THE VALUE OF VACCINATION: CAPTURING THE IMPACT OF VACCINATION ON HEALTH EQUITY IN HEALTH ECONOMIC ANALYSIS

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  - **Mariia Dronova** is an employee of Creativ-Ceutical which received funding from GSK.
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  - **Terry Nolan** was a member and co-chair of the Advisory Board for this study, established by GSK, and was paid an honorarium for his input. He received consulting fees and/or honoraria from AstraZeneca, Merck, Seqirus, Sanofi Pasteur and GSK, as well as personal payment for participation in other advisory boards, not related to this study, from Clover, Zeria and the Serum Institute of India. He is an expert in the Victorian State Government advisory group on COVID vaccine roll-out, outside of this submitted work. His institution received grants from GSK, Sanofi Pasteur, Janssen, Seqirus and the Serum Institute of India outside of this work.
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HEALTH EQUITY IS INCREASINGLY CONSIDERED IN VACCINE DECISION MAKING

The COVID-19 pandemic highlighted dramatic health inequities and the pressing need for **equity considerations** in vaccine health policy

Equity considerations in (non-pandemic) vaccine decision making:

Equity considerations are included in the deliberative process or mentioned in guidelines as potentially relevant in 6 of 7 high-income countries analysed[1]

FR GB DE AU ES US

In the US, the Advisory Committee on Immunization Practices (ACIP) has **formally incorporated an Equity category** in their Evidence to Recommendation (EtR) framework[2]

In Canada, the National Advisory Committee on Immunization (NACI) considers EEFA (Ethics, **Equity**, Feasibility, Acceptability) in their vaccine decision making[3]

In the UK, sex-related **equity considerations were included in decision making** on extending HPV vaccination coverage to boys[4]

Postma 2022[1]; ACIP EtR[2]; Ismail 2020[3]; UK Equity analysis[4]; HPV: human papillomavirus

WHAT IS HEALTH EQUITY?

- Achieving health equity requires health policies that prioritise disadvantaged groups

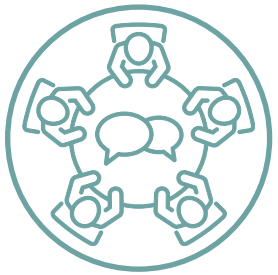
- Equity: the **absence of unfair, avoidable or remediable differences** among groups of people[1]
- Health inequalities: **unfair differences in health** between more and less socially disadvantaged groups
- Health inequalities may exist due to differences in the following **equity strata**:
  - Socioeconomic status
  - Demographics
  - Geographic location
  - Ethnicity
  - Disability
  - Other dimensions (e.g. sex, gender or sexual orientation)
- Health equity is achieved when **everyone can attain their full potential** for health and well-being[1]

[1]WHO 2013

National Immunisation Programs, as part of universal healthcare coverage, can contribute to better health equity

OVERALL APPROACH & METHODS

- Equity is a key vaccination benefit to be included in vaccine HTA/CEA



A group of experts convened to discuss the Value of Vaccination (VoV) for decision making[1,2]

- 3 key VoV concepts, including equity, were considered priorities for inclusion in HTA/CEA in the near future.

- Key policy, method and measure considerations for implementing health equity were discussed
  - Equity strata: most applicable strata and use of indices for population subgroups
  - Distributional CEA (DCEA)[3] considered viable method to incorporate health equity transparently in vaccine CEA

