
A dynamic microsimulation model for ageing and health in England: The English Future Elderly Model (E-FEM)

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Outline

1. Context
 2. Methods
 3. Validation
 4. Example Intervention: Smoking Cessation
-

Productive Healthy Ageing

Policy paper overview:

Healthy ageing: consensus statement

This statement by Public Health England and the Centre for Ageing Better sets out our shared vision for making England the best place in the world to grow old.

From: [Public Health England](#)

Published 16 October 2019

Last updated 30 September 2021 — [See all updates](#)

Public Health England, 2019. *A consensus on healthy ageing*. London: PHE publications.

Public Health England, 2019. *A menu of interventions for productive healthy ageing*. London: PHE publications.

Guidance

Productive healthy ageing: interventions for quality of life

Interventions that can be made by pharmacy teams, to improve quality of life for older people.

From: [Public Health England](#)

Published 19 March 2019

Microsimulation Global Collaborator Network



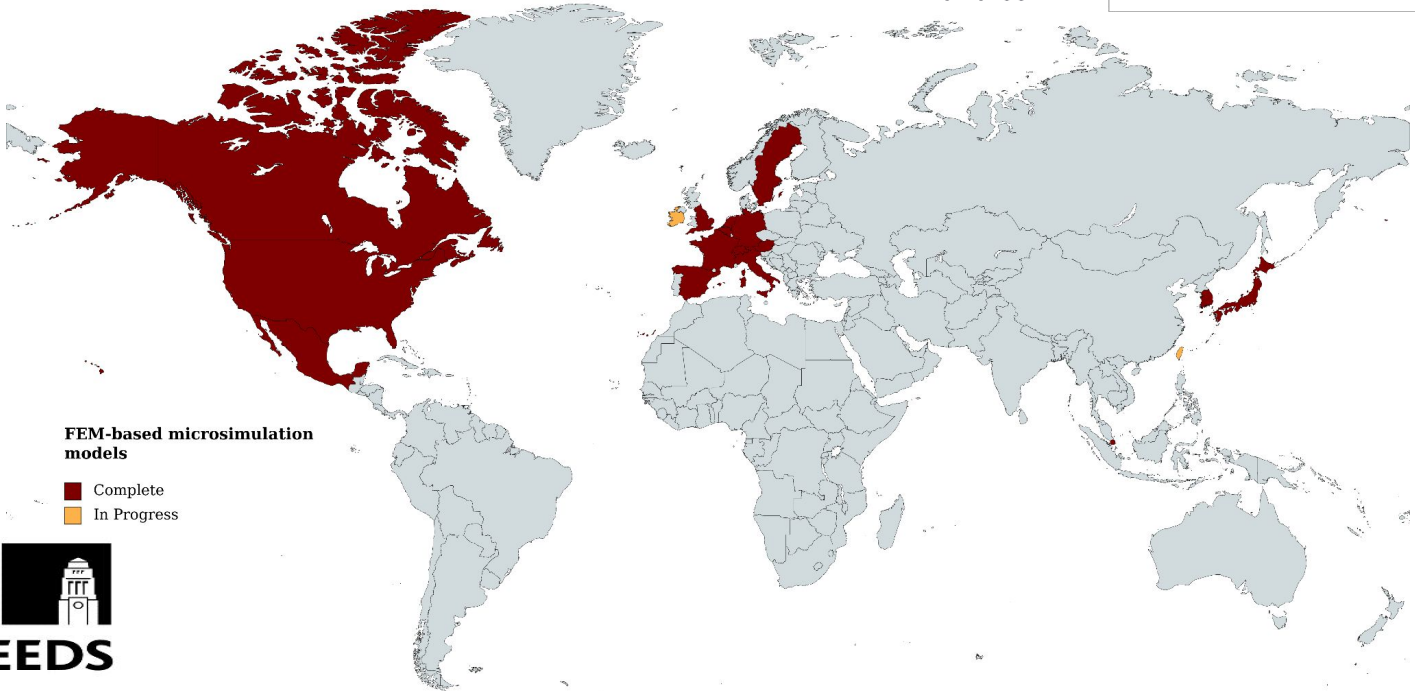
FEM-based microsimulation models

Complete

- | | |
|---------|-------------|
| Austria | Korea |
| Belgium | Mexico |
| Canada | Netherlands |
| Denmark | Singapore |
| France | Spain |
| Germany | Sweden |
| Italy | Switzerland |
| Japan | England |

