Supplementary material for *Transitions between cigarette, ENDS, and dual use in adults in the PATH study (Waves 1–4): multistate transition modeling accounting for complex survey design*

Study data and variables

The PATH study is a nationally representative, longitudinal cohort study of tobacco use, and a four-stage stratified area probability sample design was used to select adults (ages 18+) and youth (ages 12 to 17) from the U.S. civilian, noninstitutionalized population. Using the Audio Computer-Assisted Self-Interviewing scheme, the PATH Study interviews participants about use of multiple tobacco products, including cigarettes, e-cigarettes and other e-products. We considered four waves of PATH data: Wave 1 (Sep. 2013–Dec. 2014), Wave 2 (Oct. 2014–Oct. 2015), Wave 3 (Oct. 2015–Oct. 2016), and Wave 4 (Dec. 2016–Jan. 2018). PATH offers a number of different participant weights appropriate to different types of analyses. Here, we used Wave 4 all-wave adults weights (R04_A_A01WGT).

Cigarette and ENDS use variables

We defined established use for cigarettes as as ever using 100+ cigarettes in one's lifetime. We defined established ENDS use as ever using fairly regularly. ENDS were defined as e-cigarettes in Waves 1 and 2 and as e-cigarette, e-cigar, e-pipe, e-hookah, or other electronic nicotine product in Waves 3 and 4. To define current use, we first determined the number of days of use in the past 30 days, based on the responses whether participants indicated that they use every days, some day, or not at all (R0x_AC1003 and R0x_AE1003) in Wave x) and how many days they used in the past 30 days (R0x_AC1022 and R0x_AE1022 in Wave x). For example, cigarette use in Wave 1 was coded as an integer between 0 and 30 based on R01_AC1022, then set as 30 if R01_AC1003="Every day, and 0 if R01_AC1003="Not at all. This two-step method allowed us to account for skip patterns in the questionnaire and response inconsistencies.

Current use was defined for both cigarettes and ENDS as at least one day in the past 30 days. Participants who were not established for either product were considered never users, even if they indicated use in the past 30 days.

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Non-current users were established users of either cigarettes or ENDS that had not used either cigarettes or ENDS in the past 30 days. Dual users were established users of both cigarettes and ENDS who had used both cigarettes and ENDS in the past 30 days. The prevalence of each use state in the sample of 23,253 adults included in our analysis of transition by sociodemographic group are given in Table S2.

Sociodemographic variables

We considered five sociodemographic variables: age, sex, race/ethnicity, educational attainment, and income. Participant age was derived from PATH variables R0xR_A_AGECAT7 (Waves 1–3) or R0xR_A_AGECAT6 (Wave 4), with categories collapsed to our four groups: "18–24," "25–34," "35-54," and "55+." Age was allowed to change between waves. Participant sex was derived from PATH variable R01R_A_SEX_IMP, with levels "Female" and "Male." Sex was considered a fixed variable. Participant race and ethnicity were derived from PATH variables R01R_A_RACECAT3_IMP with levels "White alone," "Black alone," and "Other" and R01R_A_HISP_IMP, with levels "Hispanic" and "Not Hispanic." Our derived race and ethnicity variable had four levels: "Non-Hispanic white," "Non-Hispanic black," "Hispanic," and "Other." We did not present the results for "Other" in this analysis. Race/ethnicity was considered a fixed variable. Participant educational attainment was derived from PATH variable R0xR_A_AM0018. For participants ages 25 or older, we used the following categories: 1) "Less than High School," 2) "GED" and "High school graduate" grouped into "High school or equivalent,"3) "Some college (no degree) or associate's degree", and 4) "Bachelor's degree" and "Advanced degree" grouped into "BA or higher." Participants ages 18–24 were considered a separate category for educational attainment, and the hazard ratios for that category were not presented in this analysis. Participant educational attainment was allowed to change between waves. Participant income was derived from PATH variable R0xR_A_AM0030, with income brackets collapsed into "<$25,000," "$25,000–50,000," and ">$50,000." Participant income was allowed to change between waves. The characteristics of the sample of 23,253 adults included in our analysis of transition by sociodemographic group are given in Table S2. The sociodemographic breakdown of tobacco use state prevalence is given in Table **??**.

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Table S1: Descriptive characteristics of 23,253 adults included in our analysis of transition by sociodemographic group (PATH Waves 1–4). Note: Sample size (N) is unweighted, but percentage (%) is weighted using the PATH Wave 4 Adult All-waves Longitudinal Weight (R04_A_A01WGT). *Education attainment is defined only for participants ages 25 or older.

