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SHINE + HIIC:

Scalable Health INtervention Evaluation program and the Health Intervention Impact Calculator

Tony Blakely, 13 August

Seminar for Melbourne School of Population and Global Heatlth

1

Structure of this talk

SHINE Scalable Health Intervention Evaluation

- Rationale for SHINE and HIIC
- Demonstration of HIIC
- Briefly methods behind SHINE and HIIC:
  - Proportional multistate lifetable (PMSLT)
  - Various methods used to generate input data
- Example of research project and impact: tobacco endgame in NZ
- Discussion on how SHINE, SHINE-Consulting and HIIC can be maximally useful for you, research and policy in Australia (and beyond)

2

2

Classic paper - that is just about a three-legged stool

Population Health Metrics

BioMed Central

Review

Open Access

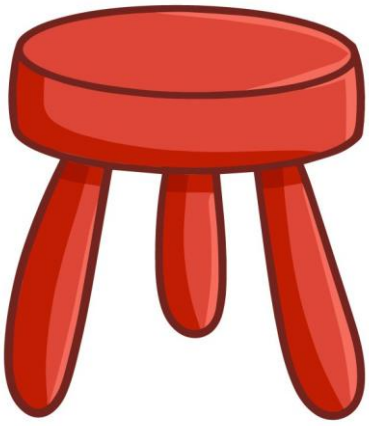
Comparative quantification of health risks: Conceptual framework and methodological issues

Christopher JL Murray[1], Majid Ezzati*[2], Alan D Lopez[3], Anthony Rodgers[4] and Stephen Vander Hoorn[4]

3

3

Three-legged stool



1. What is the burden of health loss today?
   - *DALYs by sex, age, region, social group, and disease/condition*
2. How much of that burden is **attributable** to risk factors… *as though the world had never had tobacco, never had BMI>25, etc*?
   - *Comparative risk assessment*
3. How much of future burden is **avoidable** if we change risk factors now and going forward?
   - *Simulation modelling – looking at future stream of changes in health and costs*

4

SHINE answers any question of this nature

"What is the
- Health gain
- Health system cost
- Productivity impact
- Cost-effectiveness

of intervention X over
- The population's lifetime
- The next 5, 10 or 20 years

by
- Sex and age
- Ethnic groups
- Socioeconomic group

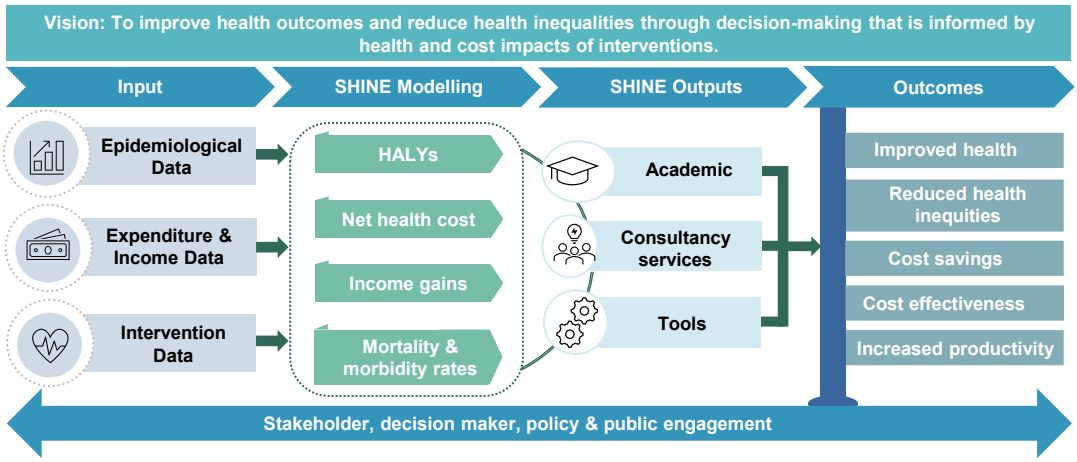
compared to
- Business as usual
- Intervention Y
- A range of interventions

?"

5

5

How does SHINE work?