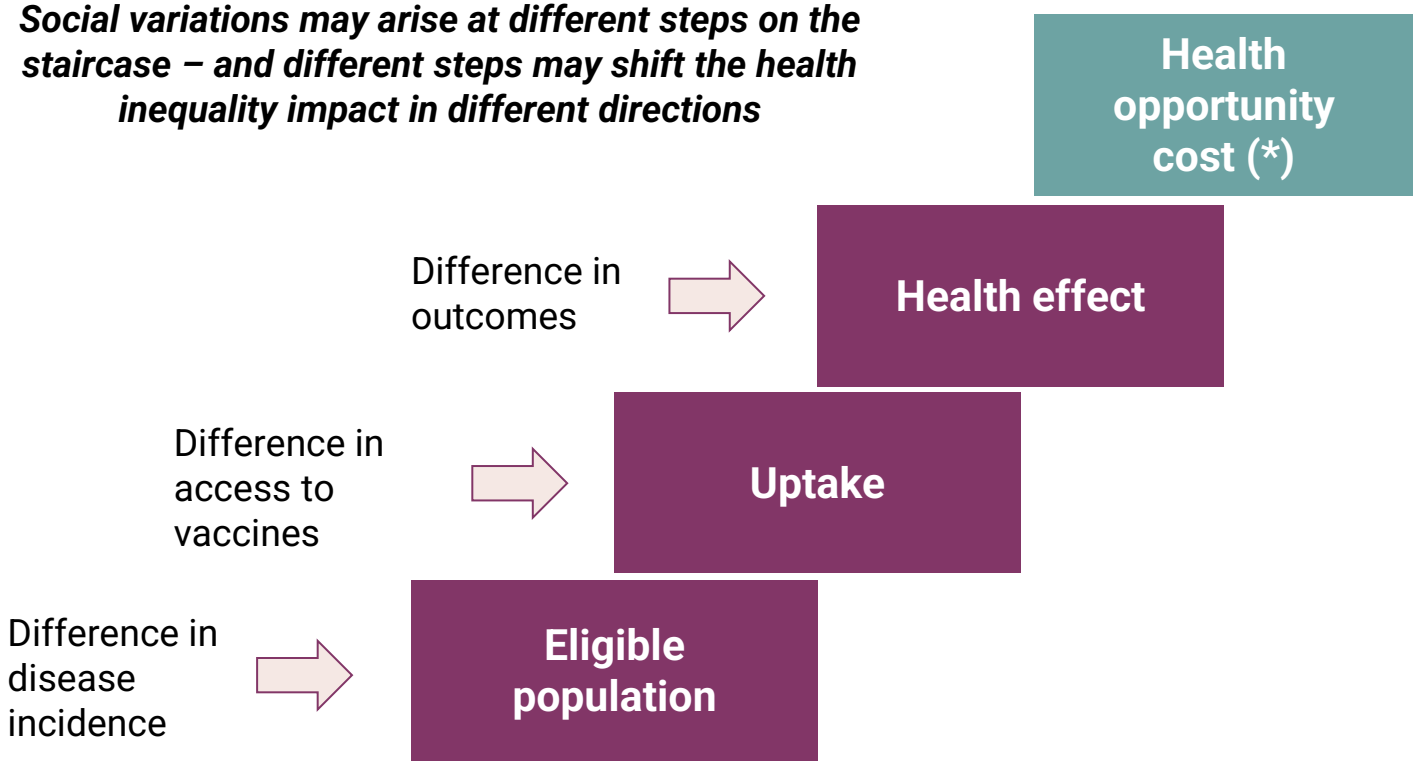
Beck 2022[1]; Postma 2022[2]; Cookson 2020

CONCEPTUAL APPROACH TO CAPTURING HEALTH EQUITY IN HTA/CEA

The staircase of health inequality impact guiding the health economics modelling approach

- Health inequities can be identified by disaggregating health indicators using equity stratifiers (e.g., socioeconomic status, ethnicity and geographic location)
- Disadvantaged groups may experience differences in:
  - Infectious disease incidence rates
  - Vaccine access/uptake rates
  - Health outcomes
- Promoting equity over efficiency has a health opportunity cost
  - E.g., more resources dedicated to disadvantaged groups

Social variations may arise at different steps on the staircase – and different steps may shift the health inequality impact in different directions



(*) Health loss due to intervention costs: scarce resources would otherwise be used to improve health in other ways. Health opportunity cost assumed to be equally distributed across individuals in population.

Figure adapted based on original figure developed by Richard Cookson and James Love-Koh (Centre for Health Economics, University of York)