	Wave 1 (N = 19,214)		Wave 2 (N = 20,991)		Wave 3 (N = 22,115)		Wave 4 (N = 22,567)	
Demographic	N	%	N	%	N	%	N	%
Age								
18–24	5,051	13.0%	5,782	12.6%	6,155	12.2%	5,594	10.3%
25–34	3,898	18.9%	4,368	18.6%	4,757	18.5%	5,243	18.5%
35–54	6,188	35.6%	6,331	34.6%	6,430	34.3%	6,553	34.2%
55+	4,077	32.5%	4,510	34.1%	4,773	35.2%	5,177	37.0%
Sex								
Female	9,978	48.4%	10,862	48.6%	11,446	48.6%	11,683	48.7%
Male	9,236	51.5%	10,129	51.4%	10,669	51.4%	10,884	51.3%
Race								
Non-Hispanic White	11,560	65.8%	12,500	65.7%	13,114	65.9%	13,293	65.5%
Non-Hispanic Black	2,929	11.6%	3,182	11.5%	3,290	11.5%	3,425	11.6%
Hispanic	3,320	15.0%	3,737	15.0%	4,042	14.8%	4,146	15.0%
Other	1,405	7.6%	1,572	7.7%	1,669	7.7%	1,703	7.9%
Education*								
Less than high school	1,789	9.4%	1,854	9.2%	1,945	9.2%	2,038	9.6%
High school or equivalent	3,742	24.4%	3,965	23.3%	4,148	23.5%	4,374	23.7%
Some college or AA degree	4,768	25.8%	5,199	27.1%	5,390	26.9%	5,762	27.4%
BA degree or higher	3,864	27.4%	4,191	27.7%	4,477	28.3%	4,799	29.0%
Income								
<$25,000	8,169	33.5%	8,560	32.1%	8,575	30.3%	8,430	29.8%
$25,000–50,000	4,391	22.8%	4,736	22.7%	5,090	22.8%	5,221	22.5%
>$50,000	6,654	43.7%	7,695	45.2%	8,450	47.0%	8,916	47.7%
Tobacco use state								
Never use	9,330	61.1%	9.743	58.0%	10,213	56.6%	10,127	55.7%
Non-current use	2,959	19.9%	3,743	22.0%	4,255	23.3%	4,714	24.5%
Cigarette use	6,098	16.8%	6,352	17.0%	6,412	16.9%	6,522	16.8%
ENDS use	341	0.9%	465	1.3%	594	1.5%	563	1.4%
Dual user	486	1.3%	678	1.7%	641	1.6%	642	1.5%

Table S2: Sociodemographic characteristics of each each tobacco use state across PATH Waves 1–4. Note: percentage (%) is weighted using the PATH Wave 4 Adult All-waves Longitudinal Weight (R04_A_A01WGT). *Education attainment is defined only for participants ages 25 or older.

Demographic	Never user	Non-current user	Cigarette user	ENDS user	Dual user
Age					
18–24	14.9%	4.2%	11.1%	24.0%	18.4%
25–34	19.3%	11.7%	23.8%	27.0%	29.3%
35–54	34.8%	30.2%	40.2%	30.1%	37.9%
55+	31.1%	54.0%	24.8%	18.8%	14.4%
Sex					
Female	44.8%	53.3%	54.1%	58.3%	53.9%
Male	55.2%	46.7%	45.9%	41.7%	46.1%
Race					
Non-Hispanic White	60.3%	76.5%	68.1%	74.7%	79.4%
Non-Hispanic Black	12.7%	6.9%	14.6%	7.7%	6.5%
Hispanic	17.8%	10.6%	12.1%	11.1%	7.1%
Other	9.2%	5.9%	5.3%	6.5%	7.0%
Education*					
Less than high school	8.1%	8.5%	15.0%	6.4%	8.0%
High school or equivalent	19.6%	26.3%	34.2%	22.8%	27.4%
Some college or AA degree	23.9%	31.7%	29.1%	33.7%	33.4%
BA degree or higher	33.5%	29.4%	10.5%	13.1%	12.9%
Income					
<$25,000	28.4%	24.9%	48.9%	33.4%	43.9%
$25,000–50,000	21.5%	24.0%	24.6%	26.1%	24.6%
>$50,000	50.0%	51.1%	26.5%	40.5%	31.5%

Markov multistate transition modeling

Definitions and concepts

We use a Markov multistate transition model to analyze the underlying transition hazard rates and hazard ratios. The states and transitions represented in this model are given in Figure 1b. A Markov multistate transition model is a continuous-time, finite-state stochastic process with the assumption that transition rates depend only on the current state and not on past states or transition history [S1]. We denote the state of an individual at time t as $S(t)$. We denote the probability that an individual is in state j after an amount of Δt since they were observed in state i as

$$P_{ij}(\Delta t) = P[S(t + \Delta t) = j | S(t) = i]. \tag{S1}$$

In general, the transition probabilities could depend on the observation time t in addition to the time span Δt, but, given that the data span fewer than five years and no substantial trends were observed in preliminary empirical analysis, we assume that the model is homogeneous in time, so that the transition probabilities depend only on the time between observations and not on the specific waves themselves. We then define the hazard of the transition from state i to state j as

$$q_{ij} = \lim_{\Delta t \to 0} \frac{1}{\Delta t} P[S(t + \Delta t) = j | S(t) = i]. \tag{S2}$$

Transition hazards ratios ρ_{ijc_ℓ} may be determined for each transition i to j for each level ℓ of a covariate c, relative to the referent c_0: $q_{ijc_\ell} = q_{ijc_0} \cdot \rho_{ijc_\ell}$. For time-varying covariates, a participant's transition rate is determined by their characteristic at their most recent previous observation. Hazard ratios were estimated in univariable models.

The transition hazards form a matrix $Q = [q_{ij}]$, where the diagonal entries are given by $q_{ii} = -\sum_{j \neq i} q_{ij}$. The transition probability matrix $P(\Delta t) = [P_{ij}(\Delta t)]$ is a function of the transition hazards and may be calculated as the matrix exponential of $\Delta t \cdot Q$, $P(\Delta t) = \exp(\Delta t \cdot Q)$. In this analysis, we calculated one-wave transition probabilities as well as two- and four-wave projections

We illustrate an example of the connection between the continuous time model and the observation process in main text Figure 2. A likelihood is calculated by comparing the observed states to $P(\Delta t)$ as parameterized by the transition hazards $\{q_{ij}\}$. Specifically, given a set of individuals $m = 1, \ldots, N$ and their observed states $S(t_{m,k})$ at times $t_{m,k}$, where k is the index of individual m's observed states ($k = 1, \ldots, 4$ for most participants), we assume individuals are independent, and thus we multiply all the modeled probabilities of the observed transitions:

$$\mathcal{L} = \prod_m \prod_k P_{S(t_{m,k}), S(t_{m,k+1})}(t_{m,k+1} - t_{m,k}). \tag{S3}$$

More details on Markov multistate transition models may be found in [S1, S2].

