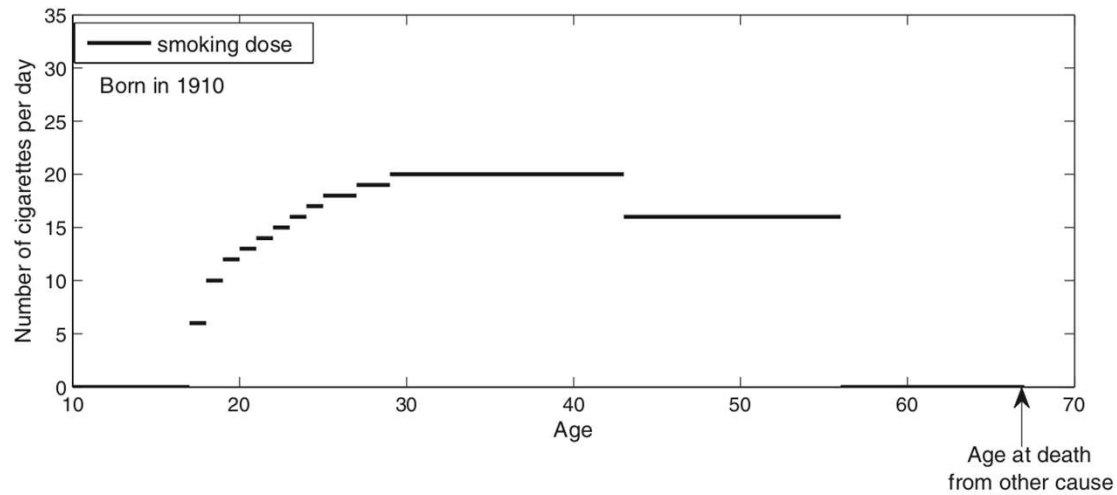


Smoking Cessation



- Smoking behaviors vary greatly by cohort
- These need to be accounted for in any modeling

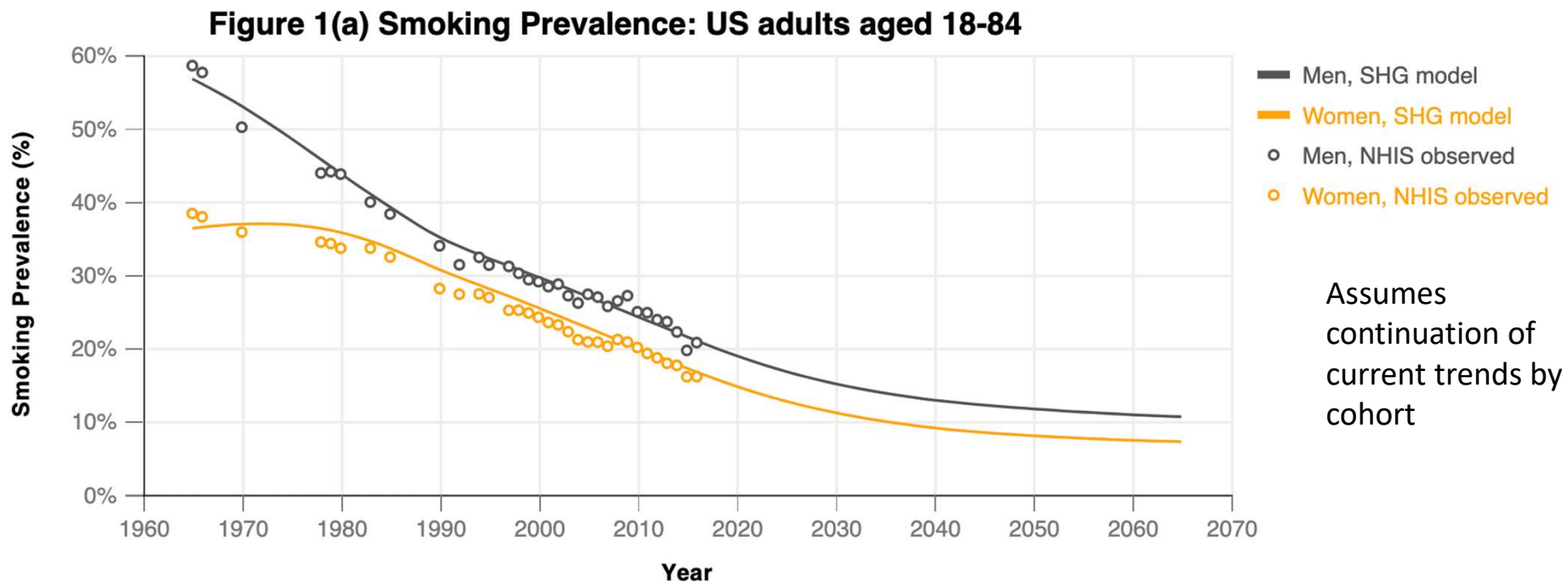
- Recent cohorts show big reductions in initiation and increases in cessation
- Will these continue?



Inputs for CISNET Lung Cancer models:

