A System Dynamics modelling approach for assessing health effect impact as a result of launching a new nicotine product in a market

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Supplementary materials

Appendix A – Core Model Data Inputs

Initial Population [Thousand People)

	Age Cohort									
Initial Population	**<10**	**11-15**	**16-19**	**20-24**	**25-34**	**35-49**	**50-59**	**60-64**	**65-74**	**75+**
Male	4167	1960	1462	1757	4293	6151	3604	1420	2294	1584
Female	3966	1867	1415	1750	4353	6263	3671	1481	2646	2784

Never Smoker Prevalence [%)

	Age Cohort									
Never Smoker	**<10**	**11-15**	**16-19**	**20-24**	**25-34**	**35-49**	**50-59**	**60-64**	**65-74**	**75+**
Male	100%	83%	67%	58%	49%	49%	37%	31%	31%	30%
Female	100%	80%	66%	54%	54%	54%	48%	55%	55%	61%

Current Smoker Prevalence [%)

	Age Cohort									
Current Smoker	**<10**	**11-15**	**16-19**	**20-24**	**25-34**	**35-49**	**50-59**	**60-64**	**65-74**	**75+**
Male	0%	9%	30%	35%	39%	31%	27%	24%	14%	9%
Female	0%	12%	28%	35%	32%	27%	28%	20%	19%	11%

Former Smoker Prevalence [%)

	Age Cohort									
Former Smoker	**<10**	**11-15**	**16-19**	**20-24**	**25-34**	**35-49**	**50-59**	**60-64**	**65-74**	**75+**
Male	0%	8%	3%	7%	12%	20%	36%	45%	55%	61%
Female	0%	8%	6%	11%	14%	19%	24%	25%	25%	28%

Former Smoker Quit Time Distribution [%)

	Time Since Quit [Years)					
Male	**>1 yr**	**1-2yrs**	**3-4yrs**	**5-9yrs**	**10-14yrs**	**15+yrs**
<10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11-15	64.2%	33.4%	2.4%	0.0%	0.0%	0.0%
16-19	50.2%	18.8%	26.6%	4.4%	0.0%	0.0%
20-24	33.4%	11.3%	19.2%	36.1%	0.0%	0.0%
25-34	32.8%	11.2%	10.5%	18.8%	13.9%	12.8%

35-49	23.4%	8.2%	9.1%	23.3%	14.2%	21.9%
50-59	12.8%	4.6%	5.2%	14.2%	11.9%	51.3%
60-64	11.2%	4.0%	4.4%	13.2%	11.9%	55.4%
65-74	7.7%	2.7%	2.9%	7.5%	9.7%	69.5%
75+	5.2%	1.9%	2.1%	6.2%	9.7%	74.9%
Female	**>1 yr**	**1-2yrs**	**3-4yrs**	**5-9yrs**	**10-14yrs**	**15+yrs**
<10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11-15	64.2%	33.3%	2.5%	0.0%	0.0%	0.0%
16-19	43.5%	16.5%	33.3%	6.7%	0.0%	0.0%
20-24	37.0%	12.6%	18.7%	31.7%	0.0%	0.0%
25-34	26.7%	9.4%	10.4%	21.1%	20.0%	12.4%
+	16.6%	6.4%	9.1%	25.4%	19.3%	23.3%
50-59	16.1%	5.7%	5.7%	12.0%	9.5%	51.0%
60-64	20.4%	6.9%	5.7%	8.9%	7.2%	51.0%
65-74	12.4%	4.0%	3.0%	7.2%	8.9%	64.5%
75+	10.0%	3.3%	2.8%	6.8%	9.5%	67.7%

Birth Rates [Thousand People/Year)

2000	688.183	**2010**	796.776	**2020**	816.234	**2030**	797.524	**2040**	827.836
2001	673.503	**2011**	811.134	**2021**	814.942	**2031**	796.859	**2041**	833.647
2002	663.251	**2012**	813.190	**2022**	813.388	**2032**	796.836	**2042**	839.154
2003	681.651	**2013**	799.235	**2023**	811.561	**2033**	797.659	**2043**	844.178
2004	707.094	**2014**	807.029	**2024**	809.423	**2034**	799.486	**2044**	848.516
2005	717.585	**2015**	809.969	**2025**	807.134	**2035**	802.329	**2045**	852.136
2006	734.222	**2016**	812.892	**2026**	804.848	**2036**	806.135	**2046**	855.075
2007	757.580	**2017**	815.228	**2027**	802.604	**2037**	810.814	**2047**	857.307
2008	790.547	**2018**	816.577	**2028**	800.536	**2038**	816.163	**2048**	858.904
2009	786.624	**2019**	816.899	**2029**	798.770	**2039**	821.921	**2049**	859.949

Cigarette Smoking Initiation [Never Smoker Annual Initiation Probability)

	Age Cohort									
Base Smoking Incidence	**<10**	**11-15**	**16-19**	**20-24**	**25-34**	**35-49**	**50-59**	**60-64**	**65-74**	**75+**
Male	-	3.1%	5.1%	1.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Female	-	3.6%	6.9%	1.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%

Cigarette Smoking Cessation [Probability Current Smoker Quits For more than 1 year)

	Age Cohort									
Base Smoking Cessation	**<10**	**11-15**	**16-19**	**20-24**	**25-34**	**35-49**	**50-59**	**60-64**	**65-74**	**75+**
Male	-	15.5%	1.0%	1.0%	3.3%	3.3%	4.3%	5.0%	8.5%	8.5%
Female	-	9.3%	1.0%	1.9%	3.3%	2.4%	3.7%	7.9%	5.1%	9.1%

Elasticity to Changes in Smoking Normality [Dimensionless)

Incidence Rate	0.500
Quit Rate	-0.448

Relapse Rate [Former Smoker Annual Relapse Probability)

	Time Since Quit [Years)					
	>1 yr	**1-2yrs**	**3-4yrs**	**5-9yrs**	**10-14yrs**	**15+yrs**
Relapse Rate	80.00%	11.50%	3.95%	1.28%	0.00%	0.00%

Never Smoker Mortality Rates [Annual Probability)

	Age Cohort									
	<10	**11-15**	**16-19**	**20-24**	**25-34**	**35-49**	**50-59**	**60-64**	**65-74**	**75+**
Male	0.074%	0.019%	0.067%	0.088%	0.105%	0.162%	0.498%	1.038%	2.530%	8.681%
Female	0.060%	0.013%	0.028%	0.032%	0.044%	0.111%	0.336%	0.693%	1.601%	6.198%

Reduction Mortality Rates [Annual %)

Male	2000	2010	2014	2024	2034	2050
<10	2.59	2.59	2.26	1.58	1.20	1.20
11-15	2.29	2.29	2.03	1.49	1.20	1.20
16-19	3.02	3.02	2.59	1.69	1.20	1.20
20-24	3.75	3.75	3.14	1.89	1.20	1.20
25-34	1.35	1.35	1.31	1.24	1.20	1.20
35-49	1.31	1.31	1.29	1.23	1.20	1.20
50-59	2.25	2.25	1.60	1.57	1.20	1.20
60-64	1.91	1.91	0.95	1.57	1.20	1.20
65-74	2.74	2.74	2.58	1.11	1.20	1.20
75+	3.40	3.40	2.73	2.26	1.20	1.20
Female	**2000**	**2010**	**2014**	**2024**	**2034**	**2050**
<10	1.79	1.79	1.72	1.52	1.20	1.20
11-15	2.04	2.04	1.94	1.66	1.20	1.20
16-19	2.27	2.27	2.14	1.78	1.20	1.20
20-24	2.50	2.50	2.34	1.90	1.20	1.20
25-34	0.75	0.75	0.80	0.95	1.20	1.20
35-49	1.29	1.29	1.28	1.25	1.20	1.20
50-59	1.88	1.88	1.60	1.61	1.20	1.20
60-64	1.79	1.79	1.33	1.61	1.20	1.20
65-74	2.40	2.40	2.08	1.28	1.20	1.20
75+	2.81	2.81	2.81	2.41	1.20	1.20