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Incorporation of complex survey design

One cannot incorporate survey weights in the widely-used R package for Markov multistate transition modeling, `msm` [S3]. Accordingly, we adapted code from this package to incorporate weights. Our code is available at [TBD]. Specifically, we incorporated PATH point estimate weights W_m (here, Wave 4 all-wave adult weights) into our likelihood by first defining normalized weights $w_m = N \cdot W_m / \sum W_m$. The normalized weights were incorporated into a weighted likelihood $\mathcal{L}$:

$$\mathcal{L}^* = \prod_m \prod_k \left(P_{S(t_{m,k}),S(t_{m,k+1})}(t_{m,k+1} - t_{m,k}) \right)^{w_m}. \tag{S4}$$

We determine weighted point estimates for the transition hazard rates $\hat{q}_{i,j}$ by minimizing $-\log(\mathcal{L}^*)$ as a function of the hazard rates (equivalent to maximum likelihood estimation).

Variance estimates are calculated using 100 replicate weights w_m^r, $r = 1, \ldots, 100$. Replicate weights are a way to account for complex survey design aspects, such as strata and primary sampling units. PATH uses a variant of balanced repeated replication called Fay's method to calculate replicate weights [S4]. We calculate $\hat{q}_{i,j}^r$ for each replicate r analogously to Eq. (S4). Then, we calculate the variance of $\hat{q}_{i,j}$ as

$$V(\hat{q}_{i,j}) = c \sum_{r=1}^{100} (\hat{q}_{i,j}^r - \hat{q}_{i,j})^2, \tag{S5}$$

where $c = 1/(100(1-0.3)^2)$ as specified by PATH [S4].

Homogeneity of rates over time

In the main analysis, we assumed that the transition rates did not change over time (i.e., over Waves). In Figure S1, we plot the estimated rates for the twelve transitions using each of the three pairs of adjacent Waves and using all Waves. The estimated transitions are closely clustered, and the estimates for each of the individual pairs is within or is close to the 95% CI for the estimates using all Waves. While there are trends in certain of the estimated rates over the waves, the magnitudes of the trends were small enough that they could be neglected.

Bias in results when not using weights

If the Markov transition framework in this analysis is used without the PATH weights, the resulting hazard rates estimates are biased, as seen in Figure S2. In particular, rates of starting cigarette and ENDS use among never or non-current users are greatly overestimated in the unweighted analysis. PATH oversamples from demographics with higher use rates.

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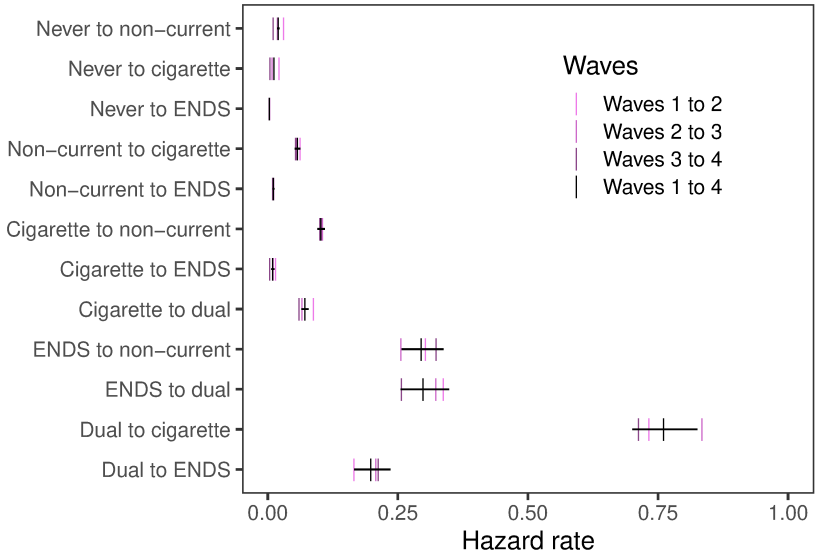

Figure S1: Estimated transition rates for adjacent Waves and all Waves. Vertical bars give point estimates while the horizontal bar gives the 95%CI for the all Wave estimate.

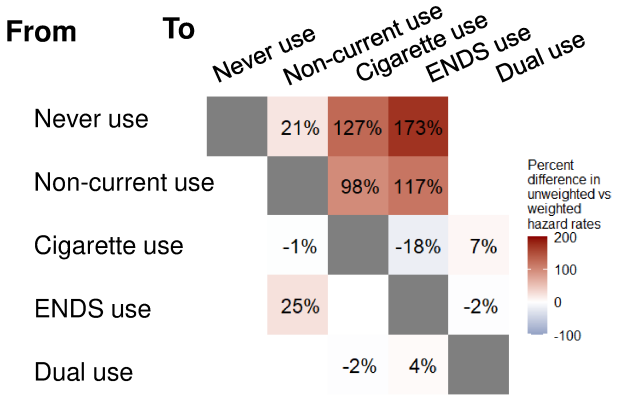

Figure S2: Percent difference in the unweighted vs. weighted transition hazard rate point estimates.

Uncertainty quantification for base model

Point estimates and 95% confidence intervals for the transition hazard rates and one-wave transition probabilities are given in Table S3.

Uncertainty quantification for hazard ratios by sociodemographic group

Point estimates and confidence intervals for selected hazard ratios are given in Tables S4–S8. The one-wave transition probabilities by demographic group (univariable models) are given in Figures S4–S7.

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Table S3: Point estimates and 95% confidence intervals for the transition hazard rates and one-wave transition probabilities.