6

SHINE scales up, out and down

Scaling up: the combined impact of packages of interventions

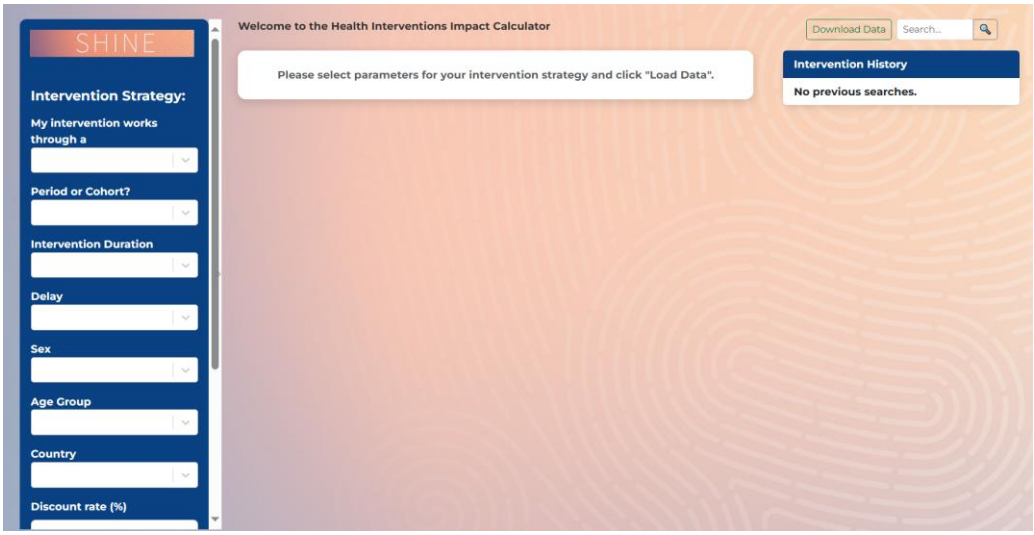
Scaling out: the impact of same interventions across countries

Scaling down: impact of interventions by sub-populations

7

Health Intervention Impact Calculator (Vers 2.0; live at www.shine-hiic.com)