In Progress

- Ireland
Taiwan

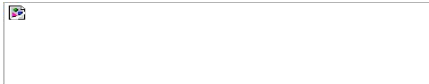


FEM-based microsimulation models

- Complete
■ In Progress



UNIVERSITY OF LEEDS



Université du Québec à Montréal



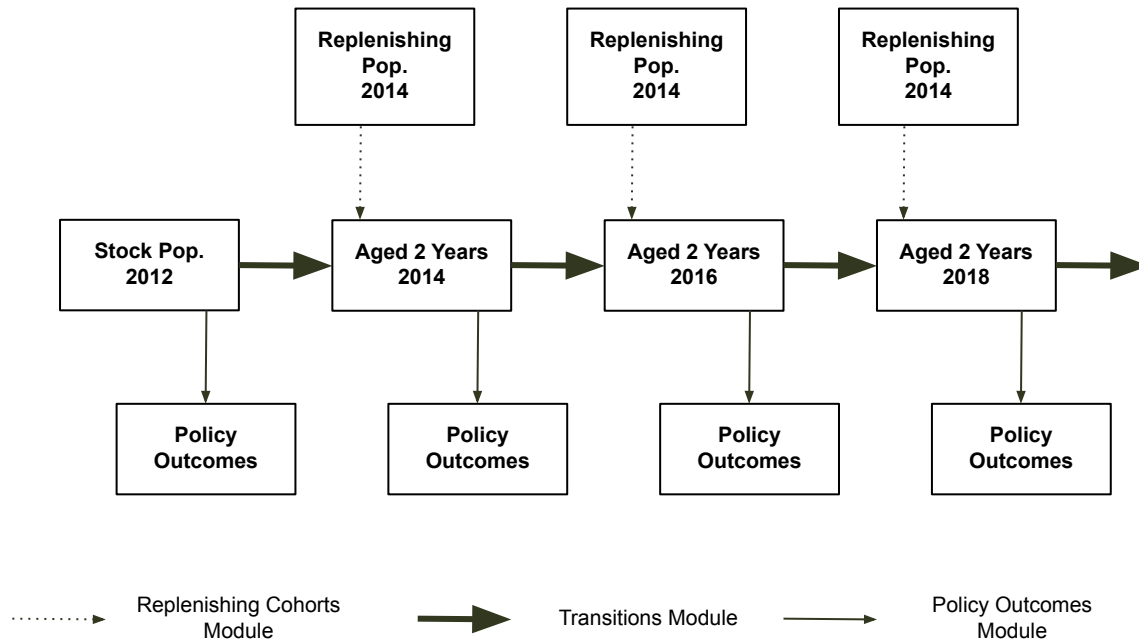
Transition Outcomes

Table 1: Variables tracked by the model.