	Hazard rate (per wave)		One-wave transition probability (%)	
Transition	Estimate	95% CI	Estimate	95% CI
Never use to				
Never use	-0.035	(-0.040, -0.031)	96.6	(96.3, 96.8)
Non-current use	0.020	(0.018, 0.023)	2.0	(1.8, 2.2)
Cigarette use	0.012	(0.010, 0.013)	1.1	(1.0, 1.2)
ENDS use	0.003	(0.003, 0.004)	0.3	(0.2, 0.3)
Dual use	—	—	0.1	(0.1, 0.1)
Non-current use to				
Non-current use	-0.069	(-0.076 , -0.061)	93.8	(93.3, 94.2)
Cigarette use	0.058	(0.053, 0.064)	5.2	(4.7, 5.7)
ENDS use	0.010	(0.009, 0.012)	0.8	(0.7, 1.0)
Dual use	—	—	0.2	(0.2, 0.3)
Cigarette use to				
Non-current use	0.102	(0.095, 0.109)	9.2	(8.6, 9.8)
Cigarette use	-0.182	(-0.200, -0.166)	85.5	(84.8, 86.1)
ENDS use	0.009	(0.006, 0.012)	1.1	(0.9, 1.2)
Dual use	0.071	(0.065, 0.079)	4.3	(4.0, 4.6)
ENDS use to				
Non-current use	0.276	(0.240, 0.318)	20.8	(18.2, 23.3)
Cigarette use	—	—	7.1	(6.1, 8.1)
ENDS use	-0.570	(-0.663, -0.491)	58.1	(55.1, 61.1)
Dual use	0.293	(0.250, 0.344)	14.0	(12.2, 15.9)
Dual use to				
Non-current use	—	—	4.3	(4.0, 4.7)
Cigarette use	0.764	(0.702, 0.832)	45.2	(42.4, 47.9)
ENDS use	0.196	(0.163, 0.236)	9.6	(8.0, 11.1)
Dual use	-0.960	(-1.068, -0.865)	40.9	(38.4, 43.4)

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Table S4: Point estimates and 95% confidence intervals for the transition hazard ratios by demographic groups.

	Never use to Cigarette use		Never use to ENDS use	
Demographic	Estimate	95% CI	Estimate	95% CI
Age				
18–24	1.83	(1.38, 2.44)	27.6	(8.12, 93.9)
25–34	1.35	(1.00, 1.83)	6.8	(1.80, 25.7)
35–54	1.13	(0.86, 1.50)	2.0	(0.52, 7.6)
55+	1	(Ref.)	1	(Ref.)
Sex				
Female	1	(Ref.)	1	(Ref.)
Male	1.66	(1.39, 1.98)	3.64	(2.51, 5.30)
Race				
Non-Hispanic White	1	(Ref.)	1	(Ref.)
Non-Hispanic Black	2.66	(2.13, 3.33)	1.49	(0.89, 2.50)
Hispanic	2.08	(1.63, 2.65)	1.89	(1.18, 3.01)
Education				
Less than high school	14.4	(8.44, 24.6)	2.54	(0.66, 9.70)
High school or equivalent	10.6	(6.26, 17.9)	2.97	(1.15, 7.51)
Some college or AA degree	4.21	(2.39, 7.41)	2.98	(1.06, 8.33)
BA degree or higher	1	(Ref.)	1	(Ref.)
Income				
<$25,000	6.26	(4.33, 9.04)	2.11	(1.34, 3.34)
$25,000–50,000	2.93	(1.94, 4.42)	0.97	(0.59, 1.61)
>$50,000	1	(Ref.)	1	(Ref.)

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Table S5: Point estimates and 95% confidence intervals for the transition hazard ratios by demographic groups.

	Non-current use to Cigarette use		Non-current use to ENDS use	
Demographic	Estimate	95% CI	Estimate	95% CI
Age				
18–24	13.9	(10.4, 18.5)	29.0	(13.2, 63.9)
25–34	7.21	(5.64, 9.24)	8.84	(3.72, 21.0)
35–54	2.65	(1.98, 3.54)	4.19	(1.95, 9.01)
55+	1	(Ref.)	1	(Ref.)
Sex				
Female	1	(Ref.)	1	(Ref.)
Male	0.89	(0.75, 1.07)	1.41	(0.86, 2.29)
Race				
Non-Hispanic White	1	(Ref.)	1	(Ref.)
Non-Hispanic Black	1.47	(1.12, 1.93)	2.26	(1.18, 4.34)
Hispanic	1.95	(1.54, 2.48)	1.70	(0.97, 2.99)
Education				
Less than high school	1.87	(1.24, 2.85)	2.42	(0.86, 6.78)
High school or equivalent	1.27	(0.93, 1.74)	1.99	(1.01, 3.90)
Some college or AA degree	1.38	(1.02, 1.87)	2.05	(1.20, 3.50)
BA degree or higher	1	(Ref.)	1	(Ref.)
Income				
<$25,000	2.16	(1.68, 2.76)	3.46	(1.91, 6.28)
$25,000–50,000	1.35	(1.06, 1.72)	1.98	(1.11, 3.52)
>$50,000	1	(Ref.)	1	(Ref.)

Table S6: Point estimates and 95% confidence intervals for the transition hazard ratios by demographic groups.