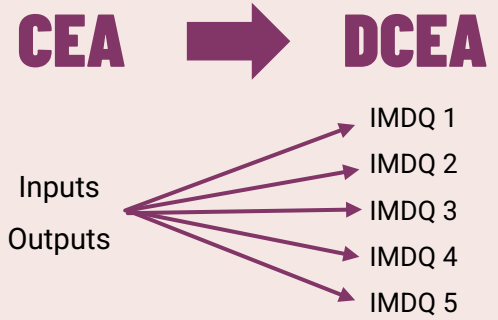
INCLUDING EQUITY IN CEA – AN ILLUSTRATIVE CASE STUDY

Experts agreed on a stepwise DCEA to assess vaccination impact on health equity

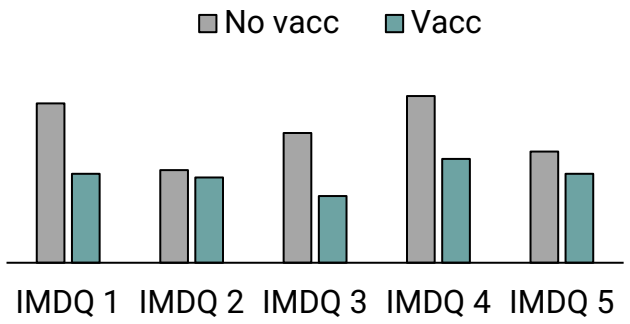
Objective: evaluate the potential impact of 4CMenB infant vaccination on health equity in England (retrospective analysis)

Existing CEA model[1] adapted for DCEA

- Stratify population into 5 socioeconomic subgroups using IMDQ
- Key equity-stratified inputs: carriage prevalence, incidence, vaccination coverage, utility, life expectancy, and productivity loss

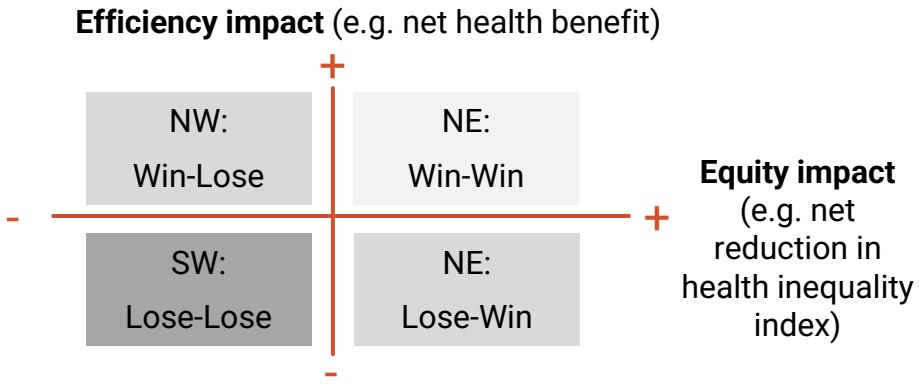


1. DISTRIBUTIONAL IMPACT



Distribution of outcomes by equity strata (IMDQ subgroups)

2. EQUITY IMPACT PLANE



Trade-off between net health benefit (efficiency) and net equity benefit of vaccination

3. DCEA

DCEA considers **fairness** in distribution of costs and effects, and efficiency/equity **trade-offs**[2,3]

Equity accounted for with QALY weighting using inequality aversion parameters

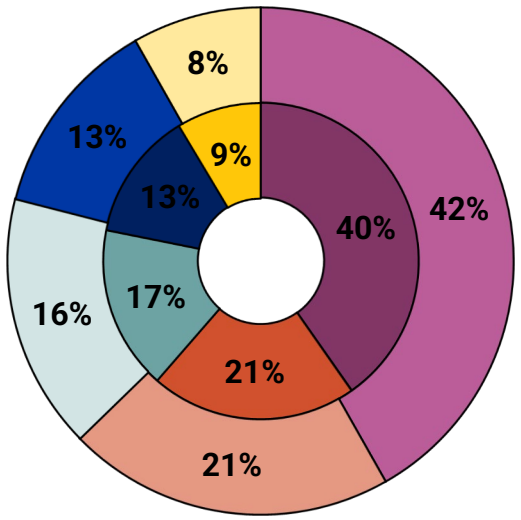
Beck 2021[1]; Cookson 2020[2]; Cookson 2017[3]; D/CEA: Distributional cost-effectiveness analysis; IMDQ: Index of Multiple Deprivation Quintiles; QALY: quality-adjusted life-year