SHINE
Scalable Health Intervention Evaluation



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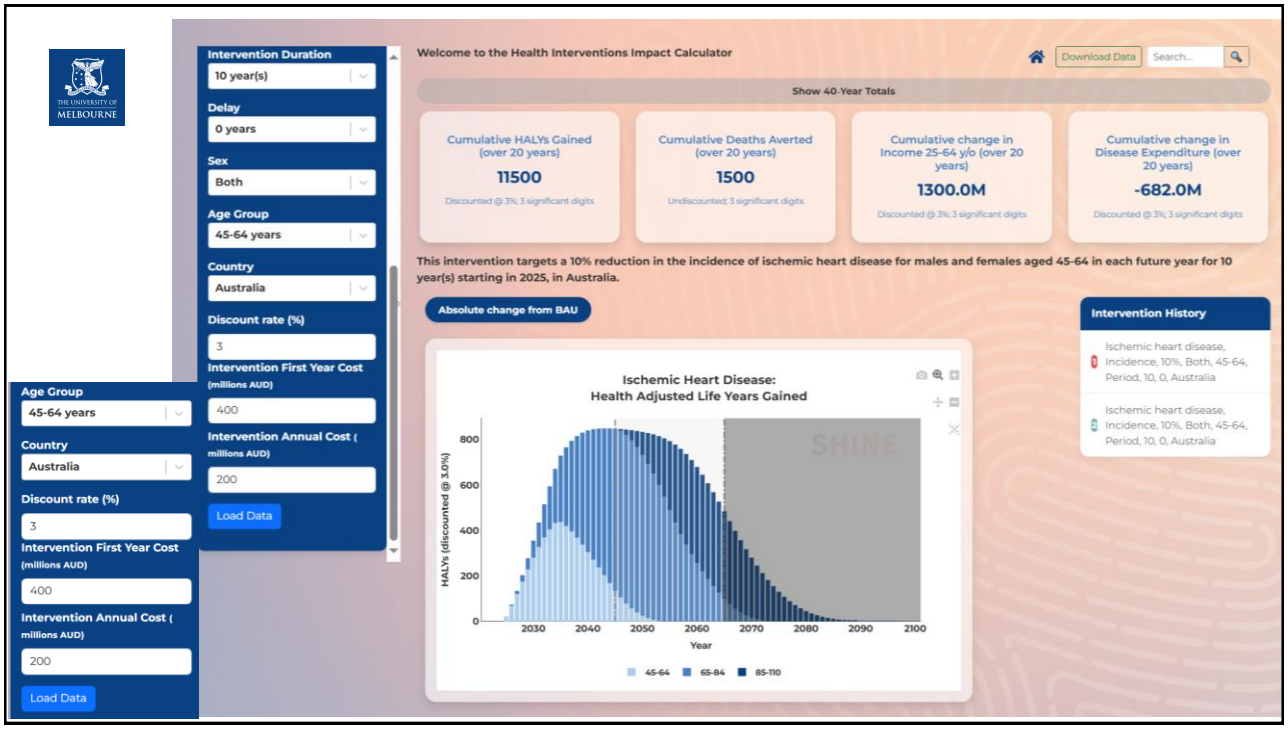
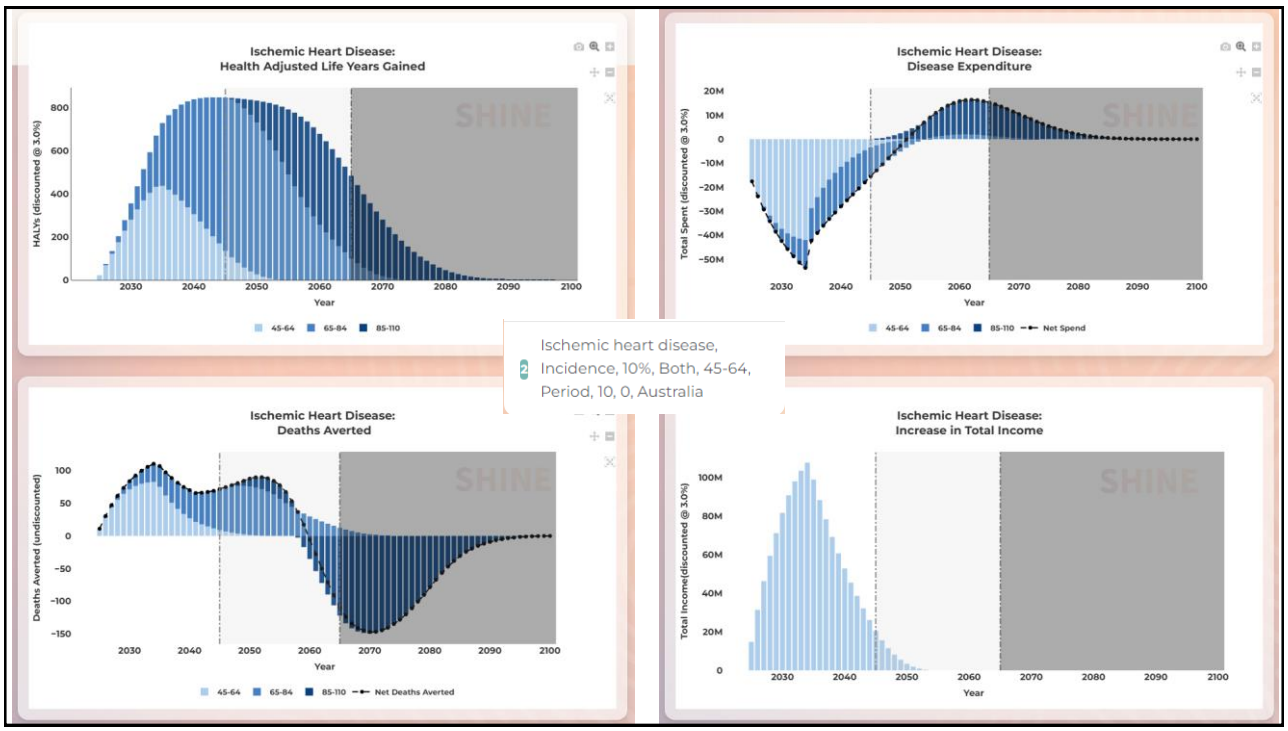
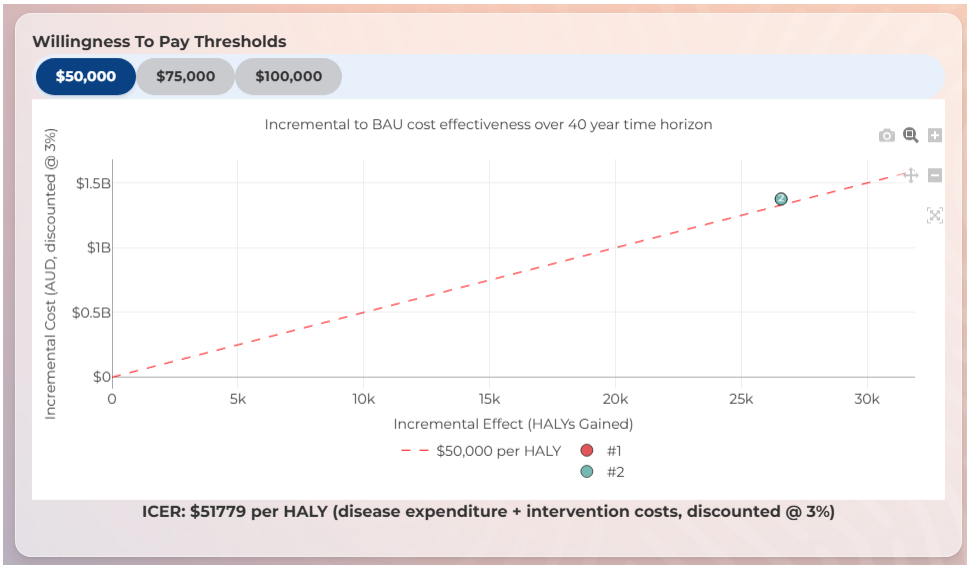