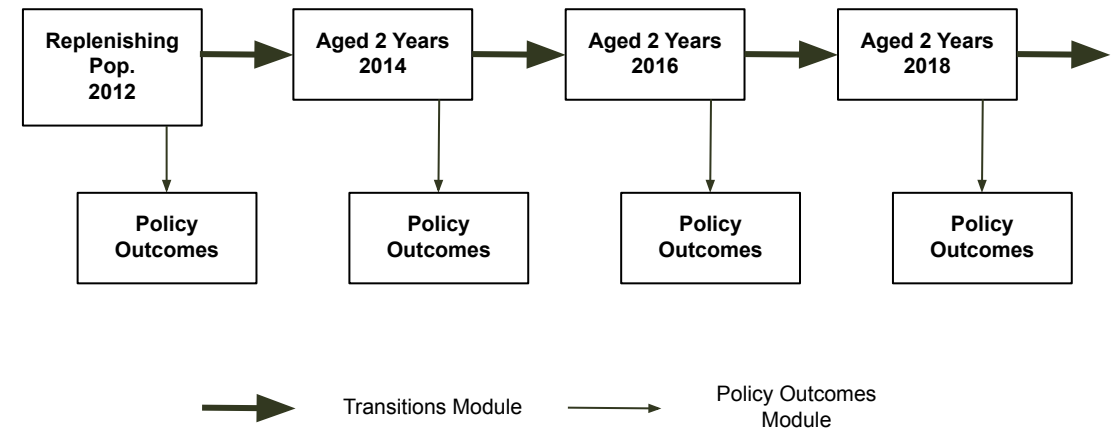
Domain	Variable
Health	Mortality, Alzheimers, Cancer, Dementia, Diabetes, Heart Disease, High Cholesterol, Hypertension, Lung Disease, Stroke
Risk Factors	BMI, Smoking Status, Alcohol Consumption, Exercise
Functional Limitations	Difficulties in Activities of Daily Living (ADLs), and Instrumental Activities of Daily Living (IADLs)
Economic	Employed, Unemployed, Retired/Disabled

Structure of the simulation

Full population simulation



Cohort simulation



Transition models

Outcome	Variable Type	Regression Model	Predictors ^(a)			
			Health Status	Risk Behaviours	Economic Predictors	Demographics
Alzheimers incidence	Binary Absorbing	Probit	Hypertension Stroke	BMI Smoking Alcohol Consumption		Age Sex Ethnicity Education
Start/Stop Smoking	Binary	Probit		BMI		Age Sex Ethnicity Education
Alcohol Consumption	Binary	Probit		BMI Physical Activity		Age Sex Ethnicity Education
BMI	Continuous	OLS		BMI Physical Activity		Age Sex Ethnicity Education
Functional Limitations	Ordered	Oprobit	Stroke Dementia Alzheimers	BMI Smoking		Age Sex Ethnicity Education
Physical Activity	Ordered	Oprobit		Functional Limitations Physical Activity		Age Sex Ethnicity Education
Labour Force Participation	Unordered	Mlogit	Functional Limitations			Age Sex Ethnicity Education