RESULTS – STEP 1: DISTRIBUTION OF HEALTH OUTCOMES BY IMDQ

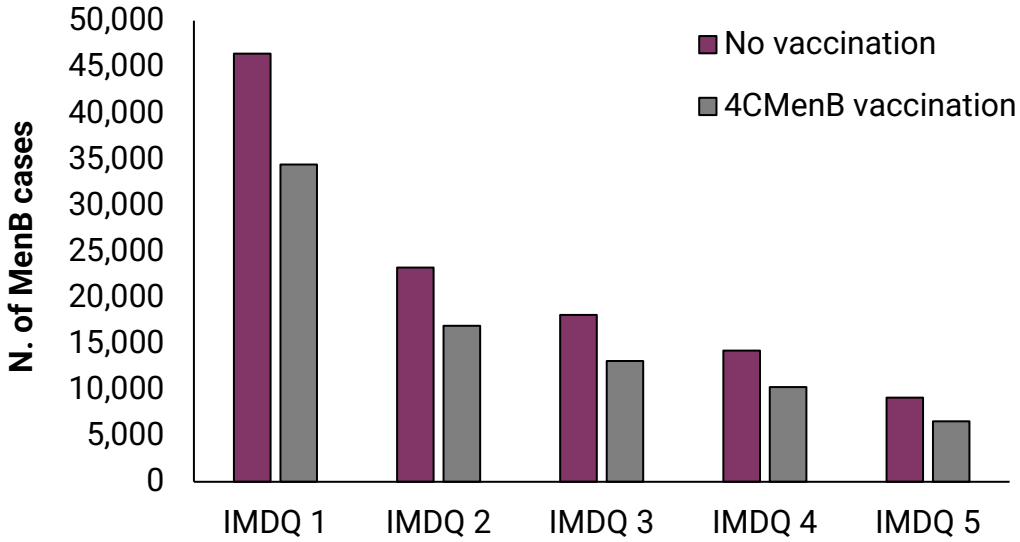
40% of cases prevented were in the most deprived IMDQ (26% of the target population aged <5y) and 78% in the 3 most deprived IMDQs

4CMenB infant vaccination disproportionately prevented MenB cases, sequelae and deaths among more deprived groups

Outer: distribution of MenB cases by IMDQ
Inner: MenB cases prevented by IMDQ



Number of MenB cases by IMDQ



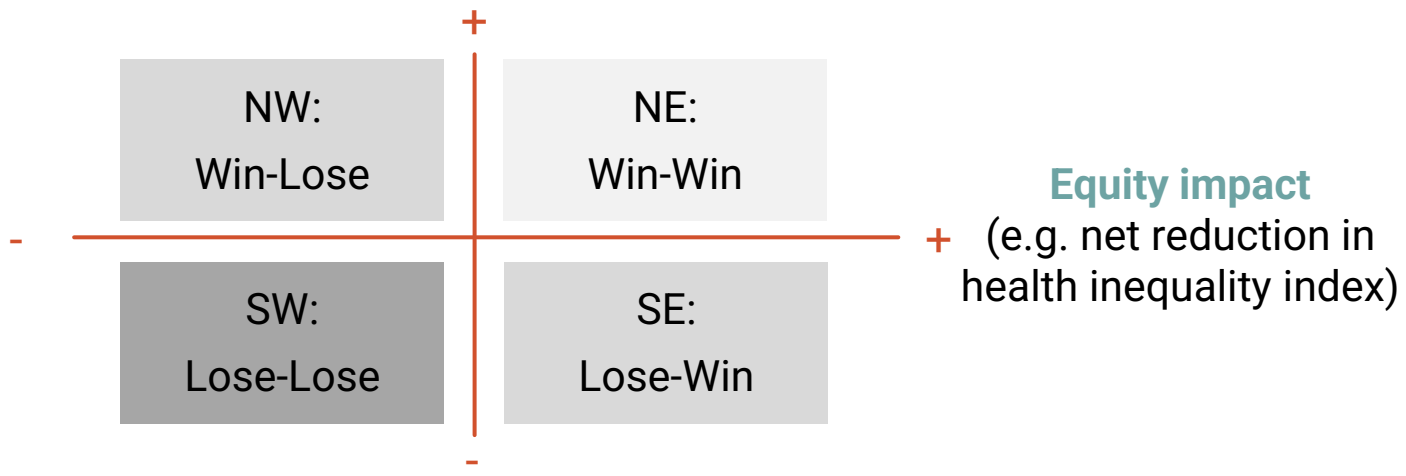
Same trends observed for other outcomes by IMDQ (e.g., for total QALY, QALY loss, incidence rate, the number of long-term sequelae, and the number of deaths related to invasive meningococcal disease)