Relative Risk [Dimensionless)

Age Cohort	Male	Female
0-10	1.000	1.000
11-15	1.000	1.000
16-19	1.000	1.000
20-24	1.000	1.000
25-34	1.000	1.000
35-49	1.810	1.660
50-59	1.810	1.660
60-64	1.810	1.660
65-74	1.810	1.660
75+	1.810	1.660

Former Smoker Relative Risk [Dimensionless]

Based on a half-life decay time of 9.08 years

	Time Since Quit [Years]					
Male	**>1 yr**	**1-2yrs**	**3-4yrs**	**5-9yrs**	**10-14yrs**	**15+yrs**
0-10	1	1	1	1	1	1
11-15	1	1	1	1	1	1
16-19	1	1	1	1	1	1
20-24	1	1	1	1	1	1
25-34	1	1	1	1	1	1
35-49	1.75047	1.69531	1.59686	1.47469	1.32408	1.17596
50-59	1.75047	1.69531	1.59686	1.47469	1.32408	1.17596
60-64	1.75047	1.69531	1.59686	1.47469	1.32408	1.17596
65-74	1.75047	1.69531	1.59686	1.47469	1.32408	1.17596
75+	1.75047	1.69531	1.59686	1.47469	1.32408	1.17596
Female						
0-10	1	1	1	1	1	1
11-15	1	1	1	1	1	1
16-19	1	1	1	1	1	1
20-24	1	1	1	1	1	1
25-34	1	1	1	1	1	1
35-49	1.61149	1.56655	1.48633	1.38679	1.26406	1.14338
50-59	1.61149	1.56655	1.48633	1.38679	1.26406	1.14338
60-64	1.61149	1.56655	1.48633	1.38679	1.26406	1.14338
65-74	1.61149	1.56655	1.48633	1.38679	1.26406	1.14338
75+	1.61149	1.56655	1.48633	1.38679	1.26406	1.14338

Net Migration [Thousand People/Year)

2000	140.5	**2010**	255.6	**2020**	165.0	**2030**	165.0	**2040**	165.0
2001	152.6	**2011**	270.5	**2021**	165.0	**2031**	165.0	**2041**	165.0
2002	190.9	**2012**	165.5	**2022**	165.0	**2032**	165.0	**2042**	165.0
2003	194.2	**2013**	164.5	**2023**	165.0	**2033**	165.0	**2043**	165.0
2004	209.9	**2014**	165.5	**2024**	165.0	**2034**	165.0	**2044**	165.0
2005	336.0	**2015**	164.5	**2025**	165.0	**2035**	165.0	**2045**	165.0
2006	254.8	**2016**	183.5	**2026**	165.0	**2036**	165.0	**2046**	165.0
2007	304.9	**2017**	171.0	**2027**	165.0	**2037**	165.0	**2047**	165.0
2008	284.1	**2018**	174.0	**2028**	165.0	**2038**	165.0	**2048**	165.0
2009	220.1	**2019**	165.0	**2029**	165.0	**2039**	165.0	**2049**	165.0

Appendix B – Counter Factual Scenario Data Inputs

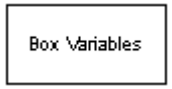
Parameter	Value
Relative harm of NGP compared to Cigarettes	0.05
Equivalence of NGP users compared to cigarette smokers for Normality of Smoking	0.5
Normality of smoking effect on NGP initiation compared to smoking initiation	0.5
NGP initiation probability by Never Smokers compared to Cigarette initiation probability	0.1
NGP User (Never Smoker) quit probability compared to Cigarette quit probability	1.0
NGP User (Smoking History) quit probability compared to Cigarette quit probability	1.0
NGP Dual User quit probability compared to Cigarette quit probability	1.0
Former NGP User (Never Smoker) relapse scalar to former smoker relapse	1.0
Former NGP User (Smoking History) relapse scalar to former smoker relapse	1.0
Former NGP Dual User relapse scalar to former smoker relapse	1.0
NGP User (Never Smoker) switching to cigarette smoking	0.05
NGP User (Never Smoker) switching to dual use	0.05
Current Smokers switching to NGP	0.05
Current Smokers switching to Dual Use	0.1
NGP Users switching to cigarette smoking	0.05
NGP Users switching to Dual Use	0.05
Dual Users switching to NGP Only	0.05
Dual Users switching to cigarette smoking only	0.05
Proportion of Former NGP User (Never Smoker) relapse rate to cigarette smoking	0.05
Proportion of Former NGP User (Never Smoker) relapse rate to Dual Use	0.05
Proportion of Former NGP Users(Smoking History) relapse rate to cigarette smoking	0.05
Proportion of Former NGP Users(Smoking History) relapse rate to Dual Use	0.05
Proportion of Former Smoker relapse rate to NGP	0.1
Proportion of Former Smoker relapse rate to Dual Use	0.1
Proportion of Former Dual User relapse rate to NGP	0.05
Proportion of Former Dual User relapse o cigarette smoking	0.05
Estimated proportion of Never Smokers that initiate E-cigarettes that would have smoked if NGP was not available	0.75
Proportion of smokers switching to NGP that would have quit in the next year	0.5

Appendix C – Model Structure Diagrams

The main Vensim model diagrams which form the model structure are contained in this appendix.

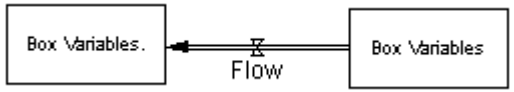
Key to Diagrams

Box Variables



Represent the accumulation of inflows and outflows to sub populations

Flows



Represent the flow of people from one sub population to another

Variables

Variable A

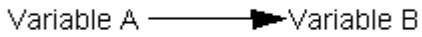
Model parameters used to calculate flows of people or calculate output measurements

Shadow Variables

<Variable B>

Model variables that are calculated elsewhere in model views, but which have an influence on current view variables

Arrows



Displays that the calculation of the value of Variable B is influenced by the value of Variable A