(a) All predictor variables are 2 year lag

Causal Pathway



Outline

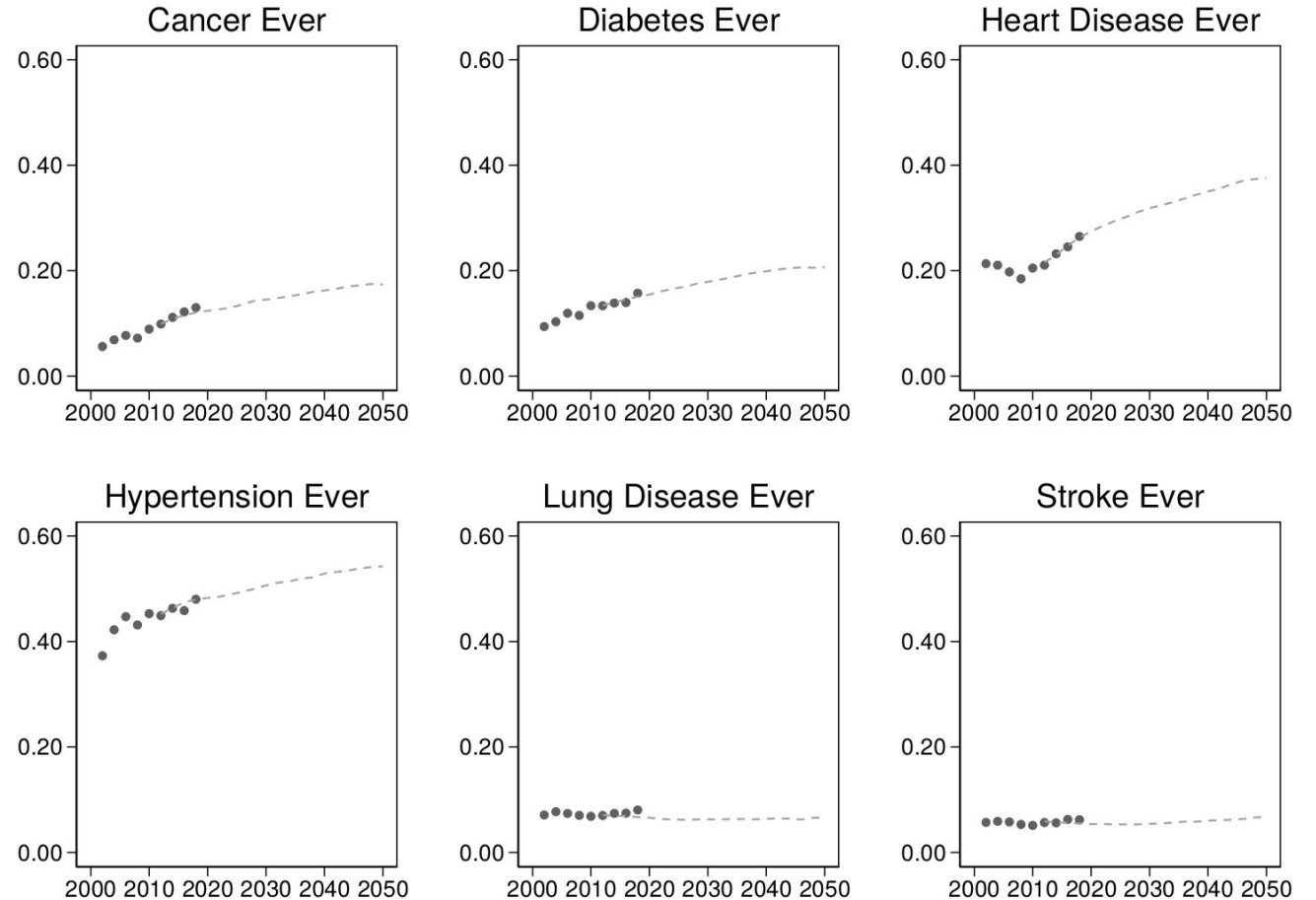
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Internal Validation

Handover Plots

- “Sanity check”
- Does simulation continue trend from data?