IMDQ: Index of Multiple Deprivation Quintiles; MenB: meningococcal B; QALY: quality-adjusted life-year

RESULTS - STEP 2: EQUITY-EFFICIENCY IMPACT PLANE (1)

Methodological considerations

- The inequality aversion parameter is computed with total QALYs, not QALY losses
- While CEA considers average health benefits for the total population, DCEA uses the equally-distributed equivalent level of health (EDEH) taking into account **inequality aversion parameters (e.g., 10.95 [Atkinson] and 0.15 [Kolm-Pollak])**
- **EDEH were computed using two social welfare functions (SWF):**
  - Atkinson SWF: reflects relative inequality (scale-invariant) in health benefit,
  - Kolm-Pollak SWF: reflects absolute inequality (translation invariant) in health benefit



NET HEALTH BENEFIT

Health opportunity cost with vaccination, at a threshold of £20,000/QALY gained

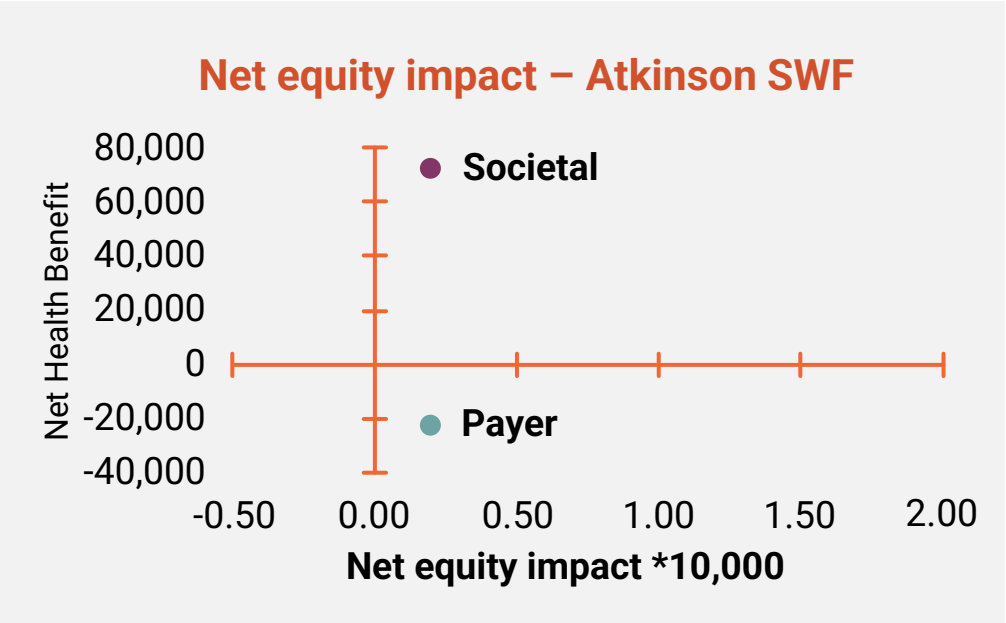
NET EQUITY BENEFIT

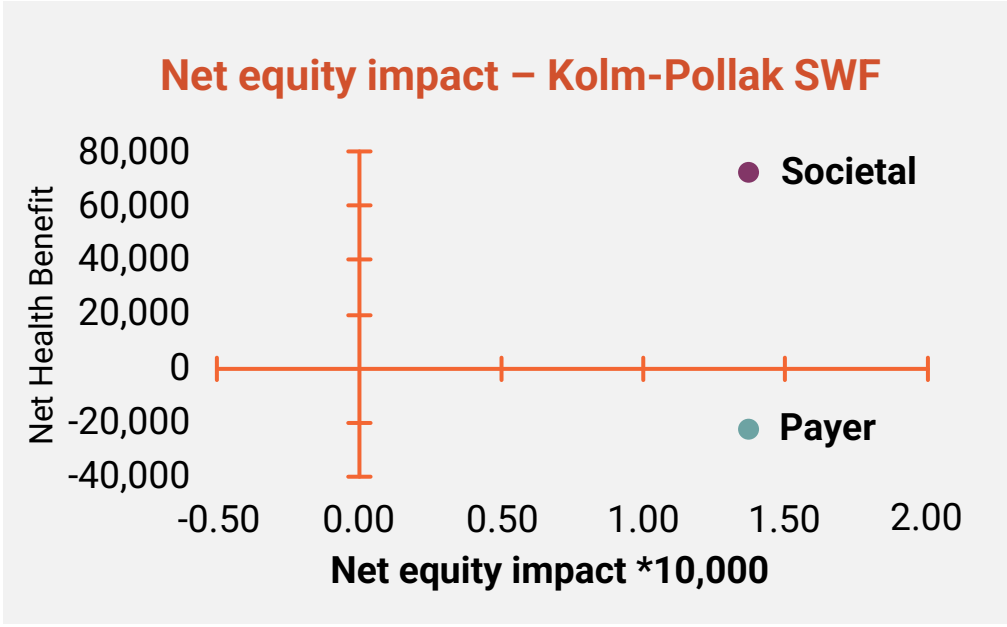
Index of inequality with no vaccination vs. with vaccination