	Cigarette use to Non-current use		Cigarette use to Dual use	
Demographic	Estimate	95% CI	Estimate	95% CI
Age				
18–24	1.91	(1.57, 2.31)	4.48	(3.19, 6.29)
25–34	1.38	(1.13, 1.69)	3.09	(2.30, 4.16)
35–54	0.85	(0.70, 1.03)	2.05	(1.53, 2.75)
55+	1	(Ref.)	1	(Ref.)
Sex				
Female	1	(Ref.)	1	(Ref.)
Male	1.02	(0.89, 1.18)	0.91	(0.75, 1.09)
Race				
Non-Hispanic White	1	(Ref.)	1	(Ref.)
Non-Hispanic Black	0.77	(0.64, 0.94)	0.39	(0.28, 0.56)
Hispanic	1.58	(1.33, 1.87)	0.66	(0.50, 0.87)
Education				
Less than high school	0.38	(0.30, 0.48)	0.66	(0.41, 1.07)
High school or equivalent	0.38	(0.32, 0.45)	0.89	(0.61, 1.30)
Some college or AA degree	0.52	(0.44, 0.62)	1.34	(0.93, 1.94)
BA degree or higher	1	(Ref.)	1	(Ref.)
Income				
<$25,000	0.63	(0.55, 0.71)	1.14	(0.91, 1.42)
$25,000–50,000	0.73	(0.63, 0.85)	1.23	(0.98, 1.53)
>$50,000	1	(Ref.)	1	(Ref.)

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Table S7: Point estimates and 95% confidence intervals for the transition hazard ratios by demographic groups.

	ENDS use to Non-current use		ENDS use to Dual use	
Demographic	Estimate	95% CI	Estimate	95% CI
Age				
18–24	4.28	(2.63, 6.96)	1.67	(0.93, 2.98)
25–34	2.14	(1.17, 3.93)	1.50	(0.79, 2.86)
35–54	1.93	(1.14, 3.28)	1.73	(0.94, 3.19)
55+	1	(Ref.)	1	(Ref.)
Sex				
Female	1	(Ref.)	1	(Ref.)
Male	1.03	(0.81, 1.31)	1.22	(0.89, 1.67)
Race				
Non-Hispanic White	1	(Ref.)	1	(Ref.)
Non-Hispanic Black	2.78	(1.85, 4.17)	0.66	(0.37, 1.18)
Hispanic	2.68	(2.00, 3.59)	0.86	(0.57, 1.29)
Education				
Less than high school	1.02	(0.51, 2.01)	1.58	(0.75, 3.31)
High school or equivalent	0.76	(0.42, 1.38)	1.38	(0.76, 2.51)
Some college or AA degree	0.84	(0.50, 1.41)	1.56	(0.94, 2.57)
BA degree or higher	1	(Ref.)	1	(Ref.)
Income				
<$25,000	1.44	(1.06, 1.94)	1.18	(0.80, 1.73)
$25,000–50,000	1.28	(0.84, 1.95)	0.87	(0.56, 1.33)
>$50,000	1	(Ref.)	1	(Ref.)

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Table S8: Point estimates and 95% confidence intervals for the transition hazard ratios by demographic groups.

	Dual use to Cigarette use		Dual use to ENDS use	
Demographic	Estimate	95% CI	Estimate	95% CI
Age				
18–24	1.13	(0.85, 1.50)	2.52	(1.11, 5.76)
25–34	1.16	(0.90, 1.51)	1.41	(0.59, 3.35)
35–54	1.06	(0.83, 1.36)	1.32	(0.60, 2.90)
55+	1	(Ref.)	1	(Ref.)
Sex				
Female	1	(Ref.)	1	(Ref.)
Male	1.00	(0.85, 1.18)	1.19	(0.86, 1.64)
Race				
Non-Hispanic White	1	(Ref.)	1	(Ref.)
Non-Hispanic Black	0.98	(0.65, 1.49)	0.90	(0.46, 1.77)
Hispanic	1.22	(0.91, 1.64)	1.34	(0.83, 2.17)
Education				
Less than high school	1.17	(0.78, 1.77)	0.44	(0.16, 1.19)
High school or equivalent	1.21	(0.87, 1.70)	0.49	(0.23, 1.05)
Some college or AA degree	1.22	(0.87, 1.70)	0.82	(0.45, 1.51)
BA degree or higher	1	(Ref.)	1	(Ref.)
Income				
<$25,000	1.22	(1.01, 1.48)	0.58	(0.40, 0.85)
$25,000–50,000	1.20	(0.97, 1.47)	0.87	(0.50, 1.50)
>$50,000	1	(Ref.)	1	(Ref.)

Brouwer AF, *et al. Tob Control* 2020;0:1–8. doi: 10.1136/tobaccocontrol-2020-055967