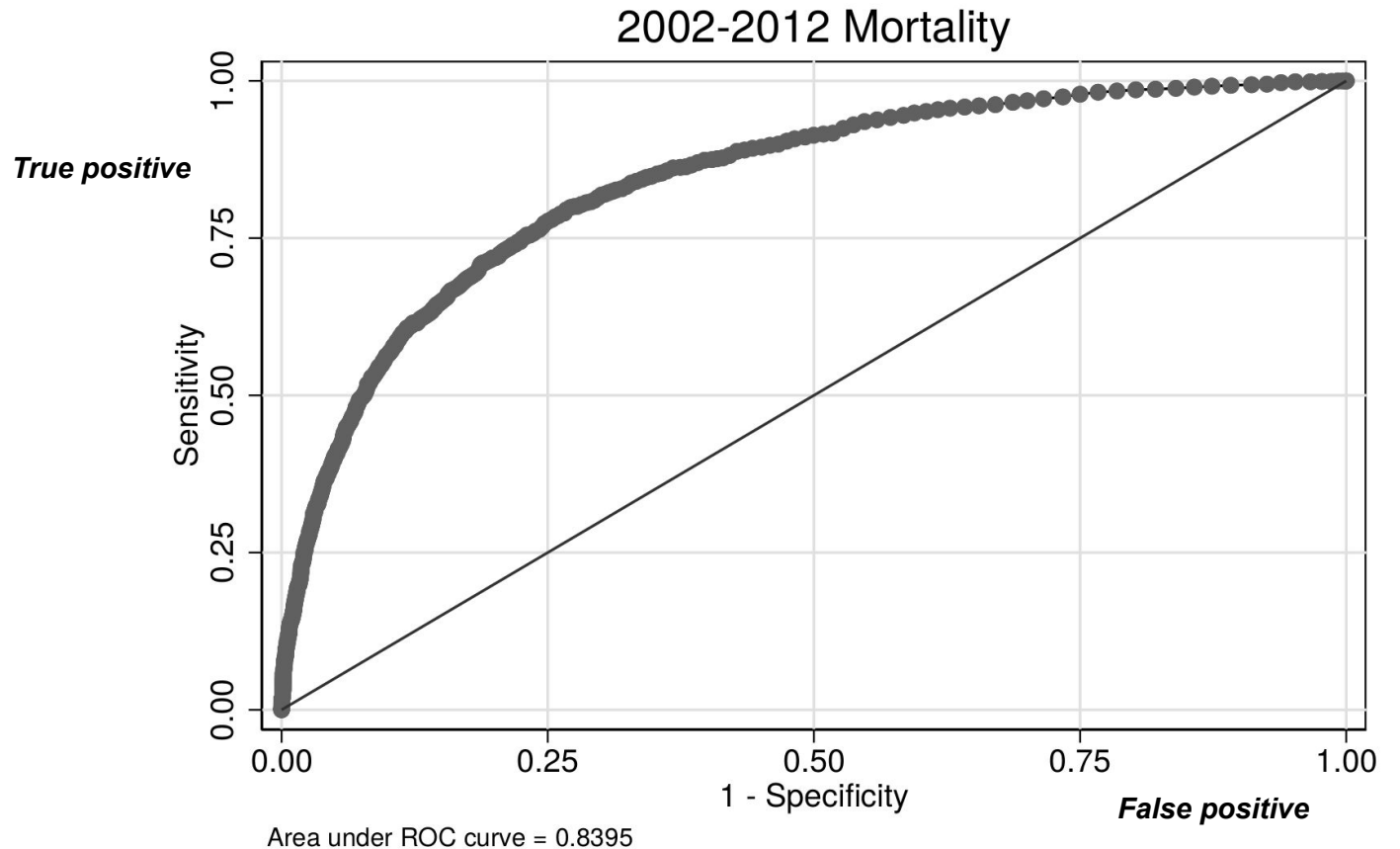
Chronic Disease - Females



Internal Validation

Receiver Operating Characteristic (ROC) Curve

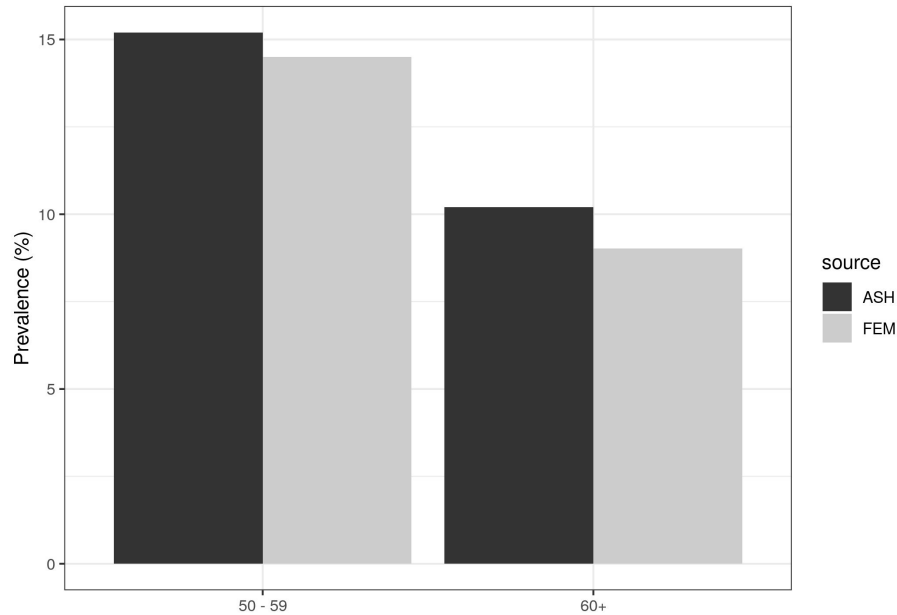
- Binary classification
- True Positive Rate vs False Positive Rate
- $\frac{\text{Sensitivity}}{(1 - \text{Specificity})}$
- Higher AUC == Better prediction
- US 10-year mortality: AUC == 0.86