Intervention Duration
10 year(s)
Delay
0 years
Sex
Both
Age Group
45-64 years
Country
Australia
Discount rate (%)
3
Intervention First Year Cost (millions AUD)
400
Intervention Annual Cost (millions AUD)
200
Load Data
Welcome to the Health Interventions Impact Calculator
Download Data
Search...
Show 40-Year Totals
Cumulative HALYs Gained (over 20 years)
11500
Discounted @ 3%; 3 significant digits
Cumulative Deaths Averted (over 20 years)
1500
Undiscounted; 3 significant digits
Cumulative change in Income 25-64 y/o (over 20 years)
1300.0M
Discounted @ 3%; 3 significant digits
Cumulative change in Disease Expenditure (over 20 years)
-682.0M
Discounted @ 3%; 3 significant digits
This intervention targets a 10% reduction in the incidence of ischemic heart disease for males and females aged 45-64 in each future year for 10 year(s) starting in 2025, in Australia.
Absolute change from BAU
Intervention History
Ischemic heart disease, Incidence, 10%, Both, 45-64, Period, 10, 0, Australia
Ischemic heart disease, Incidence, 10%, Both, 45-64, Period, 10, 0, Australia
Ischemic Heart Disease: Health Adjusted Life Years Gained
HALYs (discounted @ 3.0%)
Year
45-64
65-84
85-110
SHINE

9


Ischemic Heart Disease: Health Adjusted Life Years Gained
HALYs (discounted @ 3.0%)
Year
45-64
65-84
85-110
Ischemic Heart Disease: Disease Expenditure
Total Spent (discounted @ 3.0%)
Net Spend
Ischemic heart disease, Incidence, 10%, Both, 45-64, Period, 10, 0, Australia
Ischemic Heart Disease: Deaths Averted
Deaths Averted (undiscounted)
Net Deaths Averted
Ischemic Heart Disease: Increase in Total Income
Total Income(discounted @ 3.0%)
SHINE

10

HIIC Backup: IHD and CE plane
(same intervention, but note 40 year time horizon)



ICER: $51779 per HALY (disease expenditure + intervention costs, discounted @ 3%)

11

11

HIIC overview, I: world first

- HIIC is world first scalable infrastructure to estimate **prospective** health gains and economic impacts of preventive interventions

12

12

HIIC overview, II: timeline

- Today: as demonstrated and live at www.shine-hiic.com, for Australia HIIC can do:
  - any **disease** intervention (through incidence, case fatality, remission rate changes)
  - limited **interventions through risk factors** (blood pressure, LDL, fasting plasma glucose, BMI and tobacco smoking are priorities this year)
  - by **sex and age**; outputs of **health gain** (e.g. HALYs) / **disease expenditure** / **income gain**
  - **cost effectiveness** output if user specifies up front intervention cost
- Plan by the end of this year:
  - For Australia, more risk factors
  - For OECD countries: **any disease** and **selected risk factor** interventions; **health gain** and **disease expenditure** (but not income loss); health system perspective **cost effectiveness** if user specifies up front intervention cost
  - For all non-OECD countries: **any disease** and **selected risk factor** interventions; **health gain** output only (not disease expenditure or income gain outputs)
- Plan for next year:
  - For Australia: 10 to 20 **risk factors** added; **diseases by SES**; possibly **risk factors by SES**
  - For all other countries: growing inventory of **risk factors**

13

13

HIIC overview, III: when HIIC 'best'