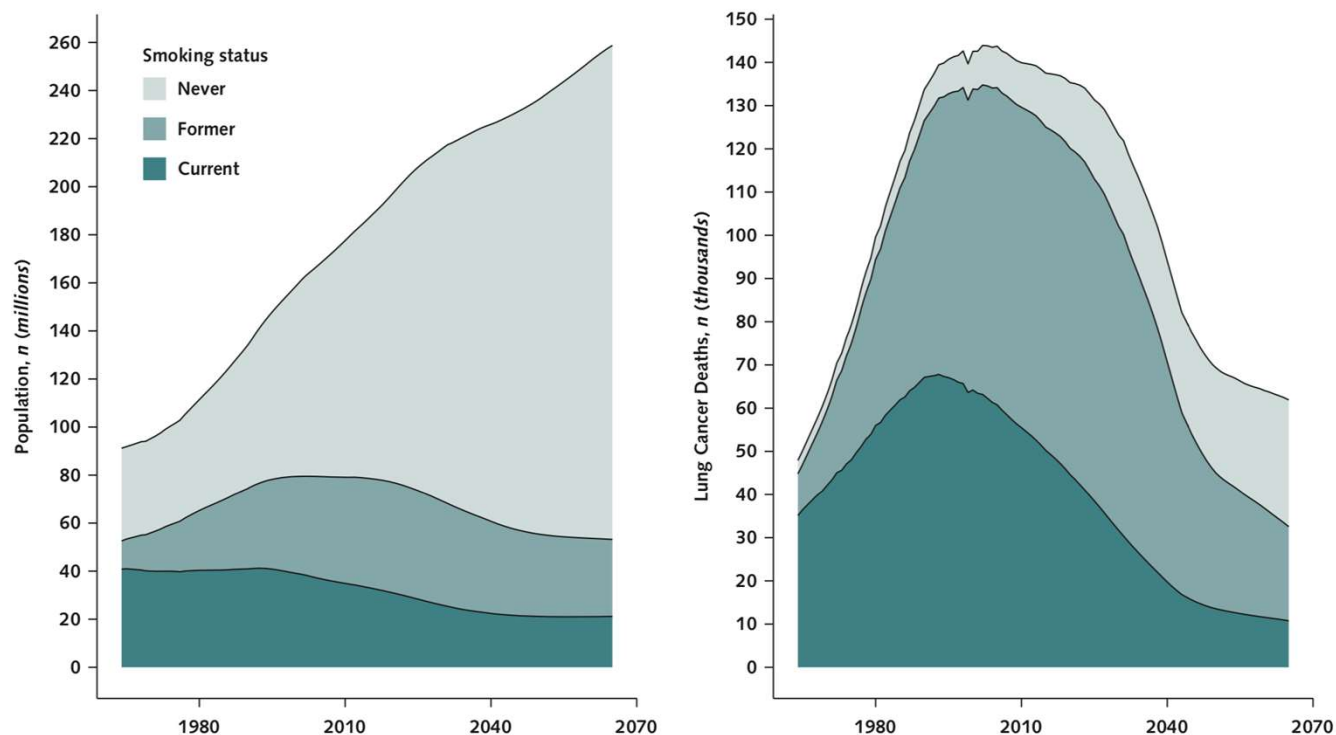
<https://cisnet.cancer.gov/lung>

Projected US smoking prevalence



Jeon et al, Annals Intern Med 2018

Future Smoking and Lung Cancer Burden



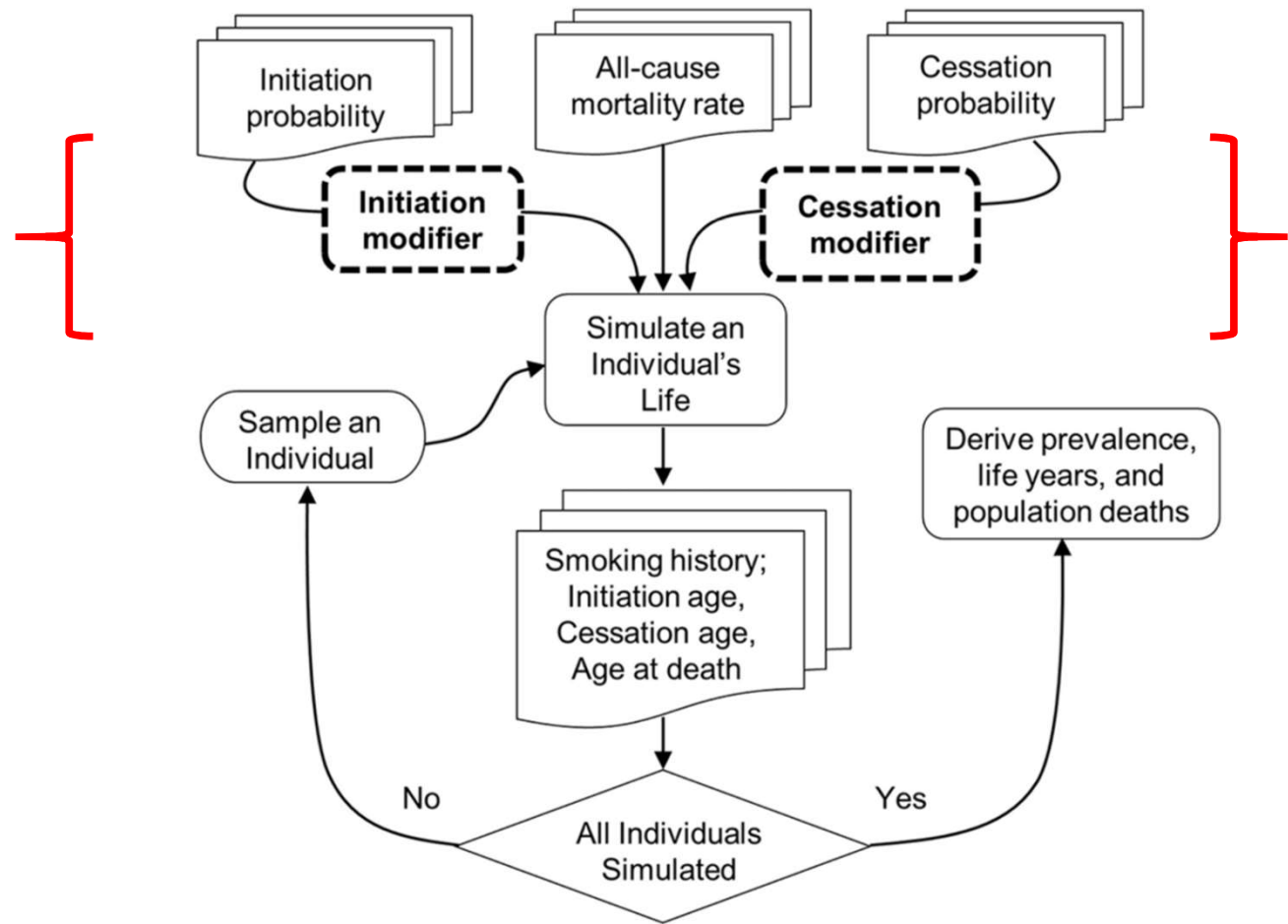
Number of lung cancer deaths overall and in current/former smokers will decrease

Still 4 million people are projected to die from LC from 2015-2065

Numbers in never smokers will increase (demographic & smoking changes)

Jeon J et al , Ann Intern Med 2018

Tobacco Policy Tool

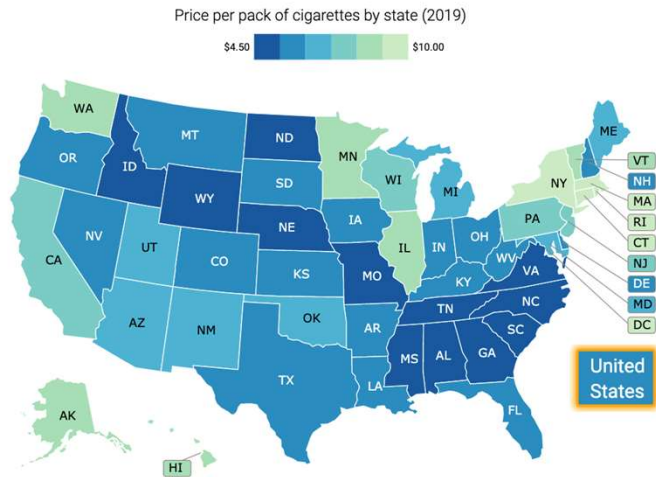


Tam et al, BMJ Open 2018

Cigarette Taxes

What if we raise cigarette taxes?

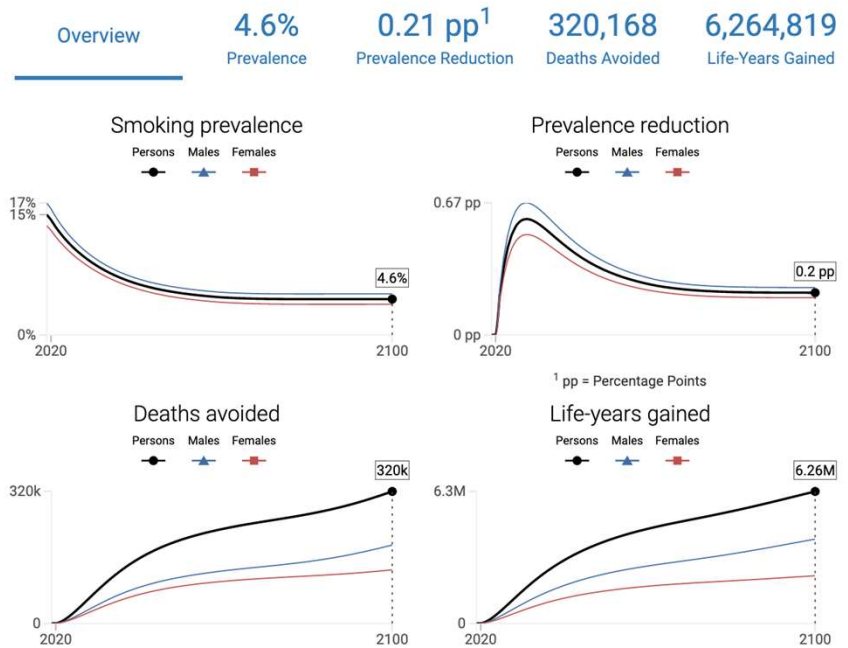
The current price for a pack of cigarettes in is about \$6.50. If we raise cigarette taxes by at the beginning of effectively raising the price to \$7.50.