Colour Coding

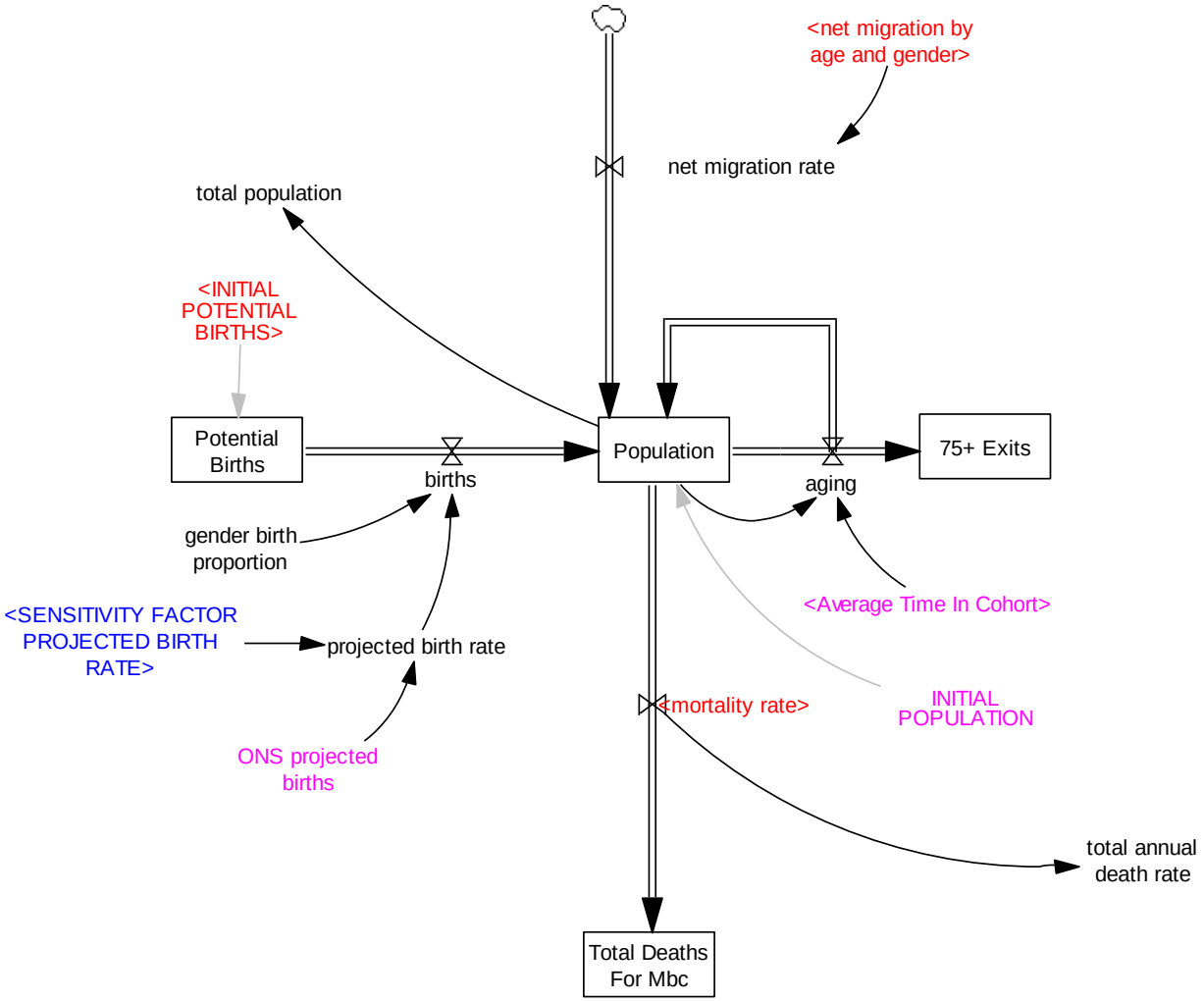
Black variables – standard model variable calculated in the current model view

Red variables – a shadow variable calculated in another view but influencing a variable on the current view