- If you want to know number of cases and deaths from disease X in a given year, or DALYs in a given year – HIIC is not your answer:
  - Instead → routine mortality data, cancer registry, GBD or AIHW burden of disease study, etc
- If you want total cost (e.g. health expenditure, income loss, or other social costing of illness) of disease X in a given year – HIIC is not your answer:
  - Instead → AIHW disease expenditure reports, and other costing of illness reports
- If you want estimate of health loss today (i.e. DALYs) ***attributable*** to ***past*** adverse risk factor exposure – HIIC is not your answer:
  - Instead → GBD or AIHW burden of disease studies, and comparative risk assessments
- If you want estimates of ***future*** health gain, changes in disease expenditure and income, for public health intervention ***scenarios*** – HIIC is your answer!
- If you want more sophisticated modelling than *scenarios* HIIC can model:
  - Then → SHINE-Consulting, Melbourne Health Economics or similar group

14

14

Caveat emptor, or disclaimer and future iterations

- There is an enormous amount of data (derivation) and modelling behind HIIC. HIIC has been years in the making and is a major achievement.
- Today's launch (13 Aug, 2025) version is Vers 2.0.
  - Please use it; and please report any potential glitches or errors to us please: population-interventions@unimelb.edu.au.
  - Please consider responding to our user survey – link at HIIC tool
- There will be updates (i.e. some output numbers will change – modestly):
  - With the next release of GBD data to 2023 – imminent. And future GBD data updates
  - With AIHW updates to disease expenditure
  - With improvements we will make to disease forecasting
    - e.g. currently we forecast changing disease rates for 20 years, then hold constant; we may add another 20 years of decreasing to zero annual percentage change
- Put simply, HIIC is a 'living' tool that will be evolved and improved.

15

15

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- Rationale for SHINE and HIIC
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- **Briefly methods behind SHINE and HIIC:**
  - **Proportional multistate lifetable (PMSLT)**
  - **Various methods used to generate input data**
- Example of research project and impact: tobacco endgame in NZ
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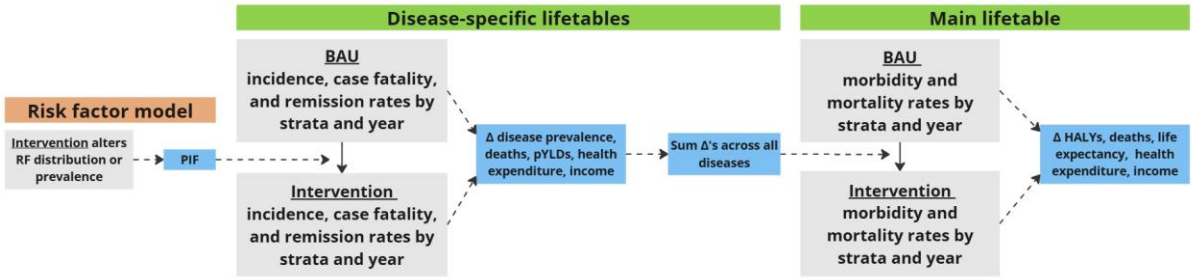
16

16

Proportional Multistate Lifetable (PMSLT)



17

17

What does SHINE need to make a global intervention simulation tool?

1. Business as usual forecasts by country, sex and age of:
   - All cause mortality *statistical forecasts* and morbidity rates *nil change*
   - Disease specific incidence, fatality and remission rates (prevalence base year only) *developed SHINE method using GBD data as input, and data science to make rates cohort coherent then forecast by cohort*
   - Risk factor distributions *developed SHINE method using GBD summary exposure values (SEVs) as input*
   - Risk factor → condition (a.k.a. risk-outcome pair) incidence rate ratios *just use GBD rate ratios*
     - *Aside: increasing **validity** of RRs (i.e. purging systematic error out of meta-analyses!), **consistency** with intervention in mind, and improving **transportability** (i.e. ability to apply RRs across time, place and person). **Critical challenges going forward** – for all of epidemiology….*
   - Disease expenditure with disease state *Australian disease expenditure, with NZ ratios for phase. We have OECD estimates using SHINE method (NHA envelope, one annual cycle of epidemiology).*
   - Income change with disease state *NZ only for now; technically feasible for Australia, 'just' need either: state-level hospital data added into PLIDA, or tax data added into AIHW National Health Data Hub.*
2. Intervention *for now HIIC user-specified …. but can be whole modelling exercise as well*:
   - Effect sizes as change in risk factor distribution or direct change in disease rates
   - Up front cost of intervention

18

18

Forecasting disease rates to populate BAU models – in BRIEF

1. Generate calibration targets – simple cohort forecasts of disease prevalence and cause specific mortality rates by sex and age
2. Optimise forecast disease specific incidence, case fatality and remission rates to 'hit' calibration targets