Source: Campaign for Tobacco-Free Kids, 2019

Read more Getting started Guided tour Print Share

By the end of for the age group of the this policy would result in the following outcomes (view scale):



Applications and Extensions

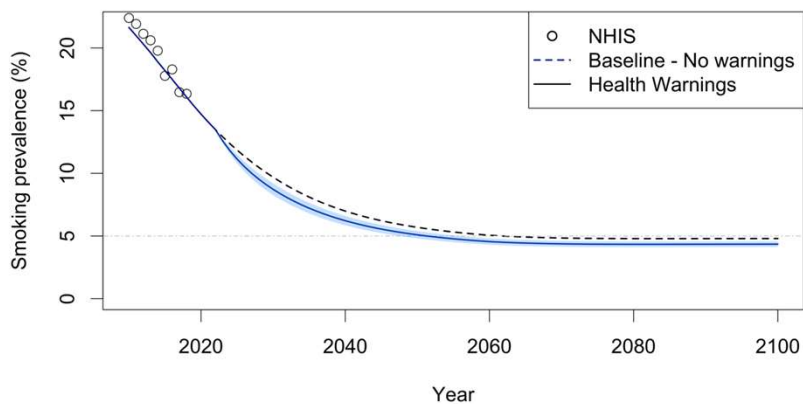
Graphic Health Warnings

- Tam et al, under review (please don't share)

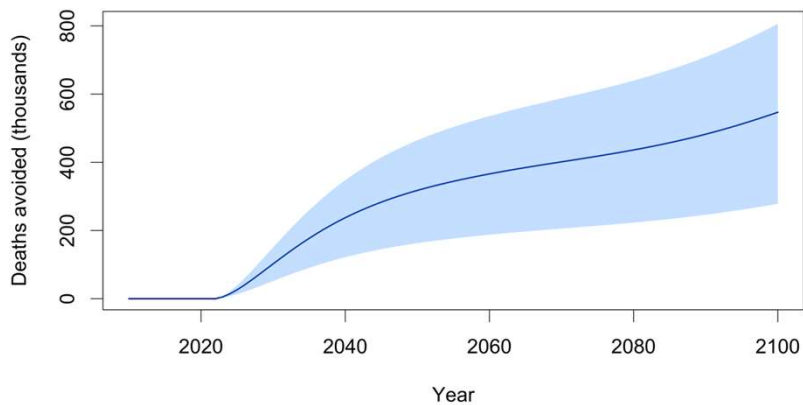
Cigarette Health Warnings

- Graphic health warnings
 - FDA issued the cigarette health warnings final rule in March 2020
 - Effective date: June 2021
 - Postponed by 120 days due to COVID-19 and then by 90 days by a court ruling
 - New effective date: April 14, 2022
- Update previous modeling study: Levy DT, Mays D, Yuan Z, et al. Public health benefits from pictorial health warnings on US cigarette packs: a SimSmoke simulation. Tobacco Control 2017;26:649-655.
- Use CISNET smoking population model to project the impact of health warnings implementation starting in 2022 or in 2012
 - Considering current decreasing trends

Smoking Prevalence - US adults



Cumulative Premature Deaths Avoided

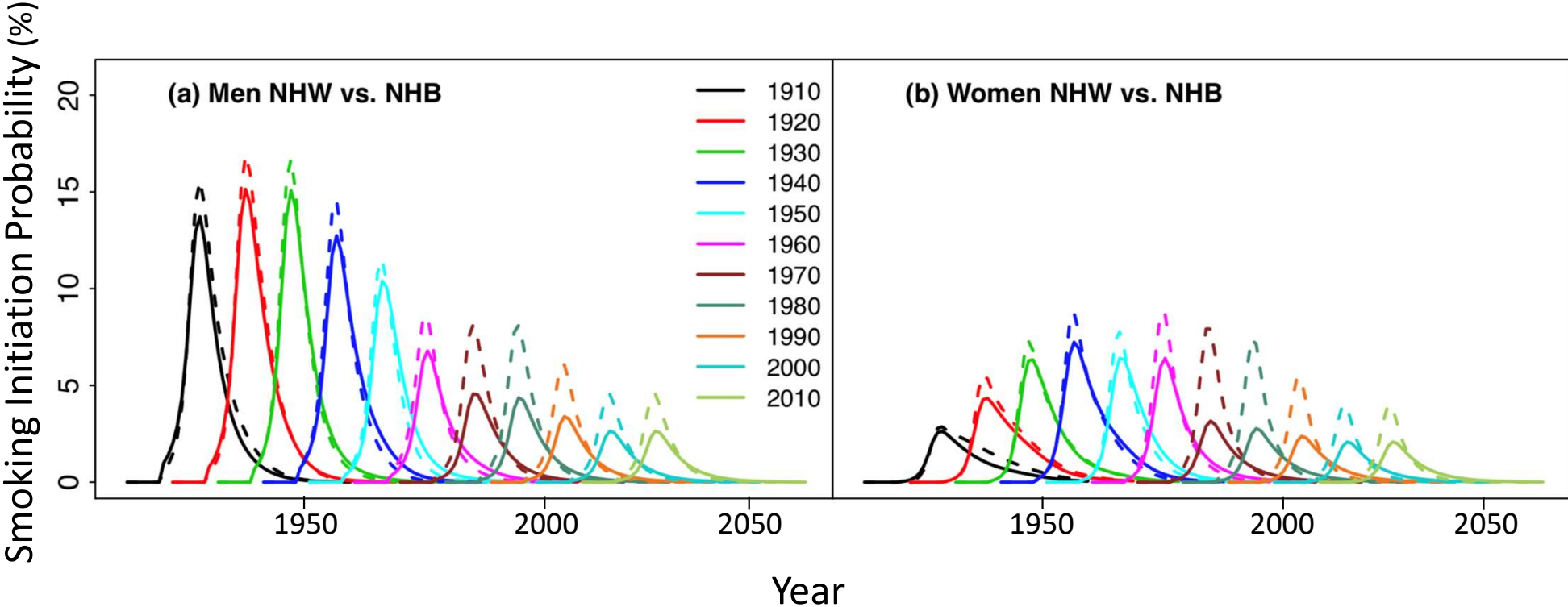


	Policy implemented in 2022			Policy implemented in 2012		
	Smoking initiation reduced by			Smoking initiation reduced by		
Smoking cessation increased by ^a	5%	10%	15%	5%	10%	15%
	Premature deaths prevented (thousands)			Premature deaths prevented (thousands)		
25%	278^b	466	644	394^b	636	866
50%	359	547^c	725	535	777^c	1007
75%	441	628	806^d	678	919	1149^d
	Life-years gained (millions)			Life-years gained (millions)		
25%	5.5^b	9	12.5	7.6^b	12.4	16.9
50%	7.1	10.7^c	14.1	10.1	14.9^c	19.5
75%	8.8	12.4	15.8^d	12.7	17.5	22.0^d