DCEA: Distributional cost-effectiveness analysis; QALY: quality-adjusted life-year; SWF: Social welfare function

RESULTS - STEP 2: EQUITY-EFFICIENCY IMPACT PLANE (2)

Vaccination had a positive net equity benefit, and was located in the 'win-win' quadrant from the societal perspective (reflecting both efficiency and equity benefits)





Note: the values obtained for net equity impact based on different SWF approaches are not directly comparable

The net equity benefit was robust to changes in distribution of uptake, MenB carriage prevalence, life expectancy and utility stratified by IMDQ, as confirmed by scenario analysis

IMDQ: Index of Multiple Deprivation Quintiles; SWF: Social welfare function

*Note: Analysis based on original model with QALY adjustment for disease severity (QALY weight *3)*

RESULTS - STEP 3: DCEA

- Analysis of equity impact: weighted QALYs to account for equity in the full DCEA

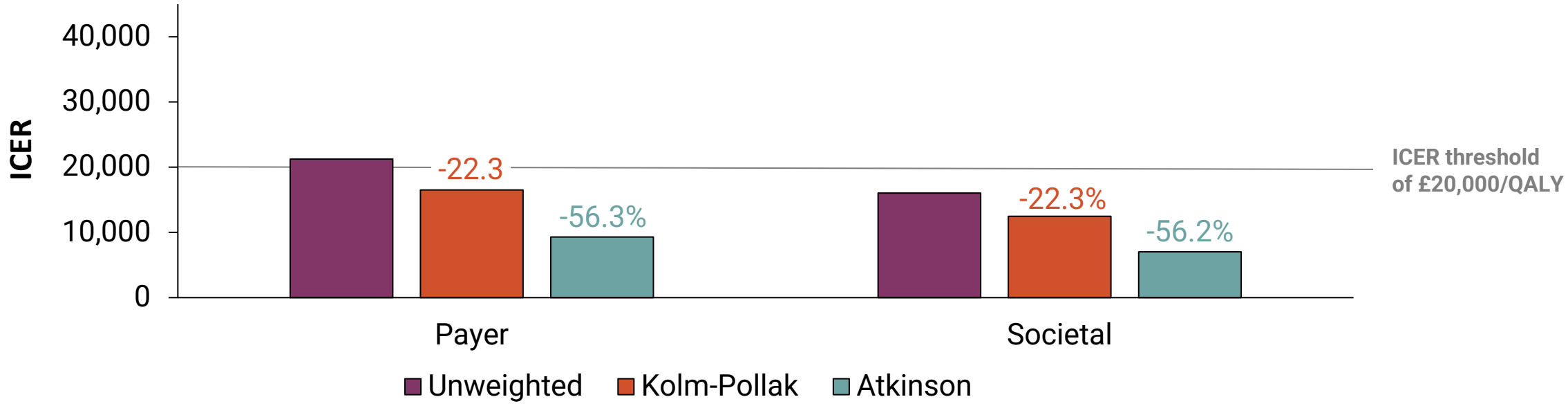
LEVEL-DEPENDENT EQUITY WEIGHTING FOR QALYS (INDIRECT WEIGHTING):