Validation

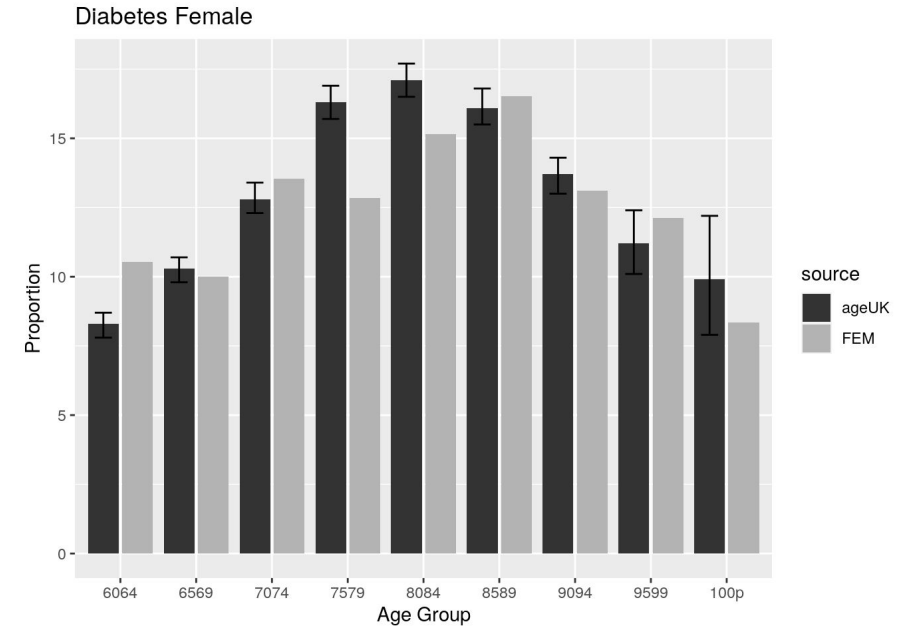
External

Smoking Prevalence (2018)



- Action on Smoking and Health
- Prevalence of smoking within age group
- 2018 (8 years of simulation)

Chronic Disease Prevalence (2014)



- Age UK almanac of disease profiles in later life
- Prevalence of major diseases
- 2014 (10 years of simulation)