- **Considerable premature deaths prevented and life-years gained**
- **Predicted premature deaths prevented and LYG increase by about 40% if policy had been implemented in 2012**

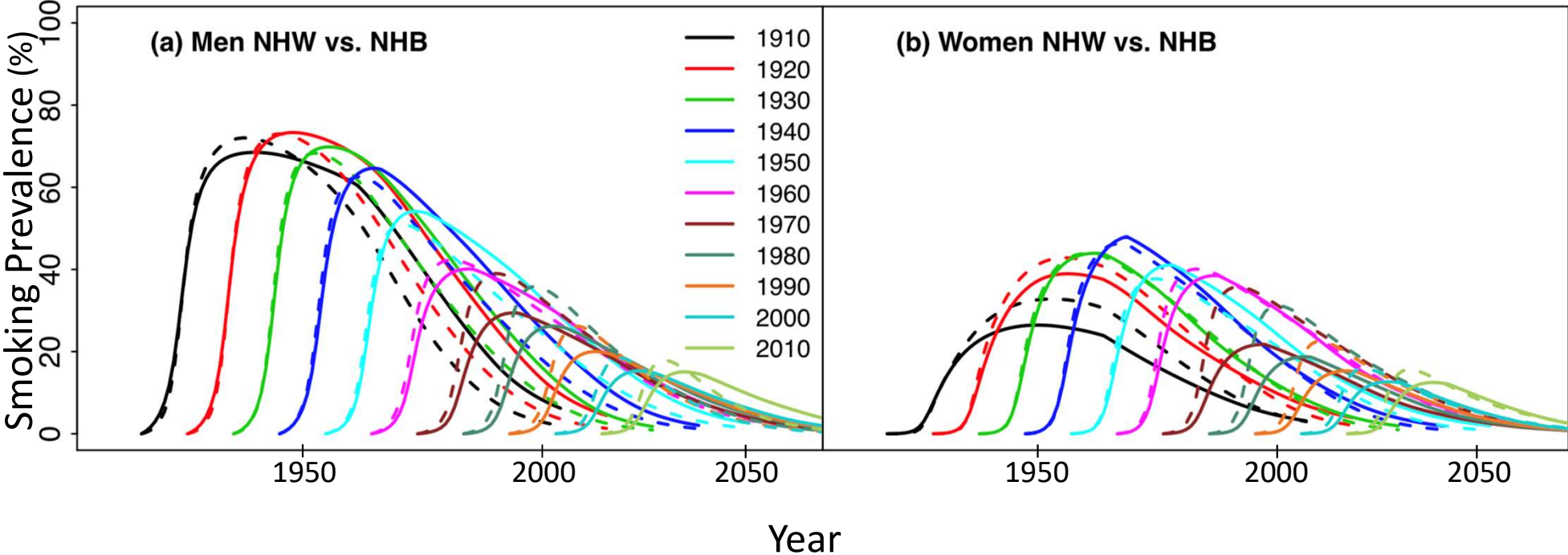
Sociodemographic Groups

Extensions to sociodemographic groups



NHW – non-Hispanic Whites (dashed) ; NHB – non-Hispanic Blacks (solid)

Extensions to sociodemographic groups

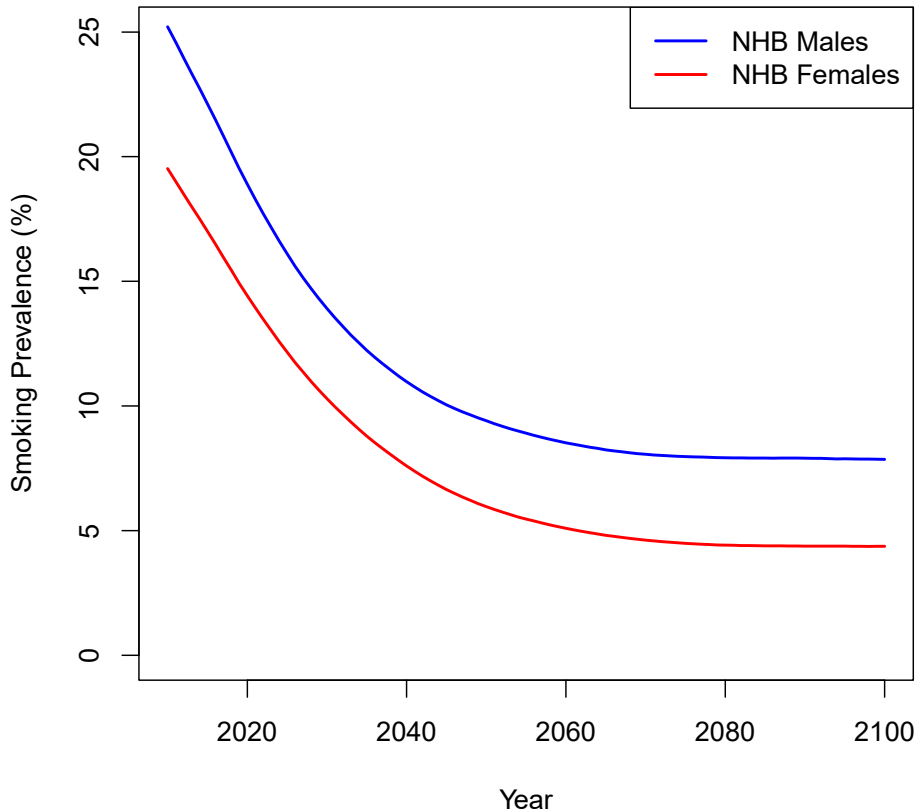


NHW – non-Hispanic Whites (dashed) ; NHB – non-Hispanic Blacks (solid)

A simulation model of smoking, ENDS use, and health outcomes among US Blacks

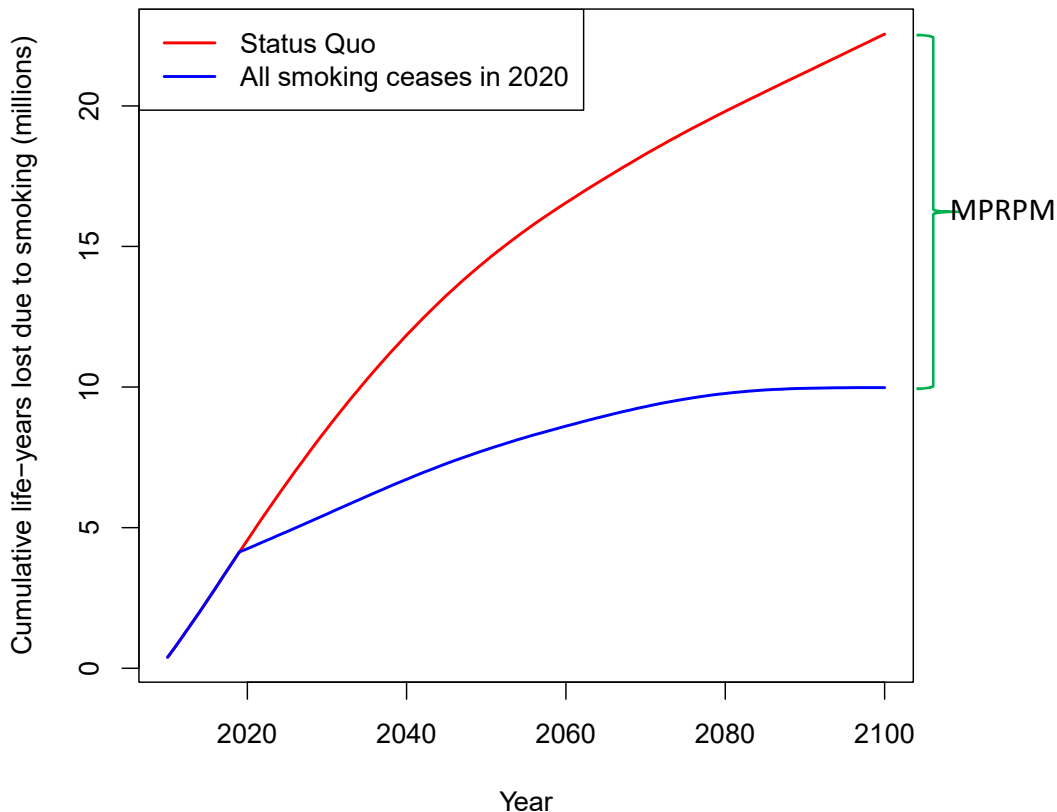
- Microsimulation model
- Extension of the CISNET Smoking History Generator
- Incorporates NHB-specific smoking and mortality parameters
- Joint simulation of individual smoking and ENDS histories
 - ENDS not shown today
- Preliminary results