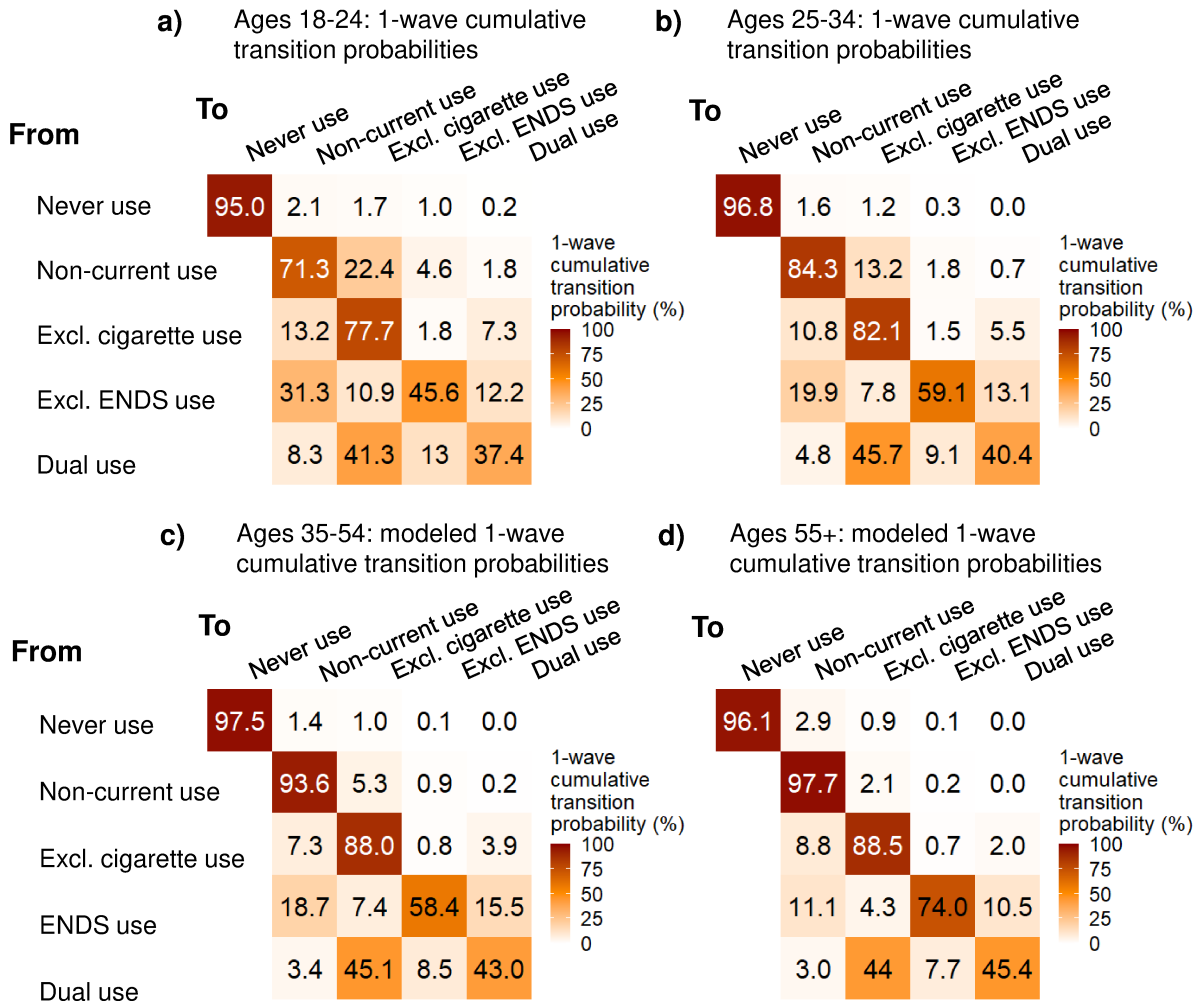

Figure S3: One-wave transition probability between tobacco use states estimated for participants ages a) 18–24, b) 25–34, c) 35–44, and d) 55+.

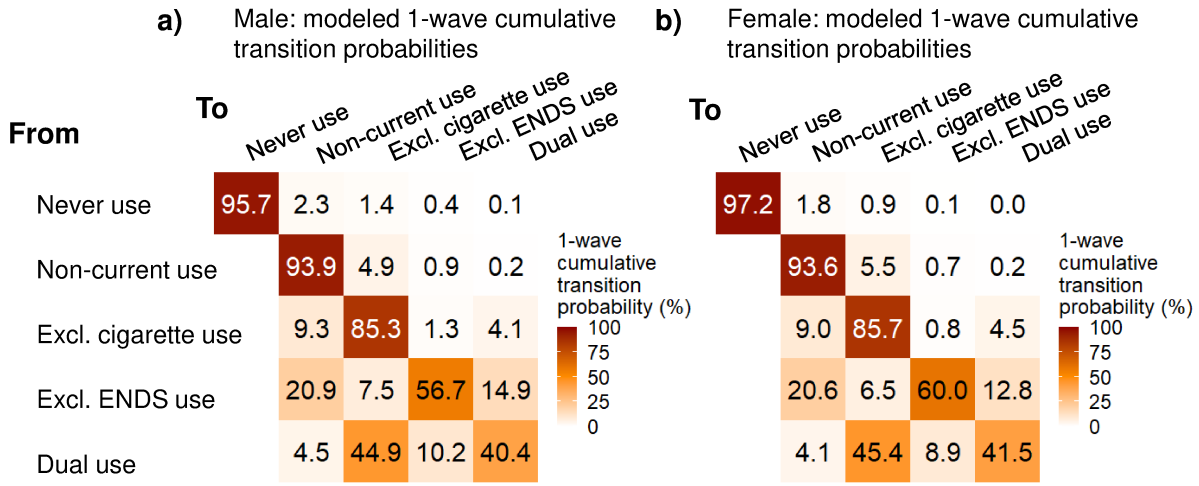

Figure S4: One-wave transition probability between tobacco use states estimated for a) male and b) female participants.