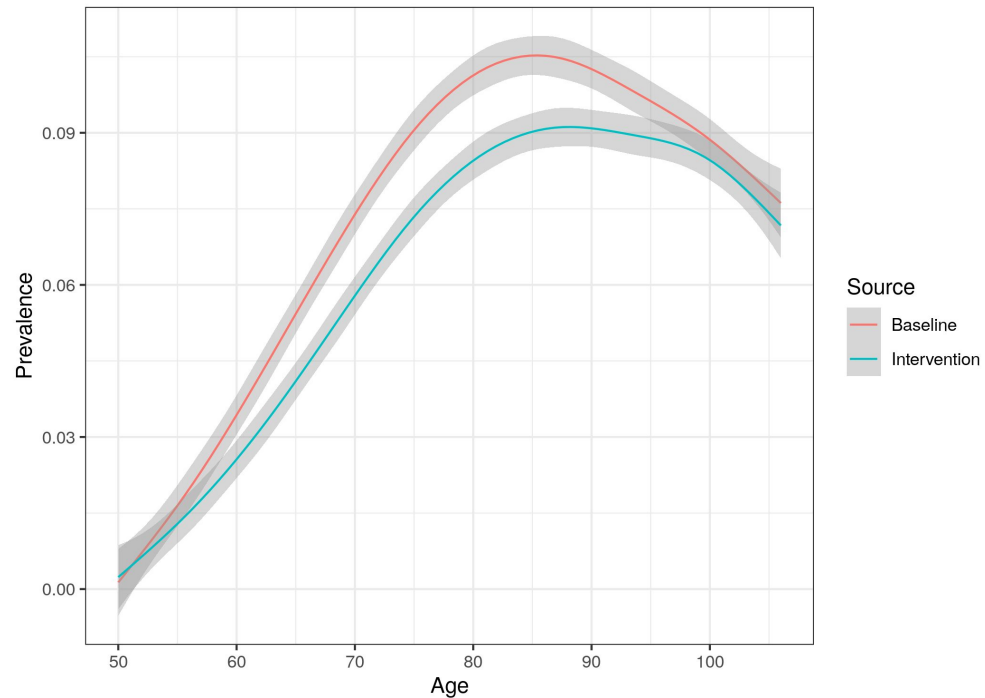
Example intervention: Smoking cessation

What if all smokers in a cohort quit at age 50 and did not relapse?

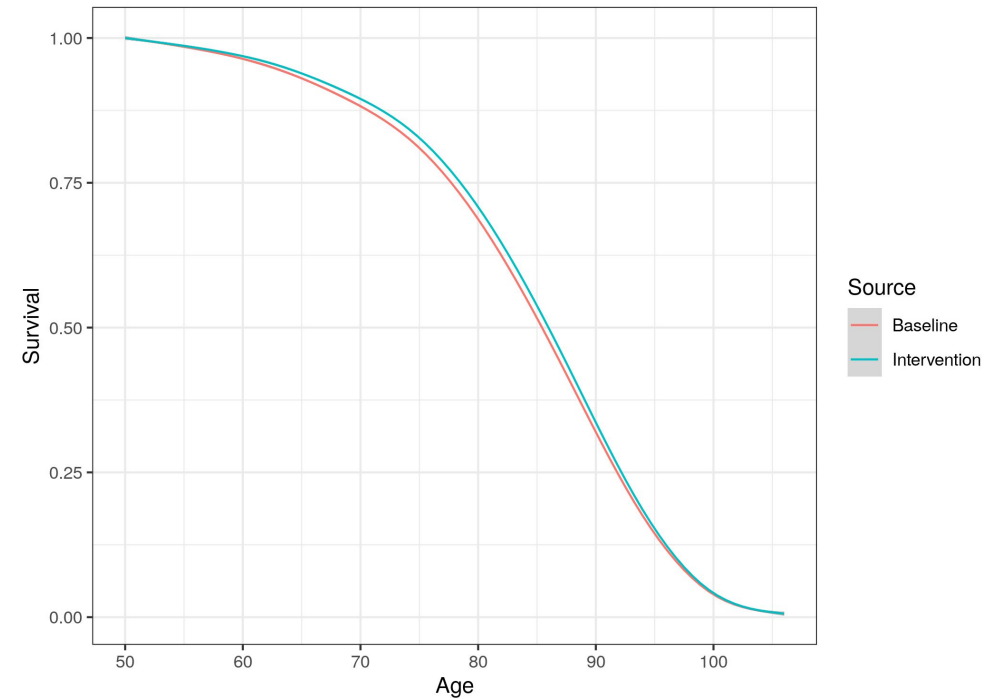
- Modified input population
- Altered transition probability

Example intervention: Smoking cessation

Lung Disease Prevalence



Survival



Sub-populations: Smokers

Scenario	Life Years	Disability-free Life Years
Baseline	24.4	16.9
Intervention	31.4	21.4