Adult Smoking Prevalence – Status Quo



- Projected smoking prevalence under a Status Quo scenario
 - Keep current initiation/cessation constant for future birth cohorts
- Accounting for sex and cohort variations in smoking initiation and cessation and mortality rates
- Smoking projected to decrease until 2060 under the Status Quo scenario

Life-years lost due to smoking, Non-Hispanic Blacks



- Projected NHB smoking-attributed mortality (2010-2100)
 - 1.6 million smoking attributable deaths (SADs)
 - 22.5 million Years of Life Lost (YLL)
- If all NHBs smoking ceases in 2020
 - 12.6 million YLL could be saved; 55.7% of the SQ YLL
 - **Maximum Potential Reduction in Premature Mortality (MPRPM); Warner & Mendez 2020**

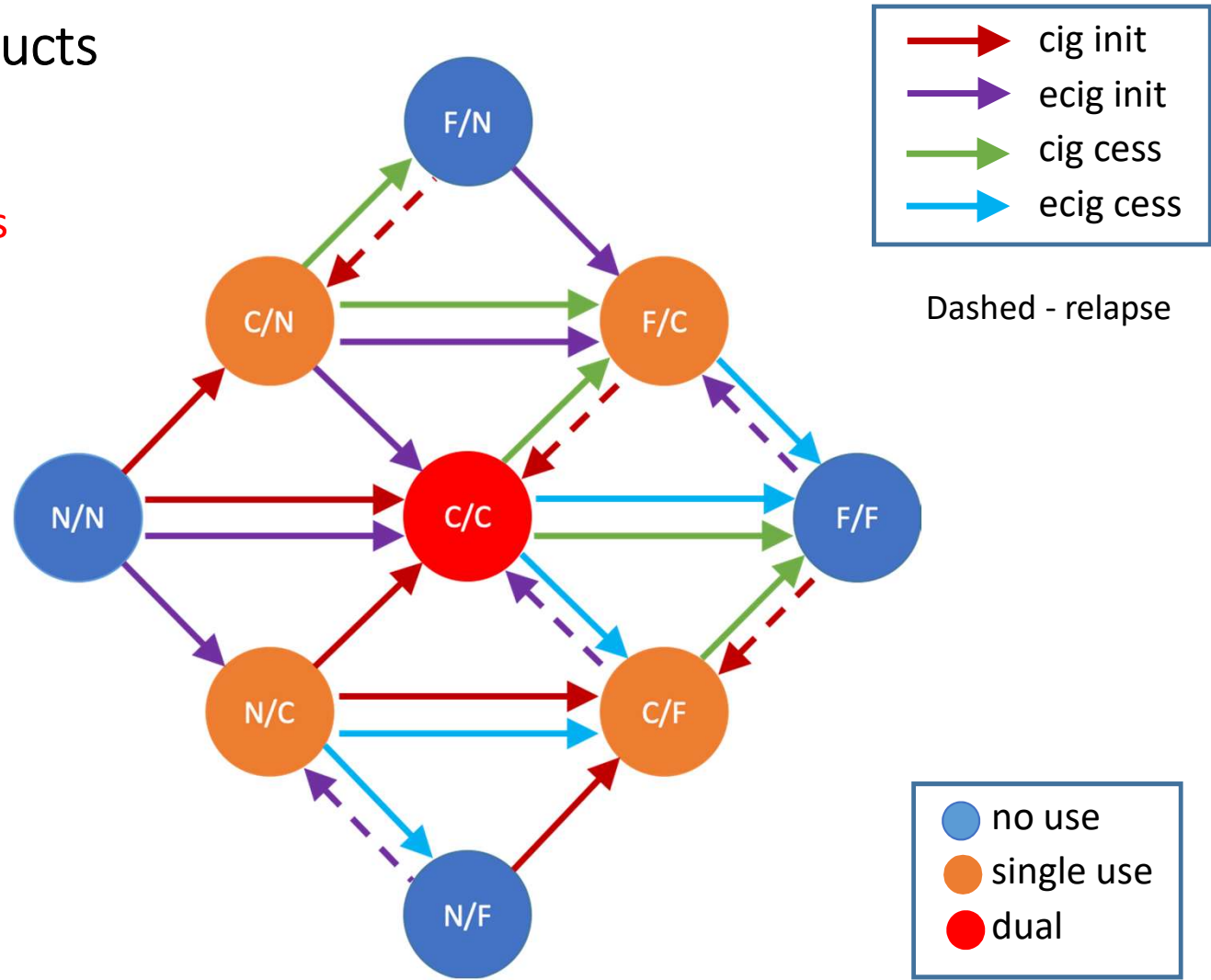
Multiple tobacco products

Extensions to other products CAsToR

Cigarette / E-cigarette status compartments

By age, sex, birth-cohort

N-never; C-current; F-former



- cig init
- ecig init
- cig cess
- ecig cess

Dashed - relapse

- no use
- single use
- dual

Markov State Transition Modeling

- PATH adult data Waves 1-4
- Cigarettes and ENDS
- Transitions between products
- By age-group
- Other covariates

a) Ages 18-24: 1-wave cumulative transition probabilities

From	To	Never use	Non-current use	Cigarette use	ENDS use	Dual use
Never use		95.0	2.0	1.8	1.0	0.2
Non-current use		67.9	24.8	5.2	2.1	
Cigarette use		12.5	78.0	1.7	7.8	
ENDS use		27.7	12.0	46.4	13.9	
Dual use		7.2	41.6	12.0	39.2	

1-wave cumulative transition probability (%)

b) Ages 25-34: 1-wave cumulative transition probabilities

From	To	Never use	Non-current use	Cigarette use	ENDS use	Dual use
Never use		96.8	1.6	1.2	0.3	0.1
Non-current use		82.6	14.7	1.9	0.3	
Cigarette use		10.2	82.5	1.4	5.9	
ENDS use		18.9	10.0	57.5	13.6	
Dual use		4.4	44.6	8.6	42.3	