19

19

Cohort coherence of disease rates

(t=calendar year; p=prev; d = deaths; r = remission; i = incidence)

	t	t+1	t+2
55 yrs	p1		
56 yrs		p2 = p1 –d1 + i1 –r1	
57 yrs			p3 = p2 –d2 + i2 –r2

- GBD provides disease prevalence, incidence rates and deaths
- GBD does not provide remission – but you can "work it out" as only unknown
- That all said, things jump around a lot due to not quite being cohort coherent (this may change with DISMOD AT)
- We optimise and smooth historical record
- Then use annual % change in cohorts to forecast future disease-specific incidence, case fatality and remission rates… to achieve a separately forecast disease prevalence and mortality rates (i.e. calibration targets)

20

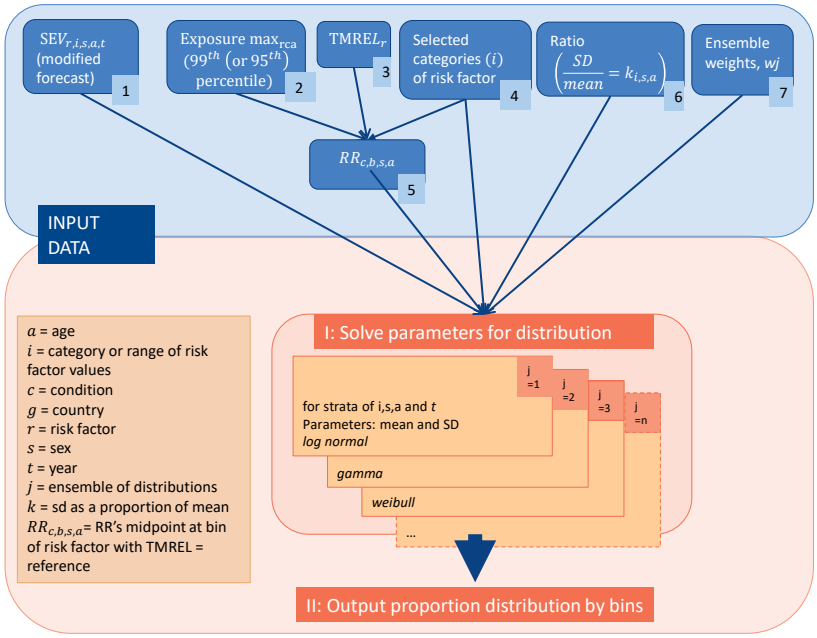
20

Generating risk factor forecasts

- GBD forecasts SEVs – specifically, SEV_r
- SEV_r is just the average of all SEV_{rc}
- Each SEV_{rc} requires the (implied) risk factor distribution, the RRs, the TMREL, the exposure max
- We want to solve the risk factor distribution. For some parametric shape (e.g. log-normal). If we just specify one more variable, the SD/Mean, we can do it….

21

21



22

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SHINE
Scalable Health Intervention Evaluation

Tobacco endgame intervention impacts on health gains and Maori:non-Maori health inequity: a simulation study of the Aotearoa/New Zealand Tobacco Action Plan

Ait Ouakrim D, Wilson T, Waa A, Maddox R, Andrabi H, Mishra SR, Summers JA, Gartner CE, Lovett R, Edwards R, Wilson N, Blakely T.

Tob Control 2023: tc-2022-057655.