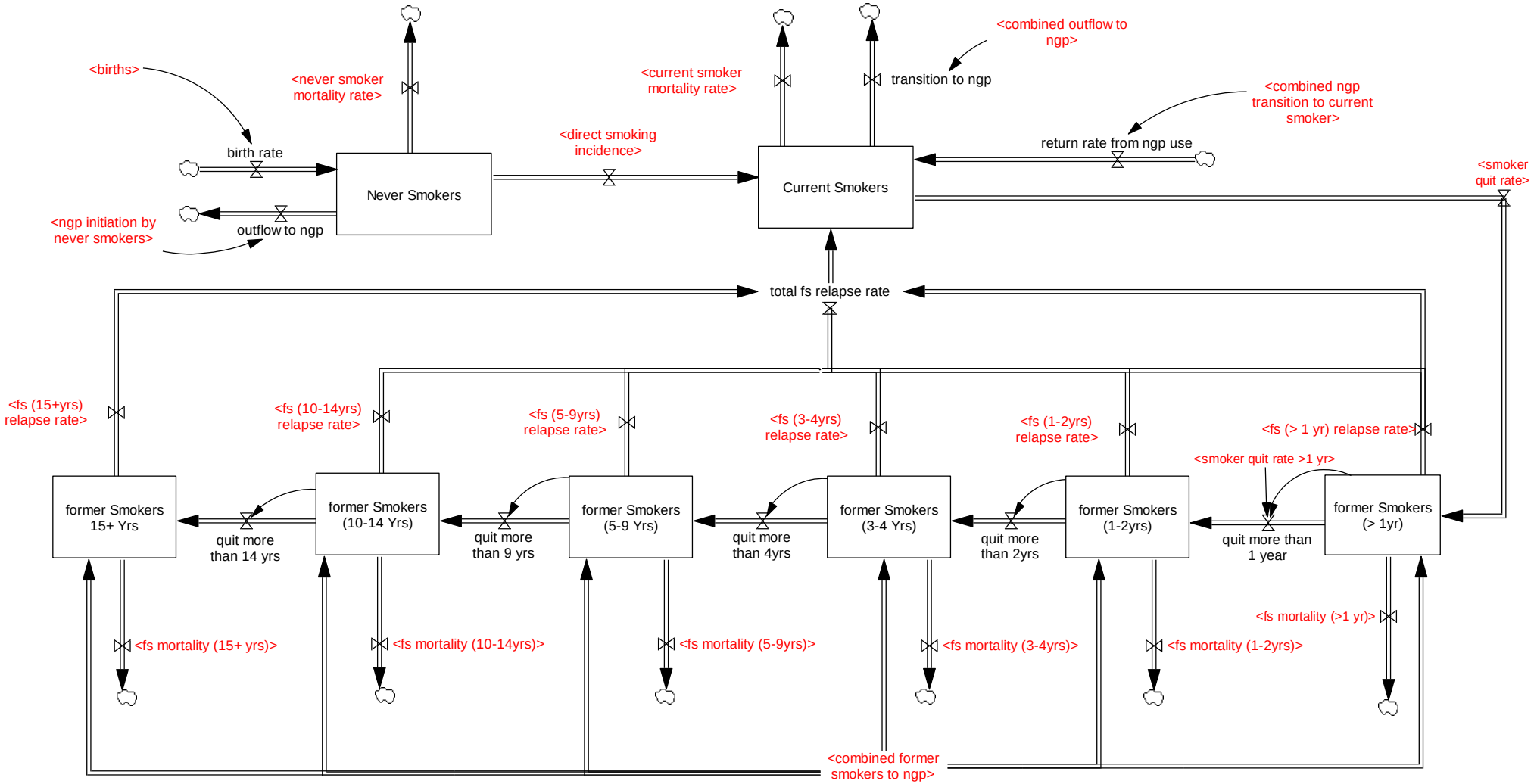
Pink Variables – model input parameters

Blue Variables – used for model sensitivity testing

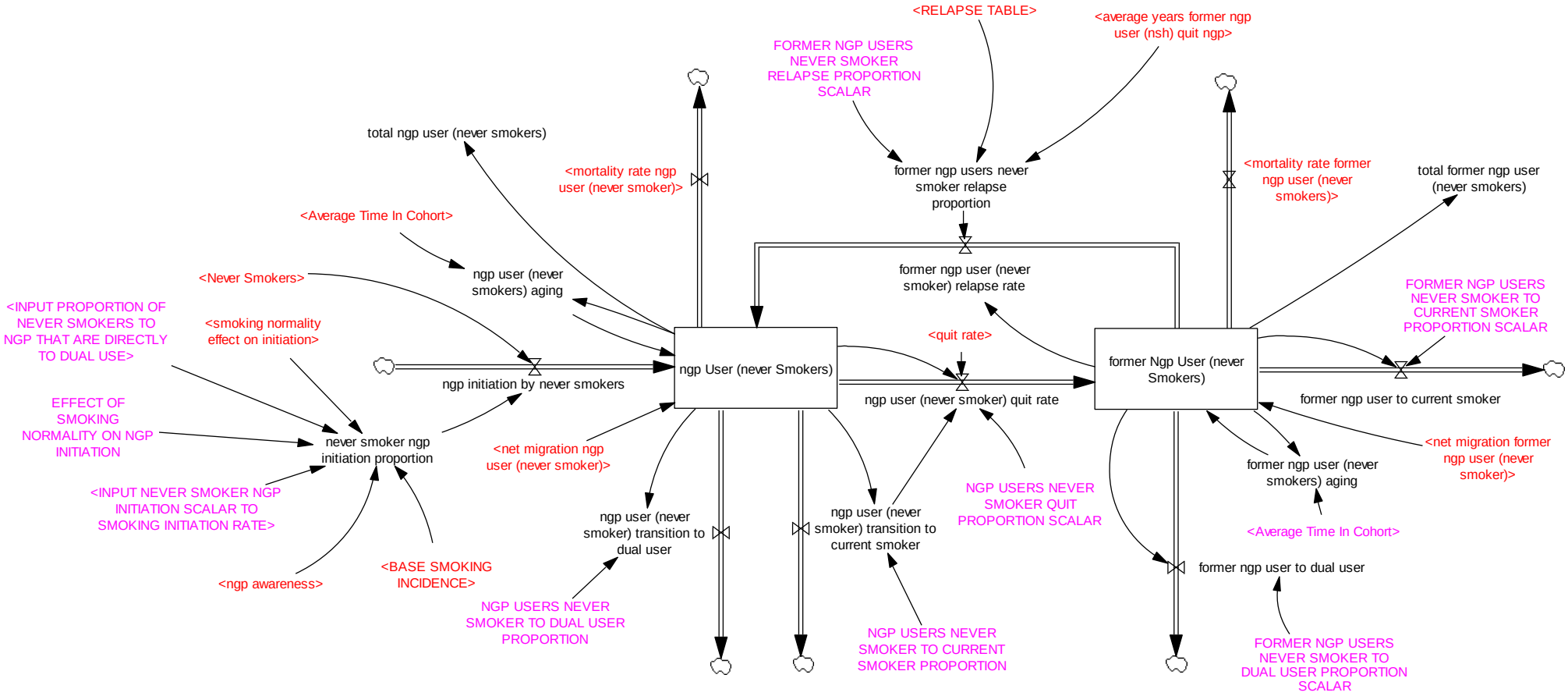
UK Population Structure



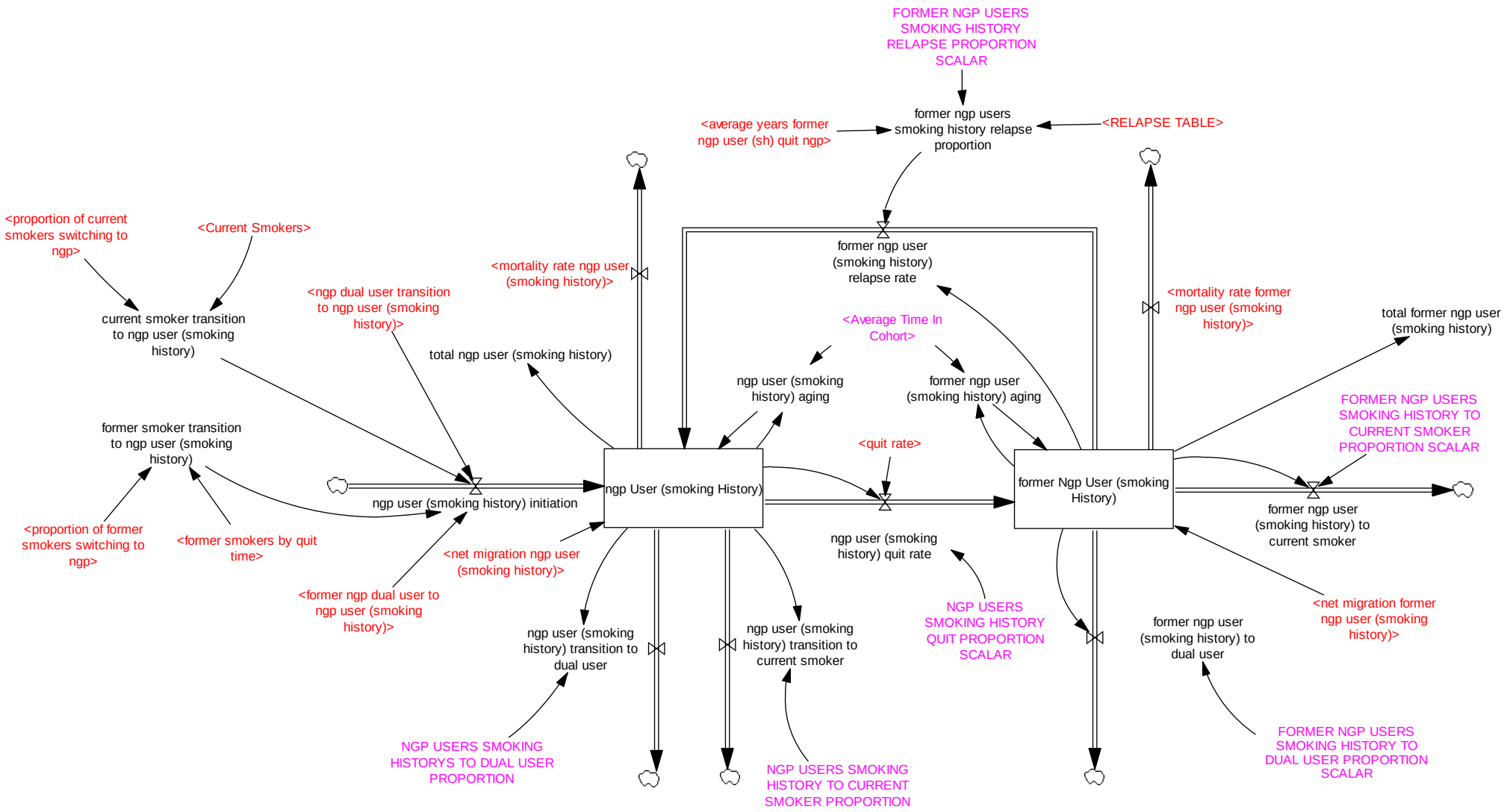
Cigarette Smoking Population Structure