1-wave cumulative transition probability (%)

c) Ages 35-54: modeled 1-wave cumulative transition probabilities

From	To	Never use	Non-current use	Cigarette use	ENDS use	Dual use
Never use		97.5	1.4	1.0	0.1	0.0
Non-current use		92.7	6.1	0.9	0.3	
Cigarette use		6.6	88.4	0.8	4.2	
ENDS use		18.1	7.6	58.2	16.1	
Dual use		3.0	44.9	7.8	44.3	

1-wave cumulative transition probability (%)

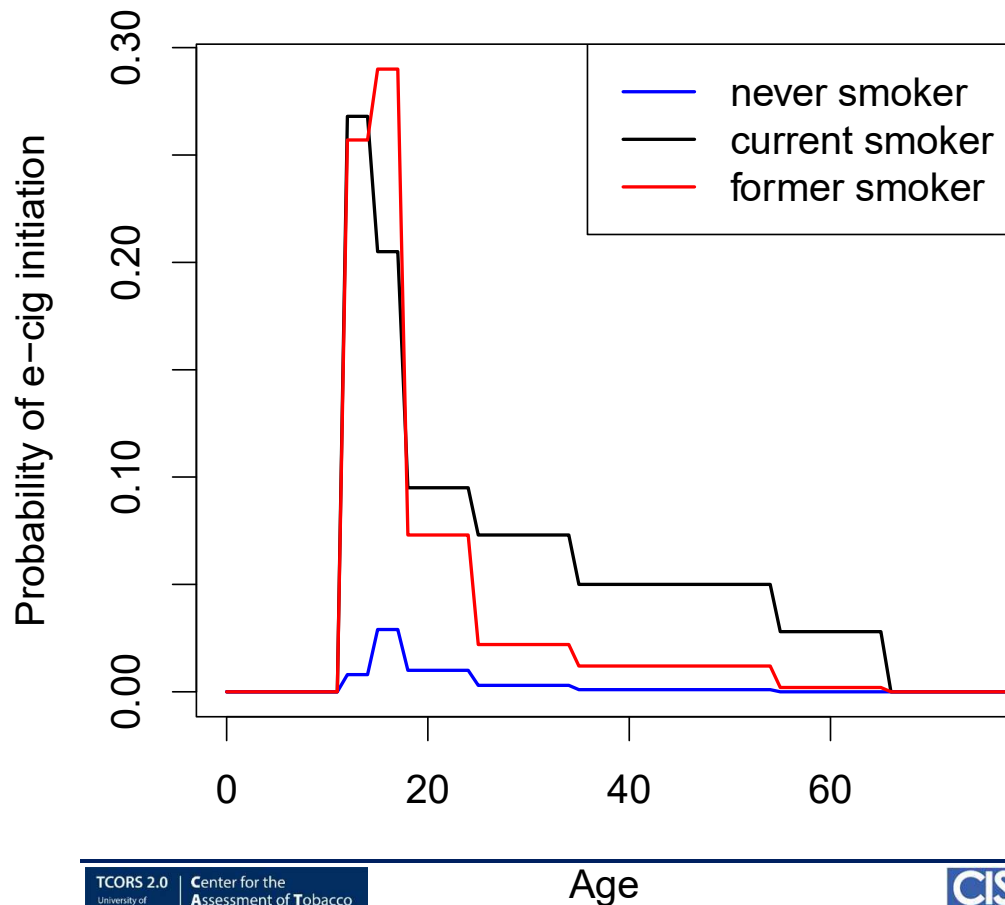
d) Ages 55+: modeled 1-wave cumulative transition probabilities

From	To	Never use	Non-current use	Cigarette use	ENDS use	Dual use
Never use		96.1	2.9	0.9	0.0	0.0
Non-current use		97.6	2.1	0.2	0.0	
Cigarette use		8.3	89.0	0.7	2.1	
ENDS use		10.7	6.3	73.9	9.1	
Dual use		2.7	42.6	7.7	47.0	

1-wave cumulative transition probability (%)

Brouwer et al, Tob Control 2020

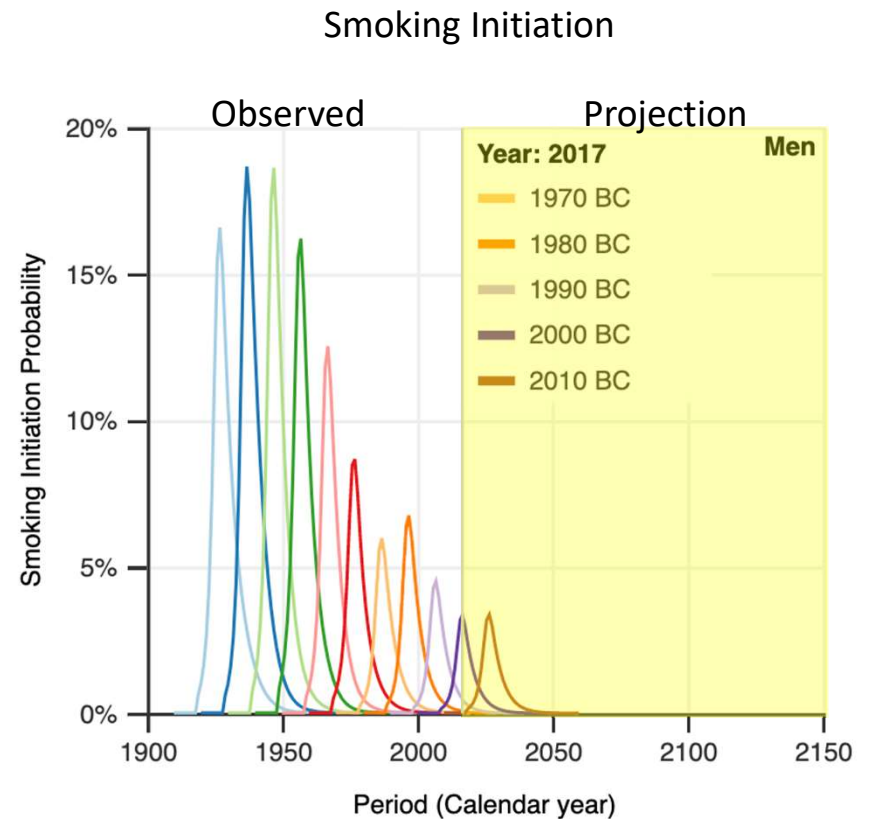
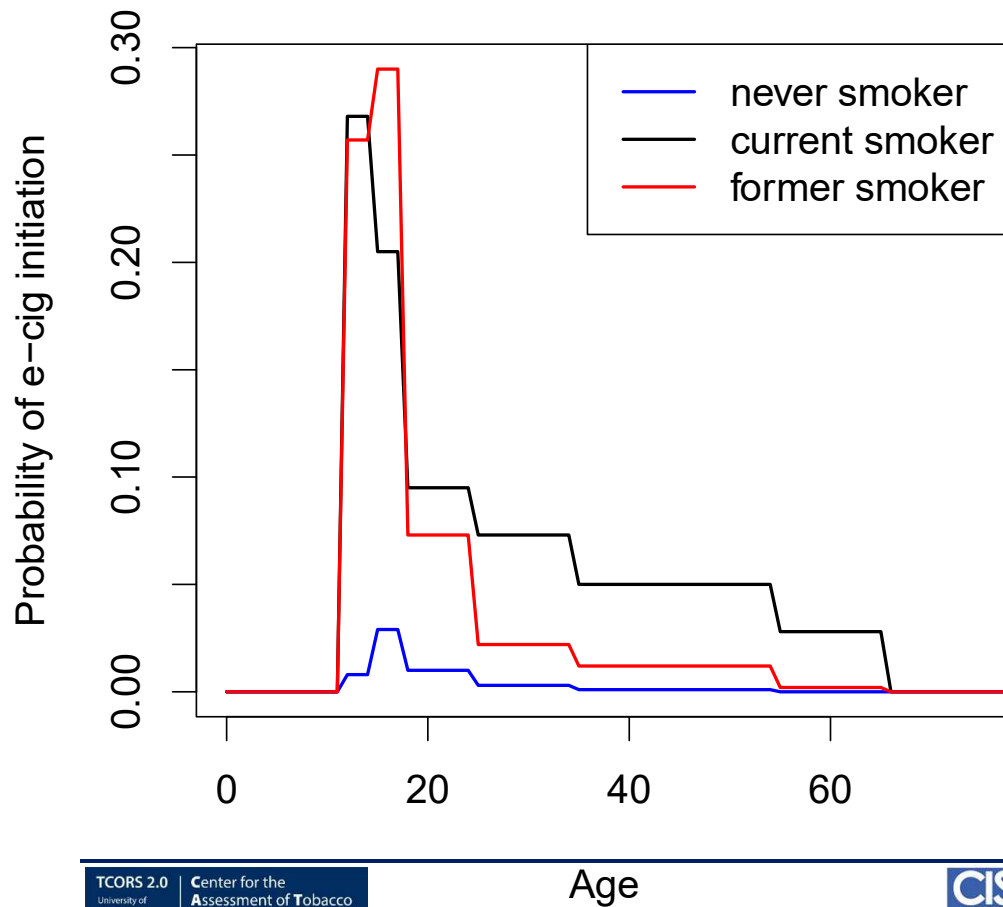
Age-specific e-cig initiation by smoking status according to Markov analysis