https://mspgh.unimelb.edu.au/shine

TOBACCO ENDGAME
NHMRC Centre of Research Excellence

23

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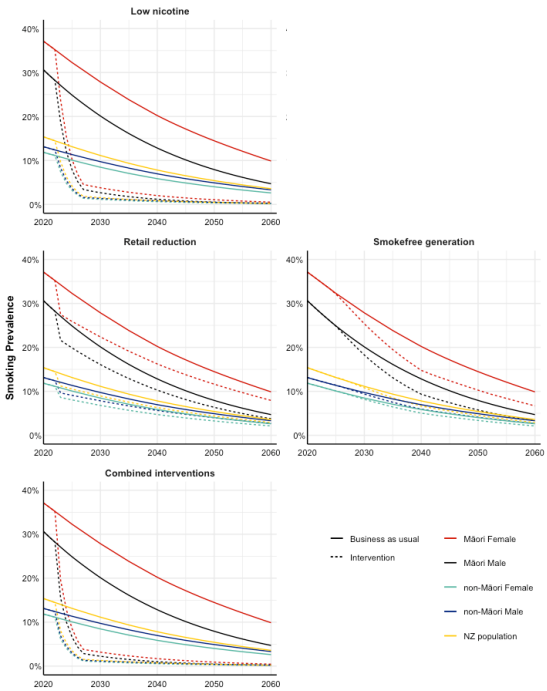
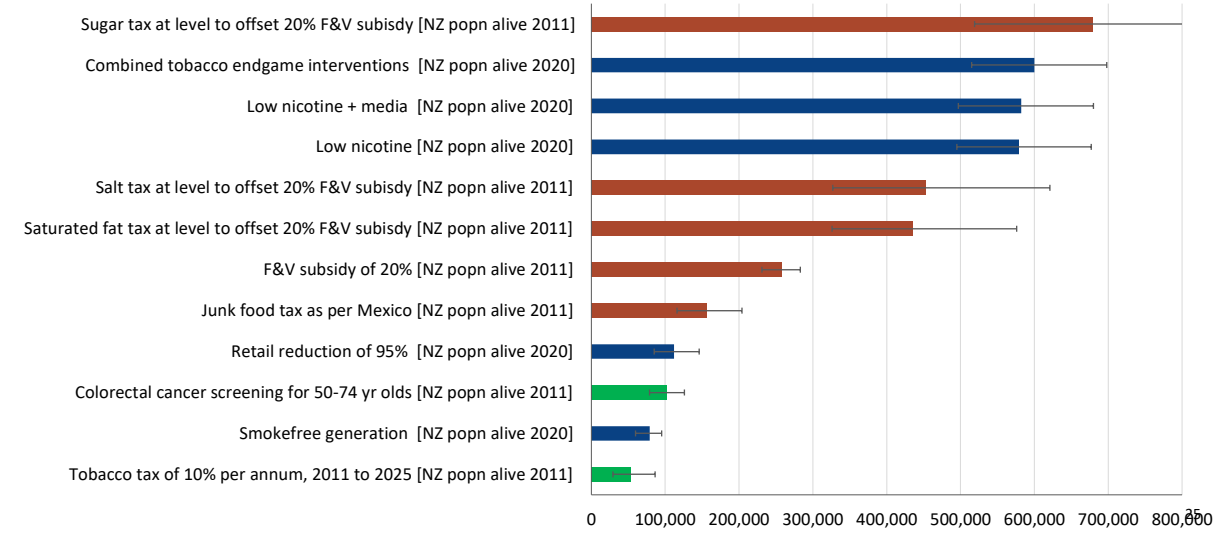
Scalable Health Intervention Evaluation

Smoking prevalence (daily, 20+ year population) in Aotearoa New Zealand: business-as-usual vs. interventions



24

How did NZ tobacco endgame interventions compare with other interventions? (Health adjusted life years, 3% discount rate)

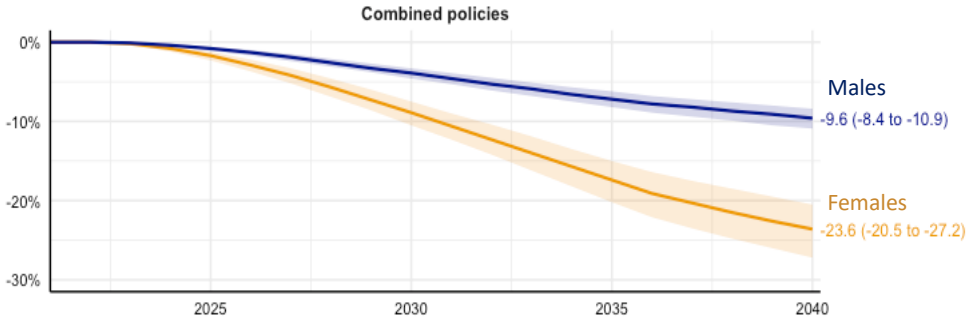


25

25

The all-cause mortality gap (age-standardized rate difference for 45+ yr olds, between Māori and non-Māori) is projected to decrease by over 20% for females and 10% for males (for the combined endgame policy c.f. BAU)

Percentage reduction in mortality rate gap (Māori c.f. non-Māori) for combined endgame polices vs BAU



No other feasible policy in NZ would decrease ethnic inequalities in all-cause mortality by this much.