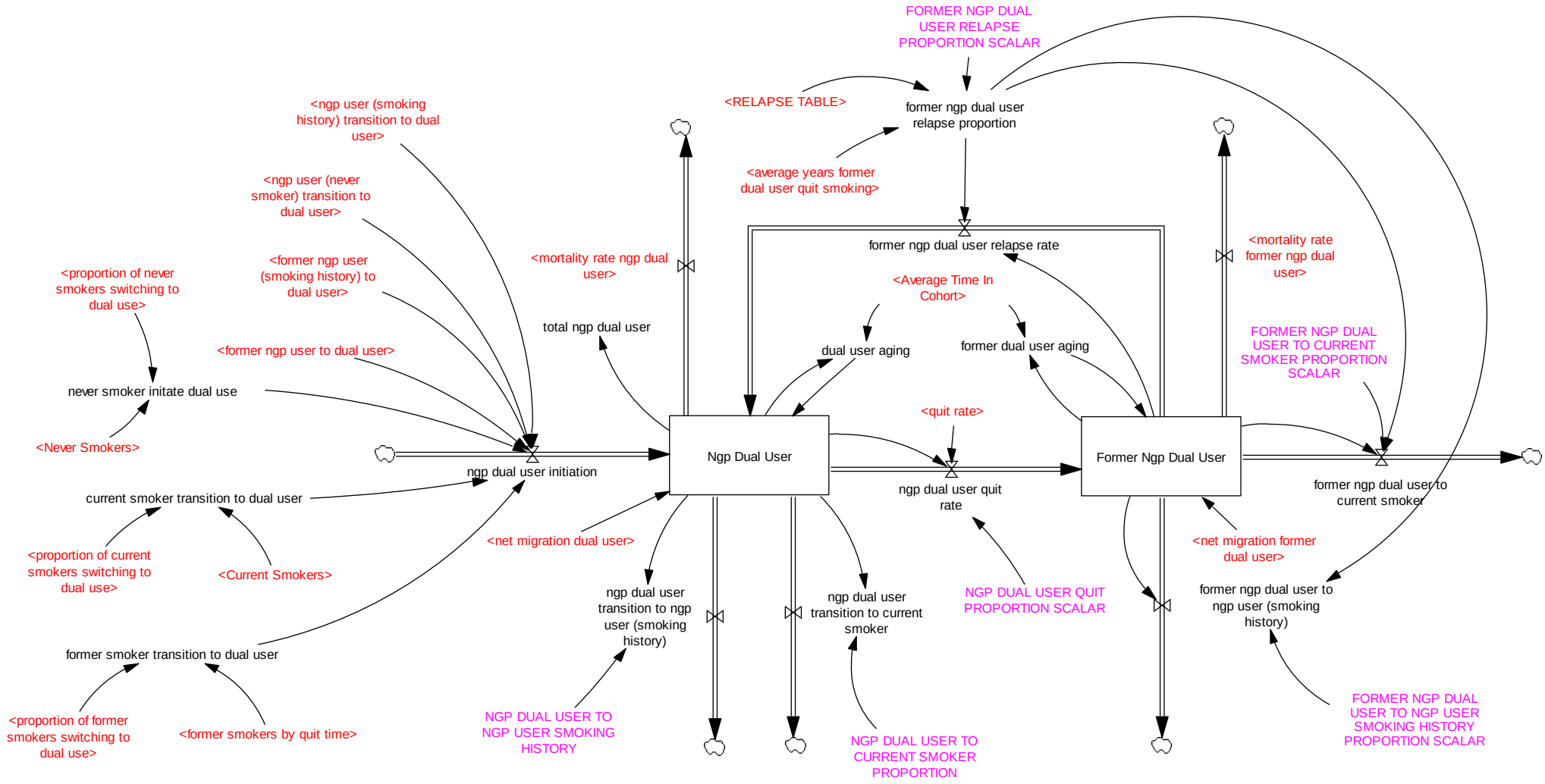
NGP User(Never Smoker) and Former NGP User(Never Smoker) Population Structure



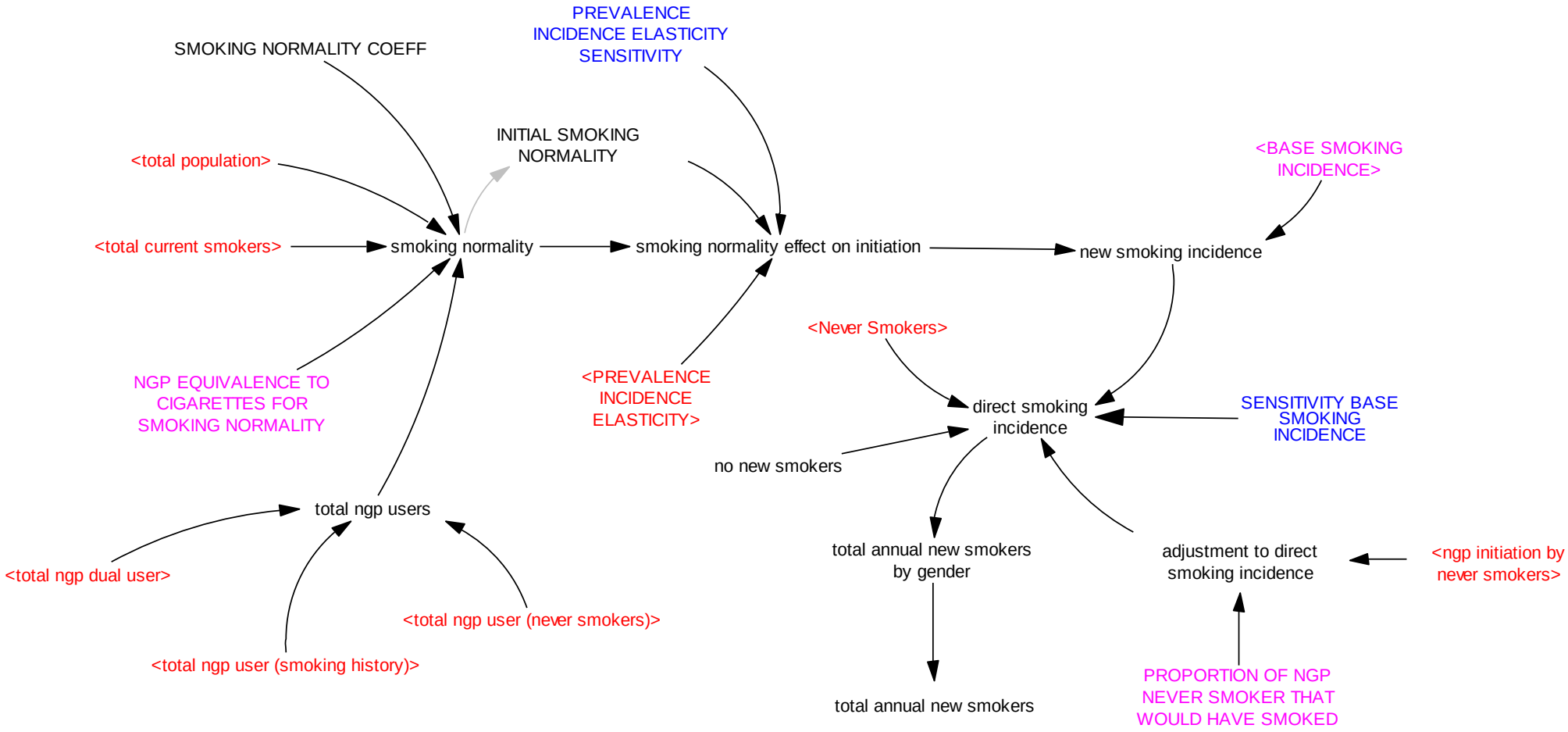
NGP User(Smoking History) and Former NGP User(Smoking History) Population Structure