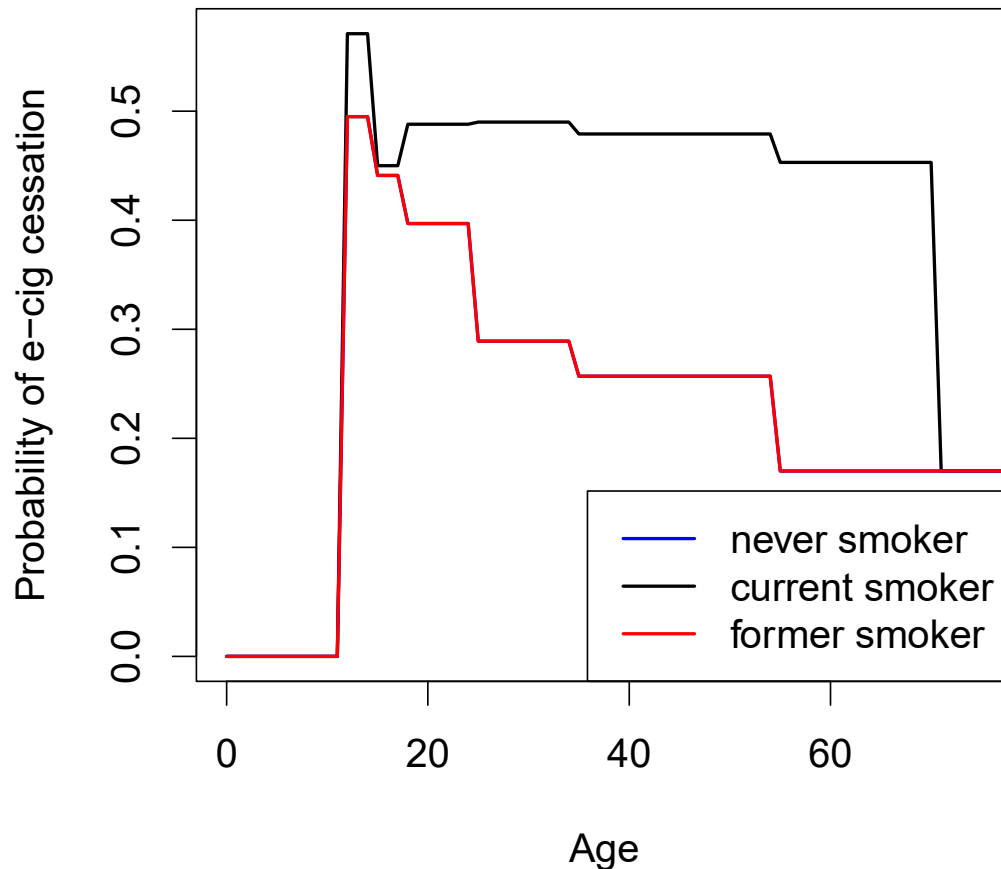
- Assumed former smoker rates are equivalent to non-current use in PATH analysis
- Assumes patterns seen by age now are truly age-effects and not cohort differences since younger people exposed to e-cigs at young age, but older folks didn't see them until late in life
- These analyses are for 2013/4 to 2016/7, i.e., pre-Juul. It is unclear that they will hold post- JUUL

Preliminary, please don't share

Age-specific e-cig initiation by smoking status according to Markov analysis



Age-specific e-cig cessation by smoking status according to Markov analysis

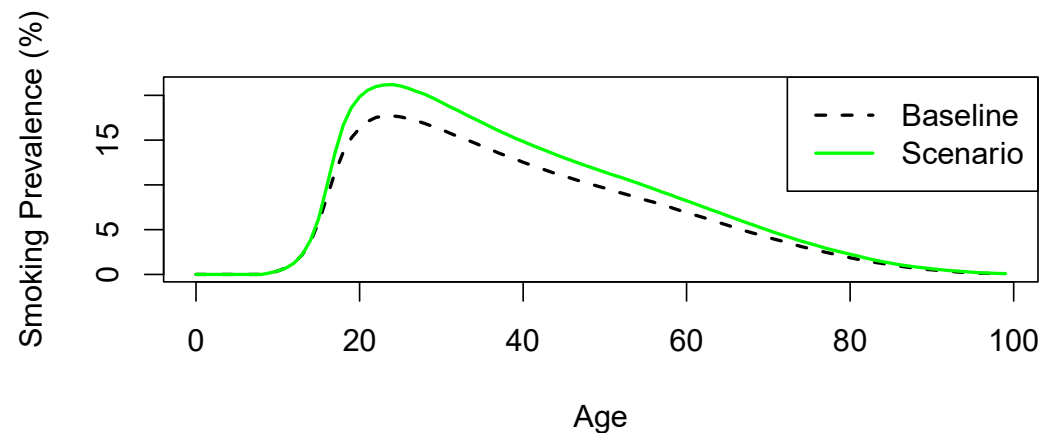
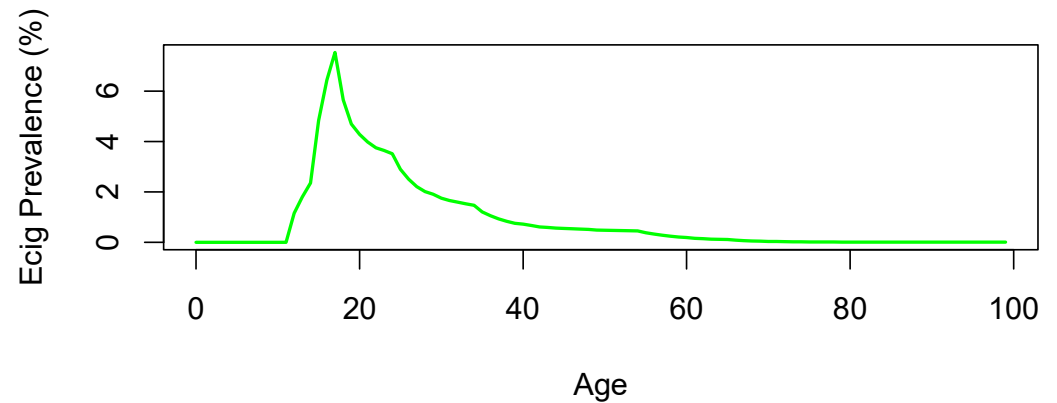