- According to the social welfare function using Atkinson's or Kolm-Pollak's inequality aversion parameters
- Equity weights for health outcomes reflect health inequality vs. IMDQ 5 (least disadvantaged group) and society's aversion to inequality
- The estimated weights for health outcomes were used to compute the equity-weighted QALYs and respective ICER
- For countries that use an ICER threshold, there is also the possibility to weight the threshold (direct weighting) e.g., as has been done for end of life treatments

RESULTS – STEP 3: DCEA WITH WEIGHTED QALYs

- 4CMenB vaccination is more cost-effective when including the equity benefits of vaccination in DCEA

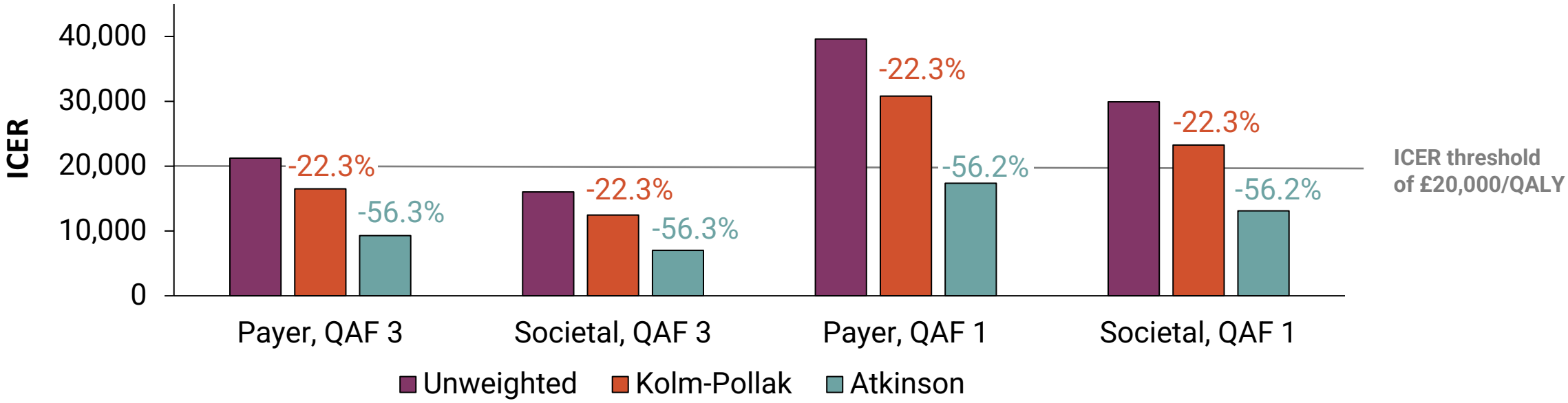
Equity-weighted QALYs resulted in **lower ICERs** from both payer and societal perspectives



Note: Analysis based on original model with QALY adjustment for disease severity (QALY weight *3)

RESULTS – STEP 3: DCEA WITH WEIGHTED QALYs

The original model included a QALY weight to account for disease severity (QAF 3). In the QAF 1 analysis, this severity weight is removed, showing just the impact of equity weights on the ICER



Deterministic (DSA) and probabilistic sensitivity analysis (PSA) showed positive net equity benefit across majority of simulations, with weighted ICERs not exceeding the threshold

DCEA: Distributional cost-effectiveness analysis; ICER: incremental cost-effectiveness ratio; QAF: quality of life adjustment factor; QALY: quality-adjusted life-year;
Note: Decision makers in England applied a QALY weight x3 to account for society's preferences to prioritise prevention of this very severe disease. QAF 1 represents removing this additional QALY weighting for severity

CONCLUSIONS AND NEXT STEPS

Health equity improvements following universal 4CMenB vaccination can and should be captured in health economic evaluation

- The 4CMenB infant national immunisation program **improves health equity**, by preventing disproportionately more cases in the most disadvantaged groups
  - Including equity weights in DCEA reduced the ICER by 22-56%
- DCEA is an important tool to demonstrate **health equity impact of vaccination**, allowing equity to be formally included in **health economic evaluation**
  - Definition and alignment of health equity strata for DCEA is a key element of an analysis
  - Dedicated evidence generation studies are needed to inform the equity-stratified model
  - Health equity considerations should be incorporated in early stages of CEA modelling
  - Further development of criteria for interpretation of equity measures could also facilitate implementation of the DCEA framework into the formal decision-making process

- **Vaccination is a building block of universal health coverage**, with a significant impact on improving health equity
- Retrospective analysis demonstrated **health equity in vaccine HTA/CEA is doable and can aid decision making - to be considered in future analyses!**

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CONTACT INFORMATION

THANK YOU!