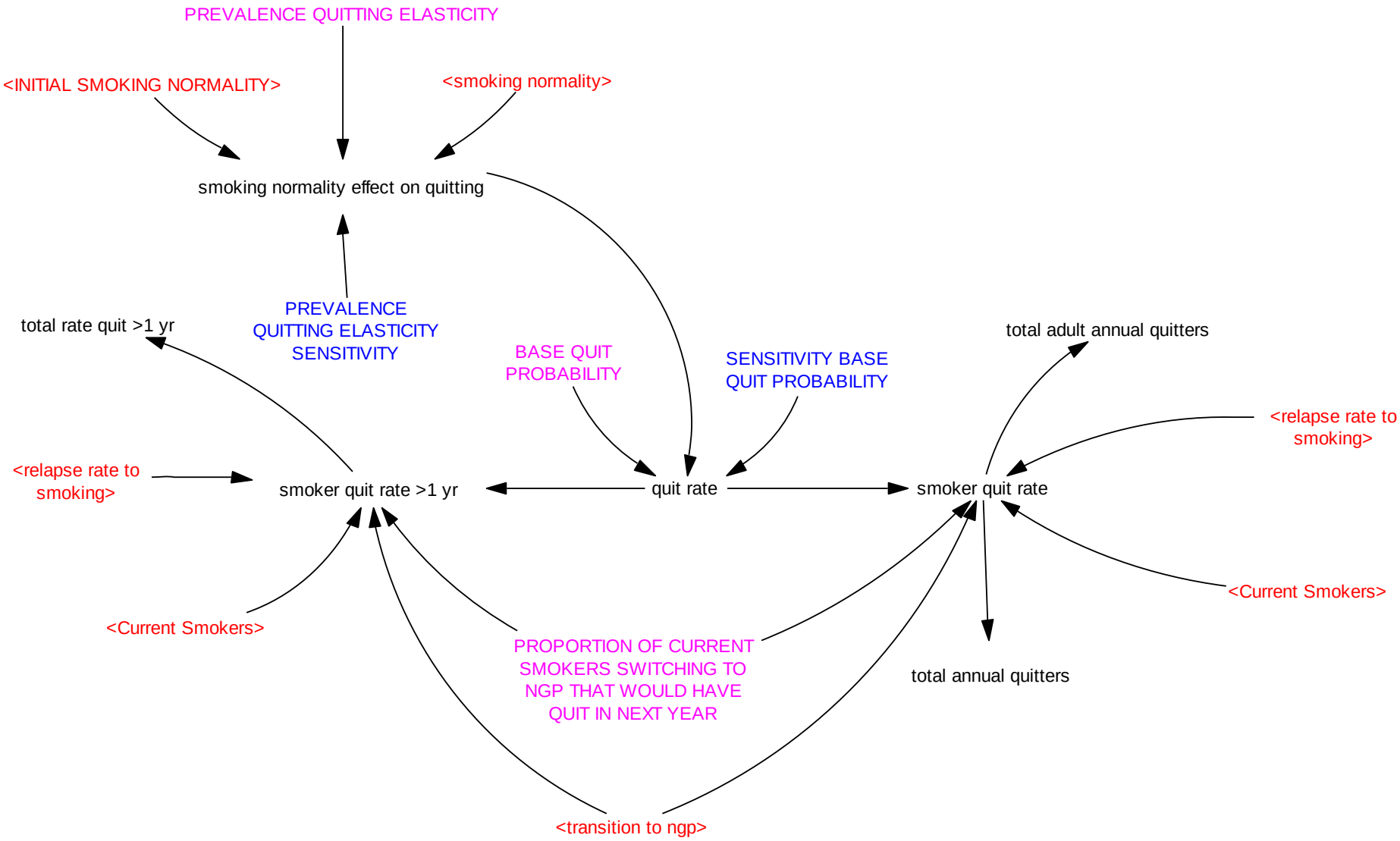
Dual User and Former Dual User Population Structure