The NEW ENGLAND JOURNAL of MEDICINE

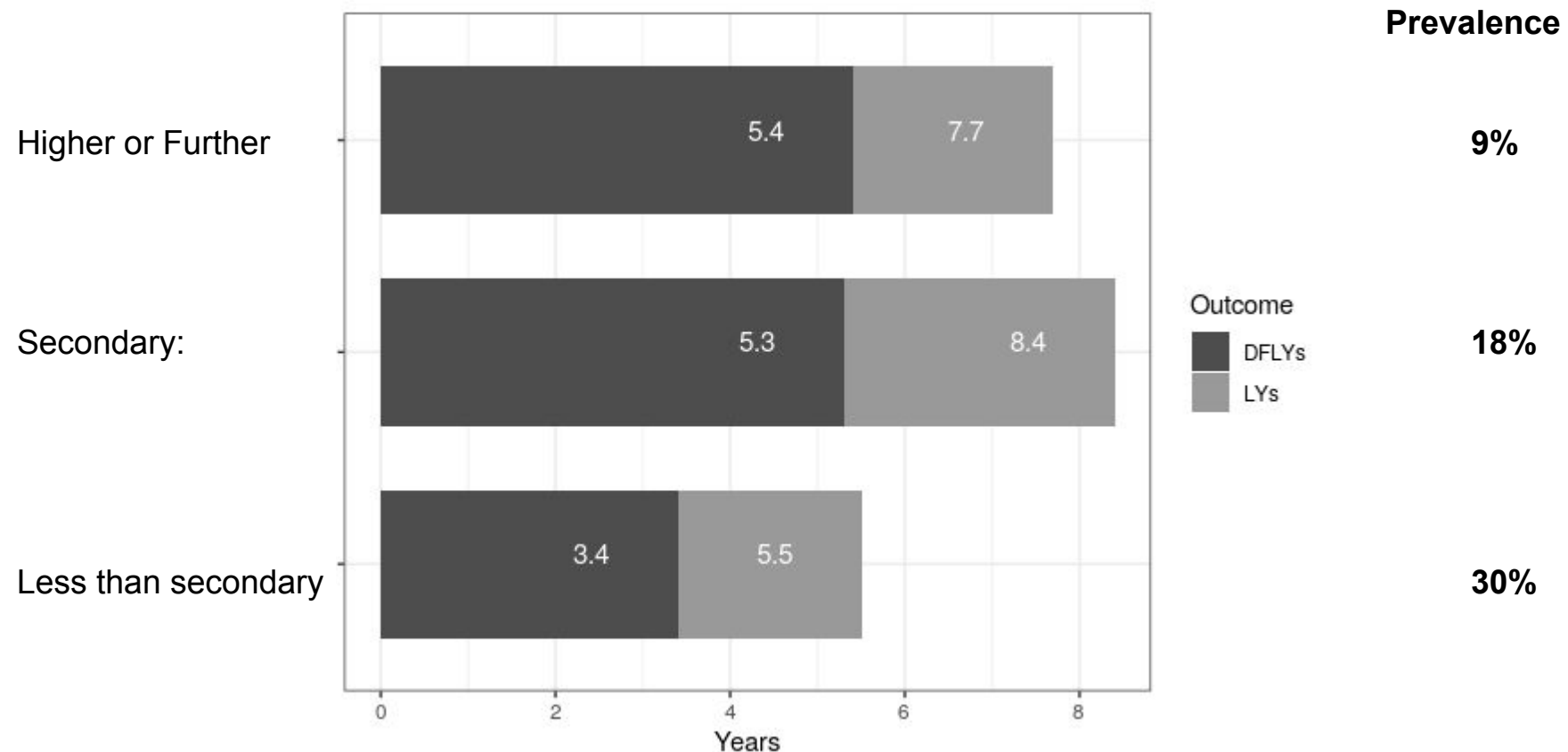
SPECIAL ARTICLE

21st-Century Hazards of Smoking and Benefits of Cessation in the United States

Prabhat Jha, M.D., Chinthanie Ramasundarahettige, M.Sc.,
Victoria Landsman, Ph.D., Brian Rostron, Ph.D., Michael Thun, M.D.,
Robert N. Anderson, Ph.D., Tim McAfee, M.D., and Richard Peto, F.R.S.

*“Adults who had quit smoking at ... 45 to 54 years of age gained about ...
6 years of life, as compared with those who continued to smoke.”*

Sub-populations: Smokers by Education





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