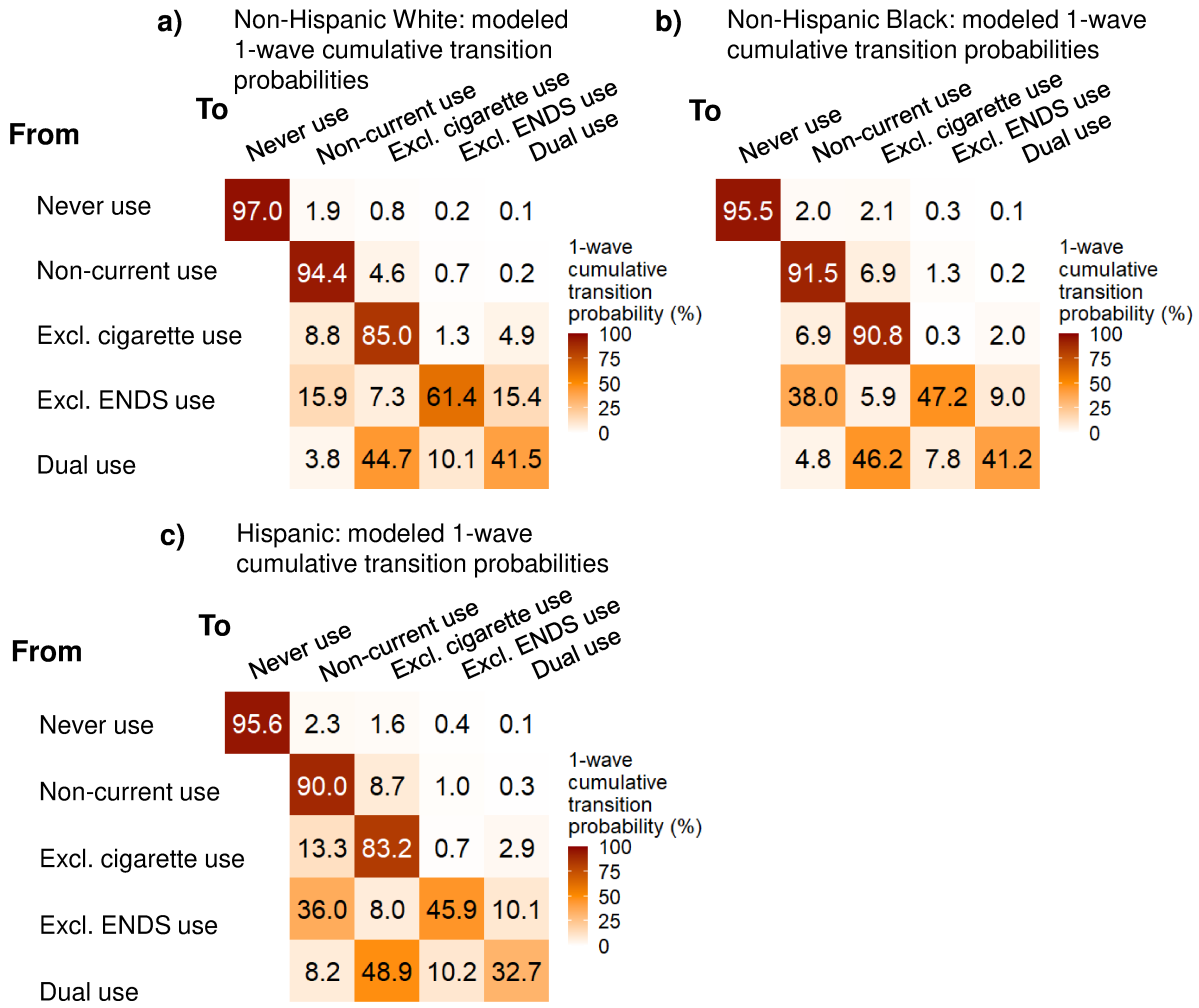

Figure S5: One-wave transition probability between tobacco use states estimated for a) non-Hispanic White, b) non-Hispanic Black, and c) Hispanic participants.