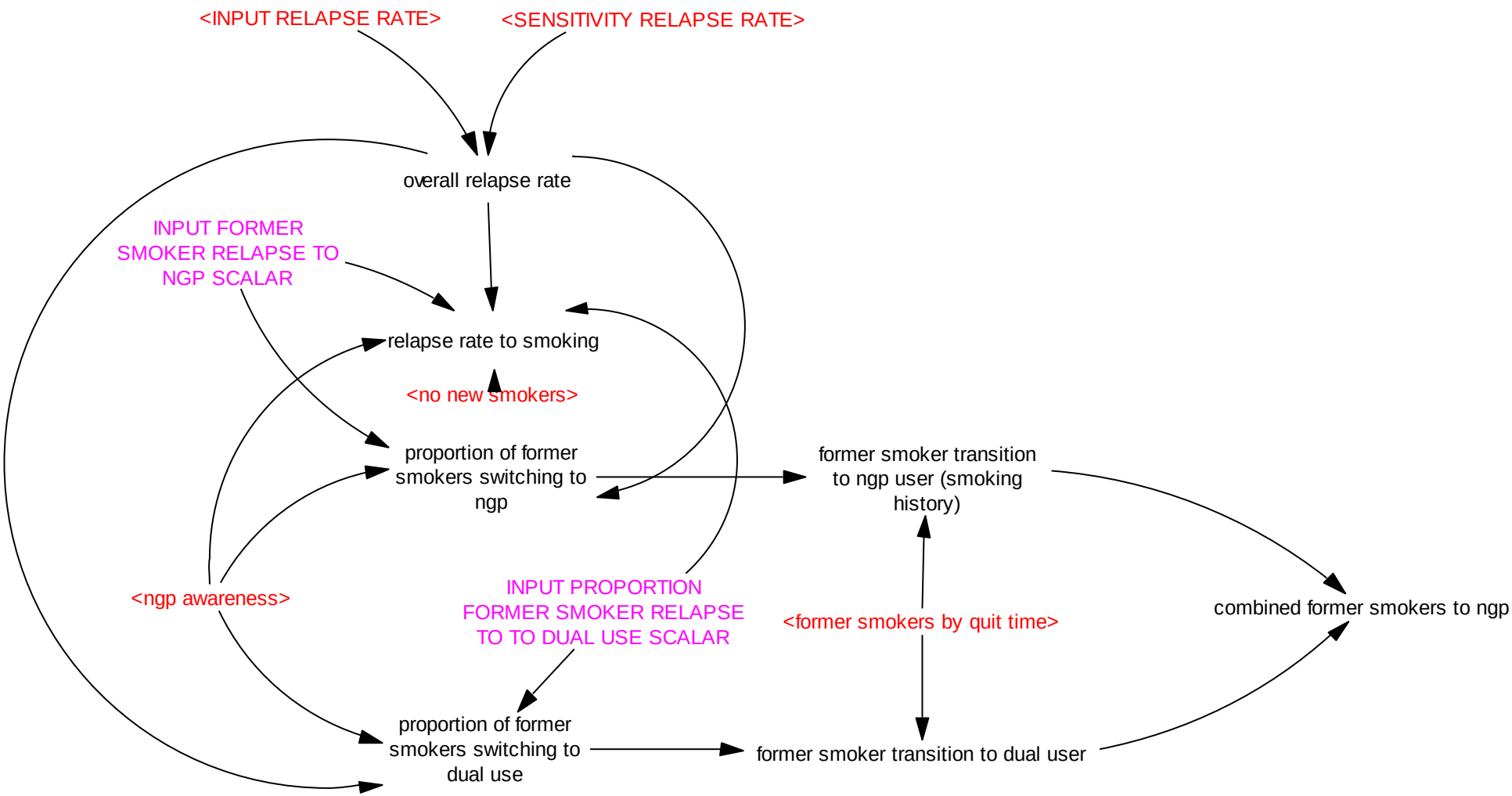
Smoking Initiation Rate Structure



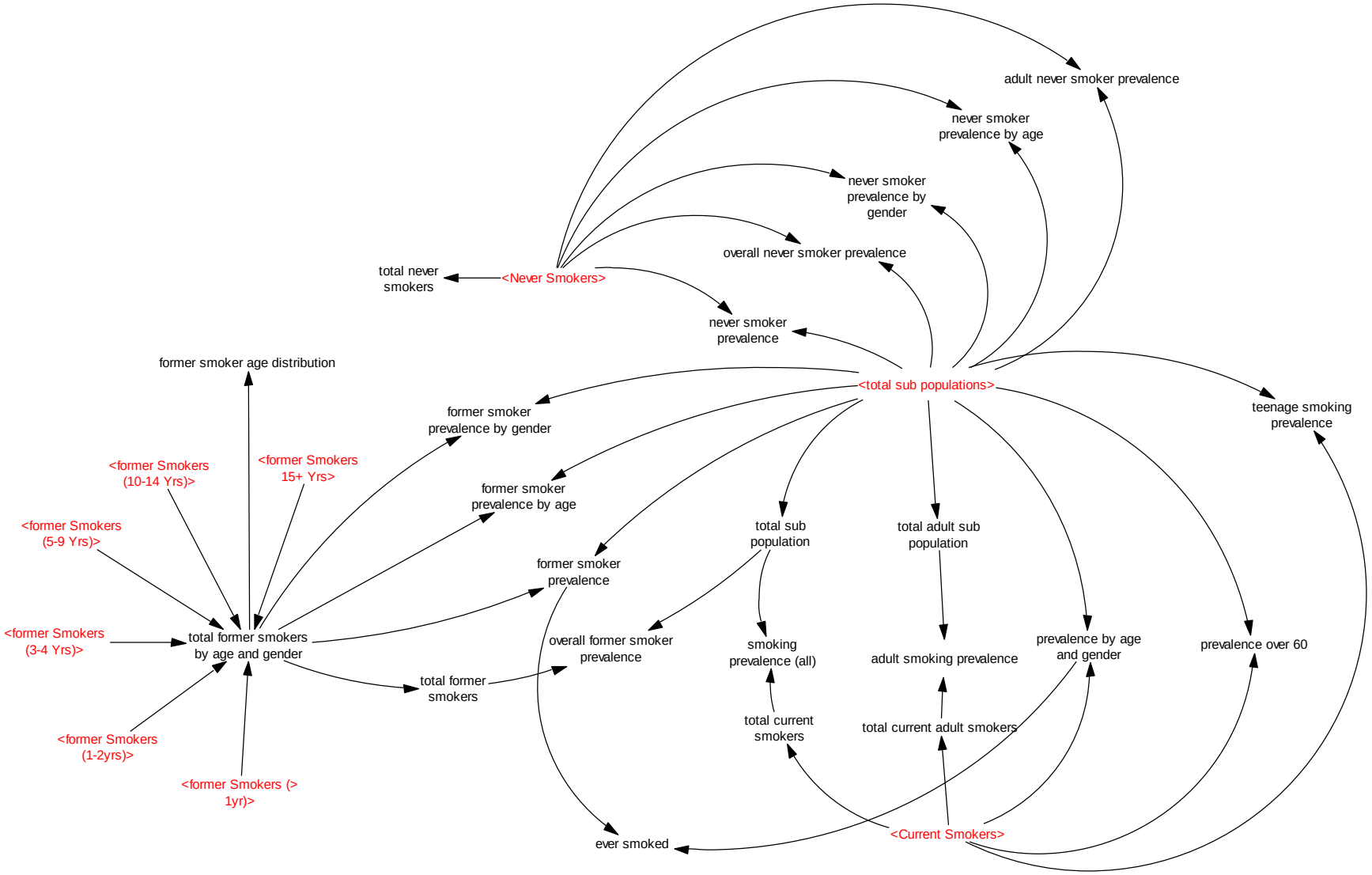
Smoking Cessation Rate Structure



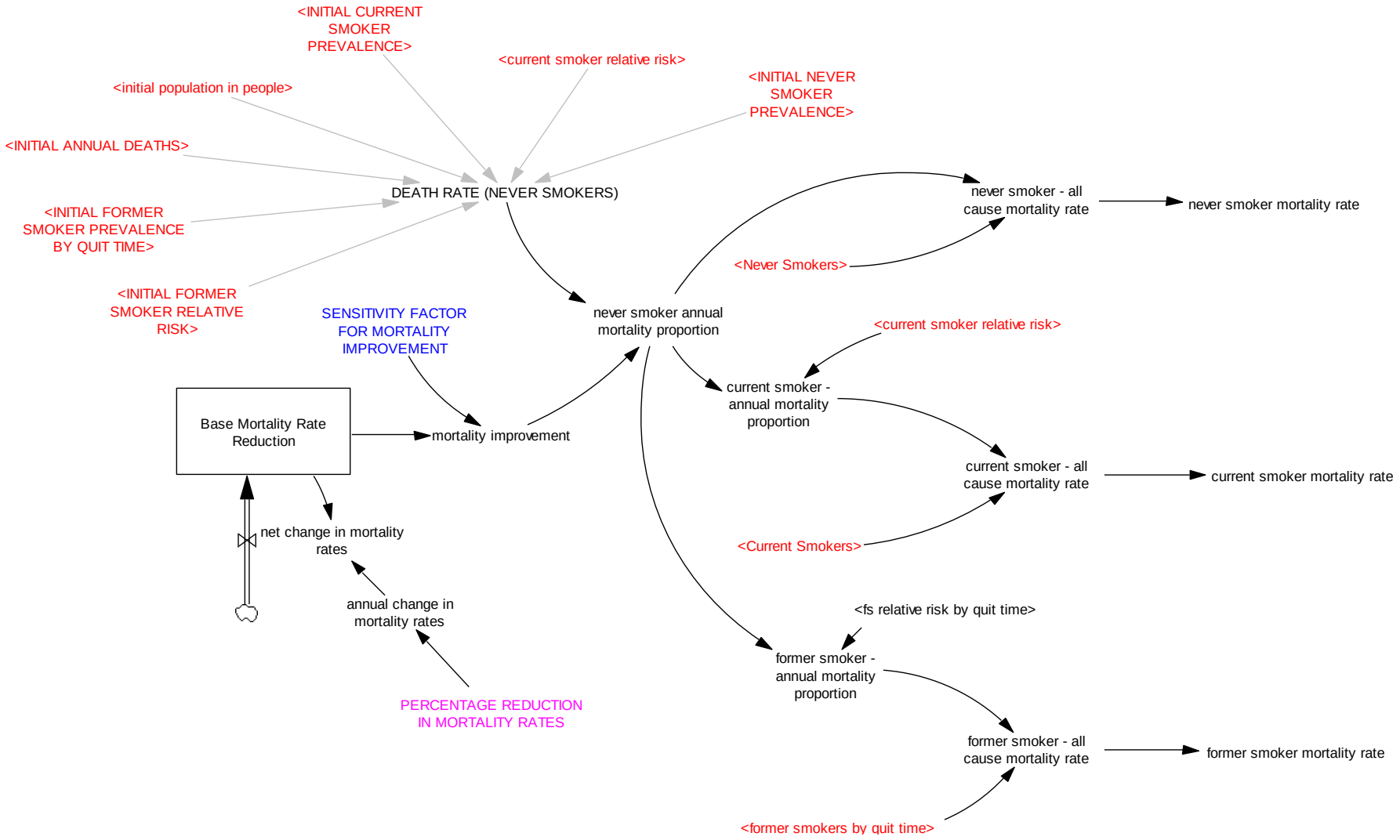
Former Smoker Transition to NGP Structure