- Assumed never and former smoker rates are similar
- Age patterns from Markov transition analysis
- Pretty high e-cig cessation rates due to observed transient use through 2017

Preliminary, please don't share

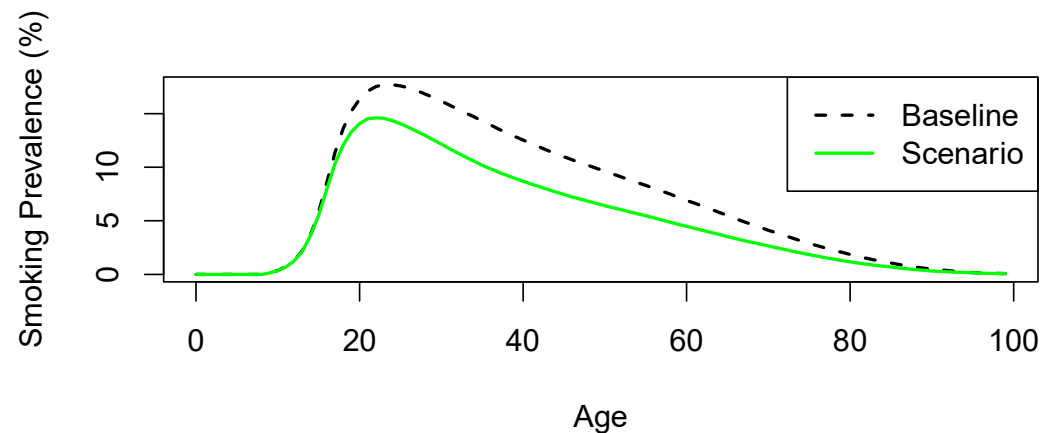
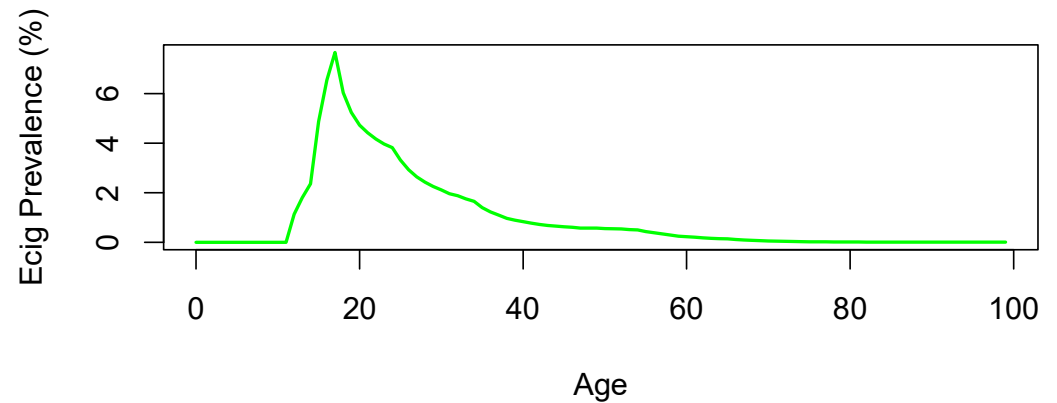
Sample simulations

- 300,000 individuals from the US 2000 birth cohort
- E-cig initiation/cessation as in previous slides
- **Ecigs increase smoking initiation by 10**
- **Ecigs don't affect smoking cessation**



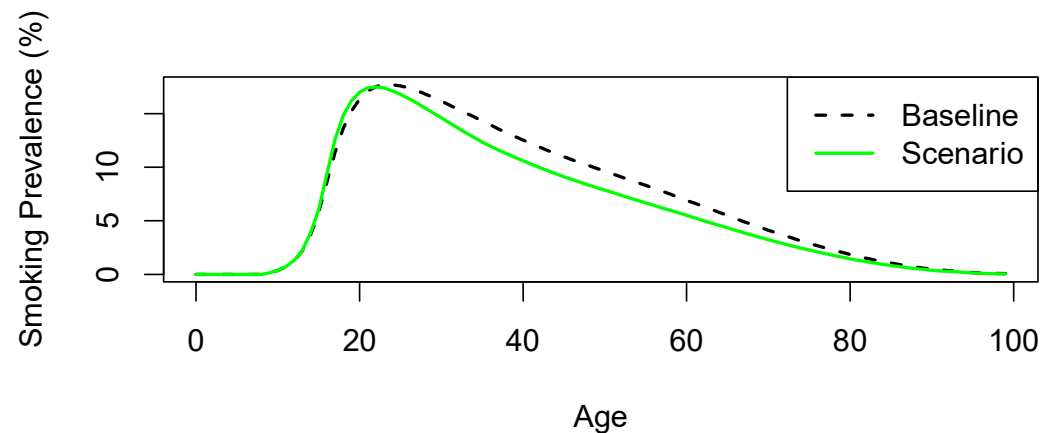
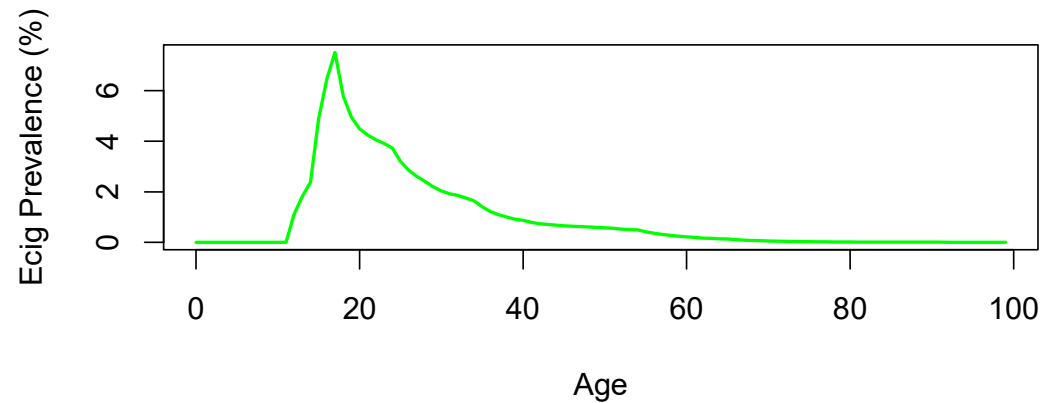
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Sample simulations

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- **Ecigs increase smoking cessation by 10**



Future Directions



- **Extensions to other sociodemographic groups**
 - Education, income, by state
- **Modeling of other tobacco-related conditions**
 - Mental Health - Jamie Tam
 - COPD - Luz Maria Sanchez
 - CVD
- **Multiple tobacco products**
 - Use (longitudinal exposure) and outcome metrics
 - Product interactions
- **More advanced modeling methods and dissemination tools**
 - Use of multiple data sources in an automated way – timely modeling
 - Model accessibility
 - Train the new generation of modelers