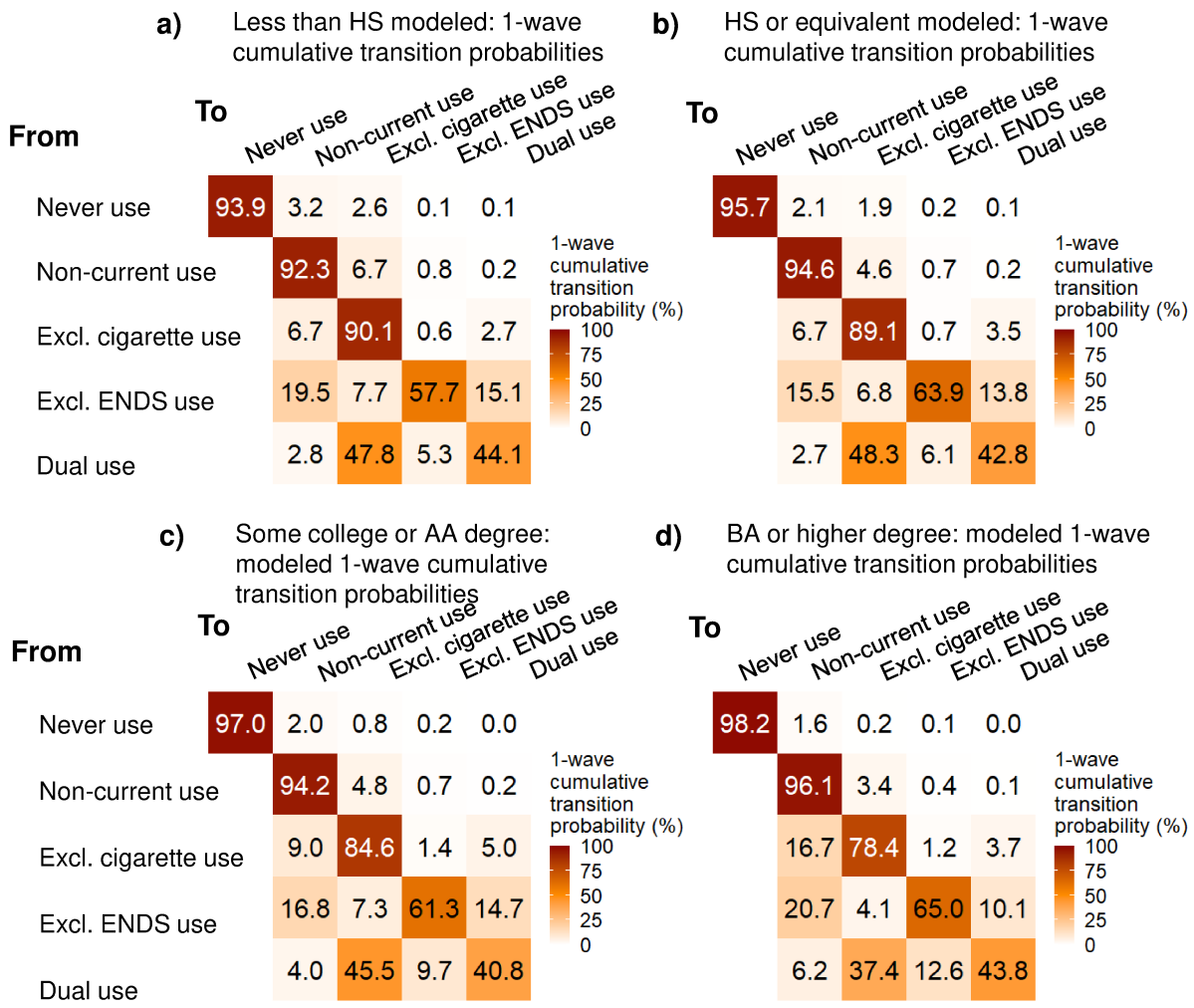

Figure S6: One-wave transition probability between tobacco use states estimated for participants (ages 25+) with an educational attainment of a) less than high school (HS), b) high school or equivalent, c) some college or an associates (AA) degree, and d) bachelors degree (BA) or higher.

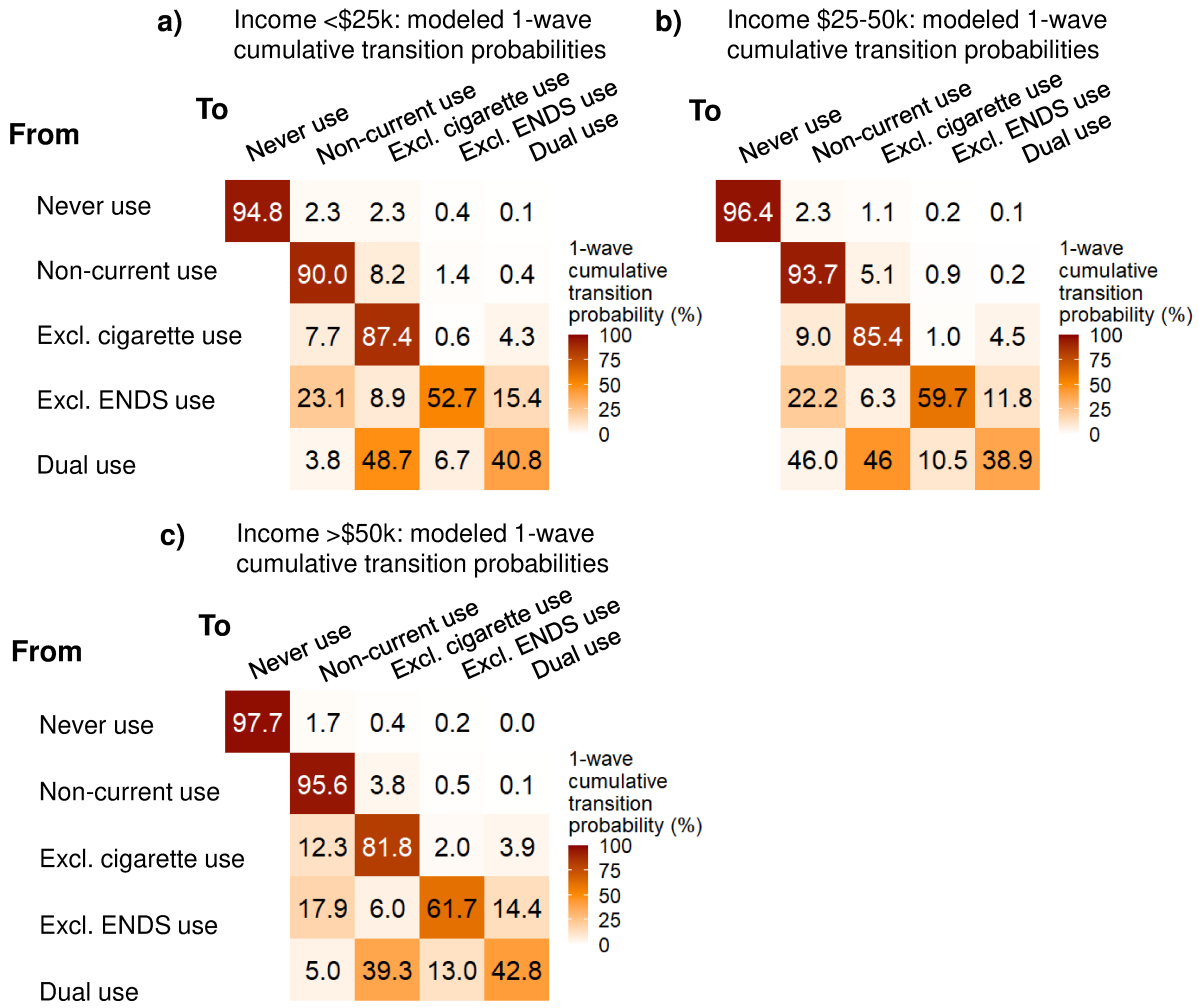

Figure S7: One-wave transition probability between tobacco use states estimated for participants with income a) <$25k, $25–50k, and c) >$50k.

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[S2] Jackson, C. (2019a). Multi-state modelling with R: the msm package. https://cran.r-project.org/web/packages/msm/vignettes/msm-manual.pdf.

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[S4] National Institute on Drug Abuse, Food and Drug Administration Center for Tobacco Products (2019). Population Assessment of Tobacco and Health (PATH) Study [United States] Public-Use Files User Guide. Inter-university Consortium for Political and Social Research [distributor], 2019-11-21.