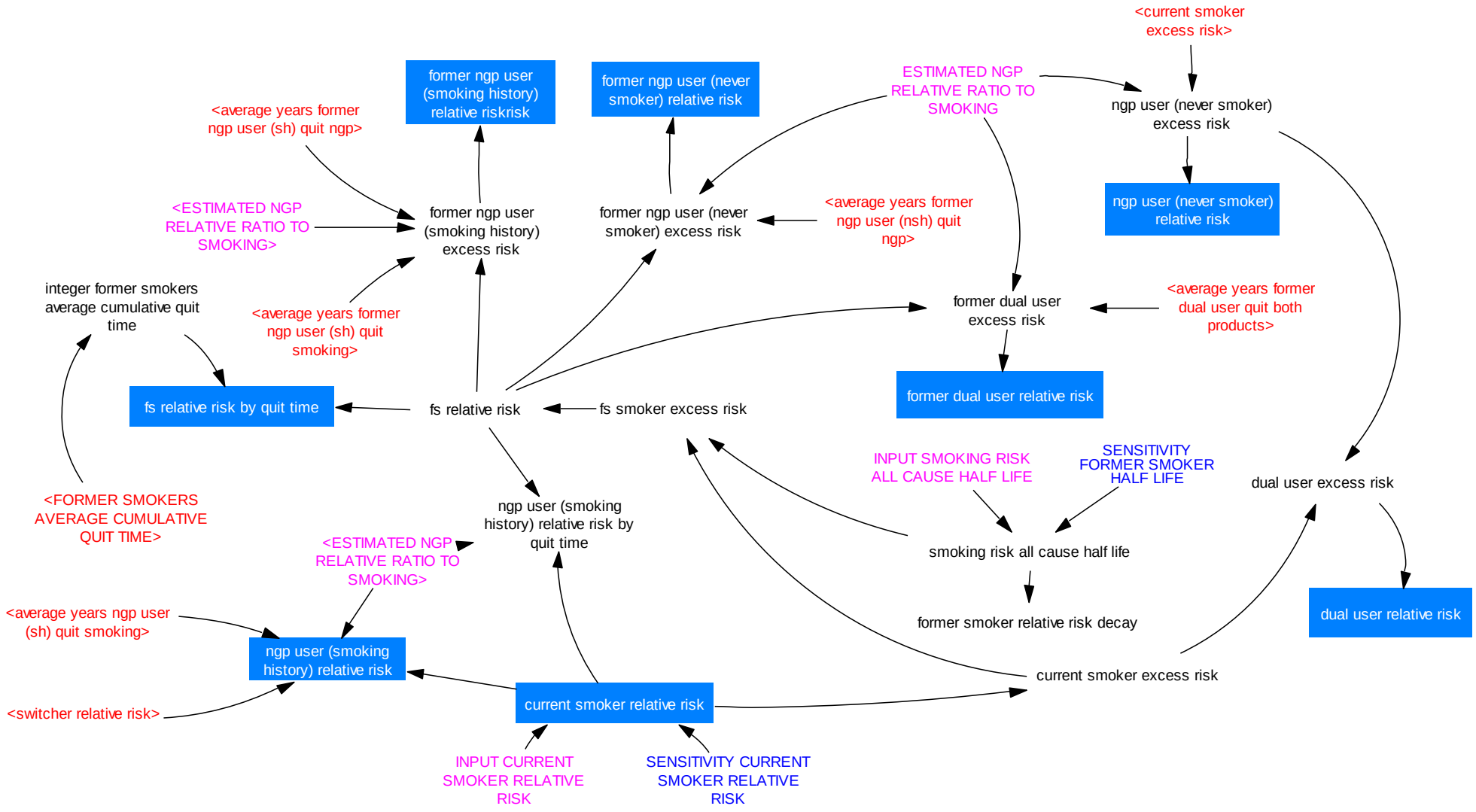
Smoking Prevalence Structure



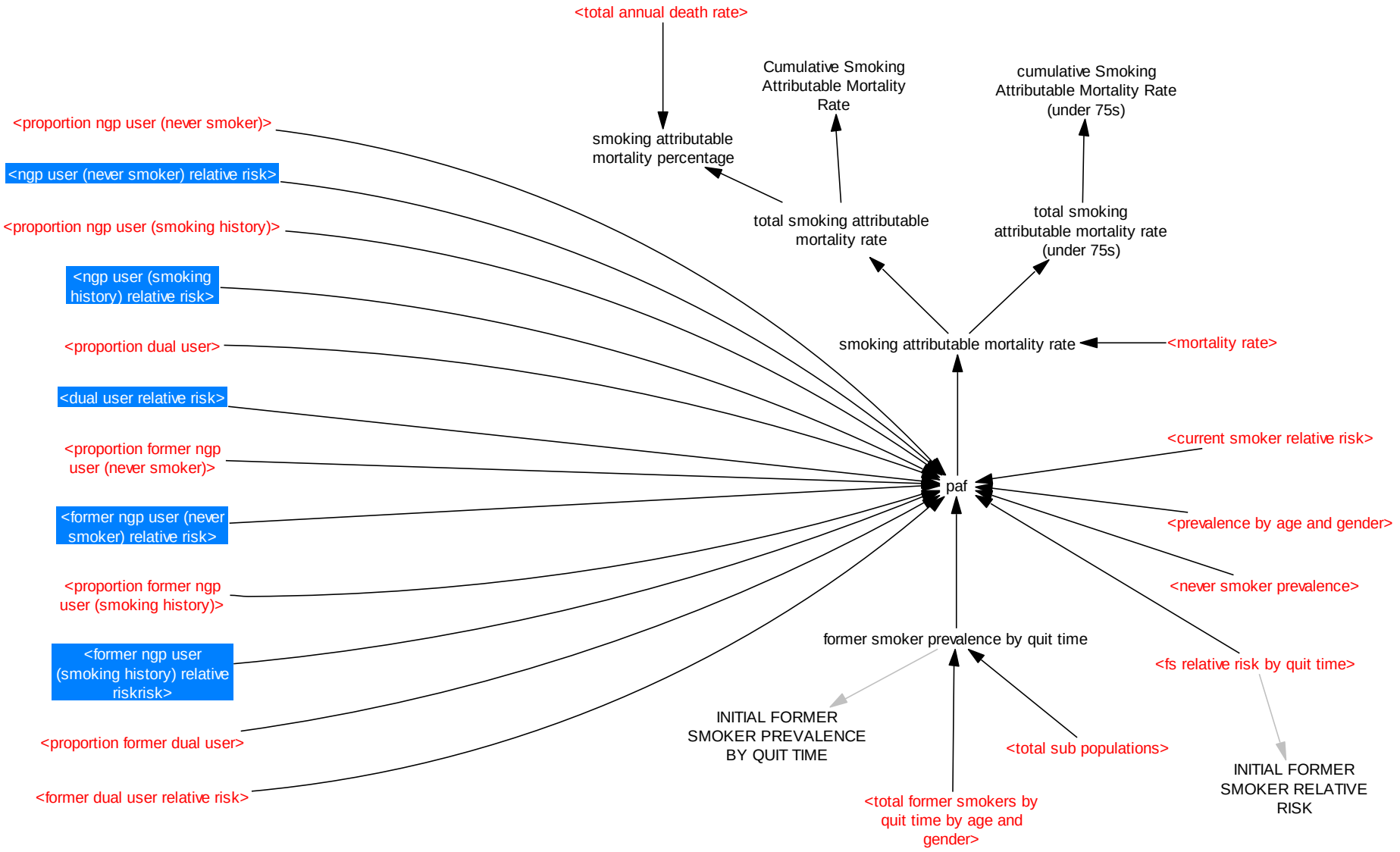
Mortality Rate Structure



Relative Risk Calculation Structure



Smoking Attributable Mortality Structure



Mass Balance Check Structure