Currently working on Aboriginal and Torres Strait Islander c.f. non-Indigenous in Australia

26

Health expenditure savings and income gains of NZ tobacco endgame (legislated 2022; repealed 2023)

Health expenditure savings:

- Due to less tobacco-related disease, and even accounting for people living longer and getting other diseases (with costs), the combined endgame package saved the NZ health sector:
  - NZ$1.3 billion between 2021-2040 (3% discount rate; approx. $US850 million)

    Which is equivalent to 6.4% of Vote-Health in 2020

Income gains (as measure of productivity gains):

- Due to less tobacco-related disease, and even accounting for people living longer and getting other diseases, the combined endgame package increased NZ 25-64 yr old total income:
  - NZ$1.4 billion between 2021-2040 (3% discount rate; approx. $US1 billion)

    Which is equivalent to 0.4% of NZ's total GDP in 2020

These estimates were important in the Regulatory Impact Statement, and at Cabinet, for assisting the Action Plan's adoption by Govt (as dispelled the argument that lost tobacco taxes are a major concern)

27

27

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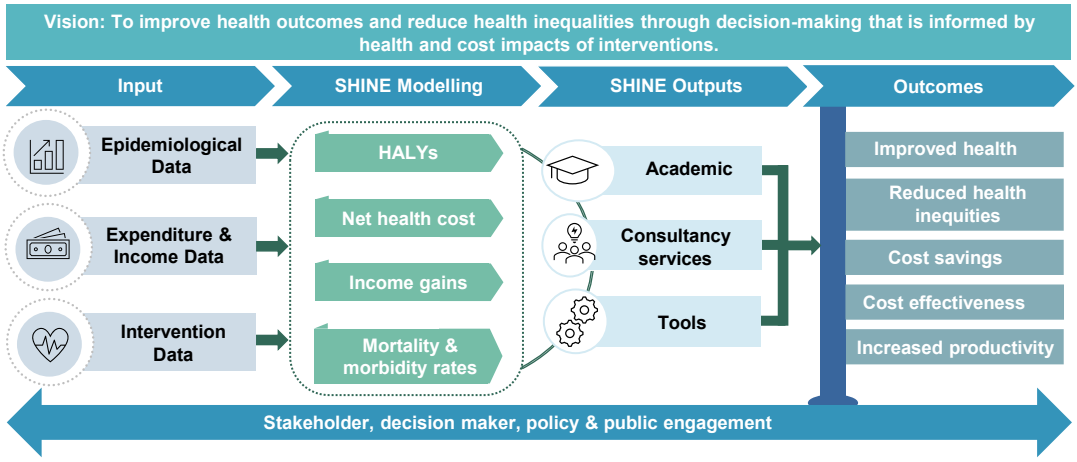
- Example of research project and impact: tobacco endgame in NZ
- **Discussion on how SHINE, SHINE-Consulting and HIIC can be maximally useful for you, research and policy in Australia (and beyond)**

28

28

How does SHINE work?



29

Discussion: How (if) SHINE can be maximally useful for you, research and policy

We would like to open a discussion now, and afterwards if you prefer, on:

- Is SHINE useful to you?
- Is SHINE concentrating on preventive interventions for now 'okay'? Or are you only really interested if SHINE can also model screening and treatment interventions?
- Does HIIC look useful?
  - If not, why not?
  - What else do you want/need from HIIC?
- Would you use SHINE-Consulting?
  - If not, why not?
  - If yes/possibly, what are some requirements that you may have that we should be aware of? (timeliness, confidentiality, etc)
- Any other comments or suggestions?

30

30

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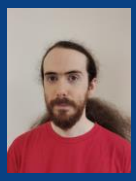
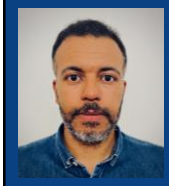


Dr Tim Wilson
Programming, algorithms, modelling

Dr Stephanie Khuu
HIIC tool, programming, modelling



Dr Driss Ait Ouakrim
Academic lead tobacco modelling

Dr Bibha Dhungel
All risk factors other than tobacco, academic lead SHINE-Consulting

Sami Howe
Tobacco modelling (PhD), SHINE Protocol

Emily Kay
Research manager, first point for enquiries

Amit Virdi (MPH): Visualisation tools, including evaluating HIIC
Dr Emily Bourke (PhD, AIHW): Physical activity, disease expenditure
Shania Rossiter (PhD): Pandemic scenario modelling
Dr Daniel Ramsay (PhD): Impact on morbidity and productivity
Wondmagegn Demsiss Sarhie (PhD): Modelling sub-Saharan Africa
Yuxi Li: Housing interventions

31

31

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2

32