FOR FURTHER QUESTIONS, PLEASE CONTACT

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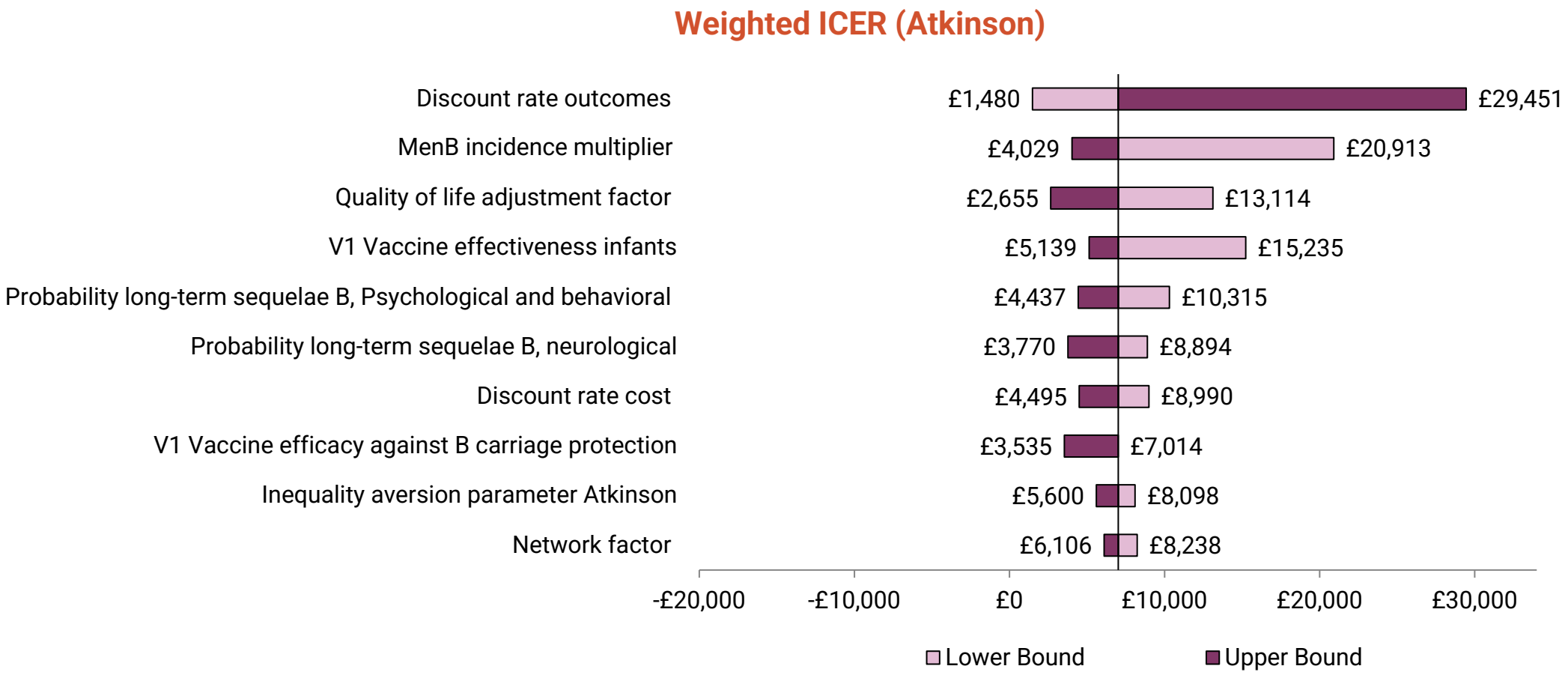
APPENDIX: DETERMINISTIC SENSITIVITY ANALYSIS

Deterministic sensitivity analysis (DSA) showed that the main drivers of the model results were discount rates, MenB incidence in total population and QAF

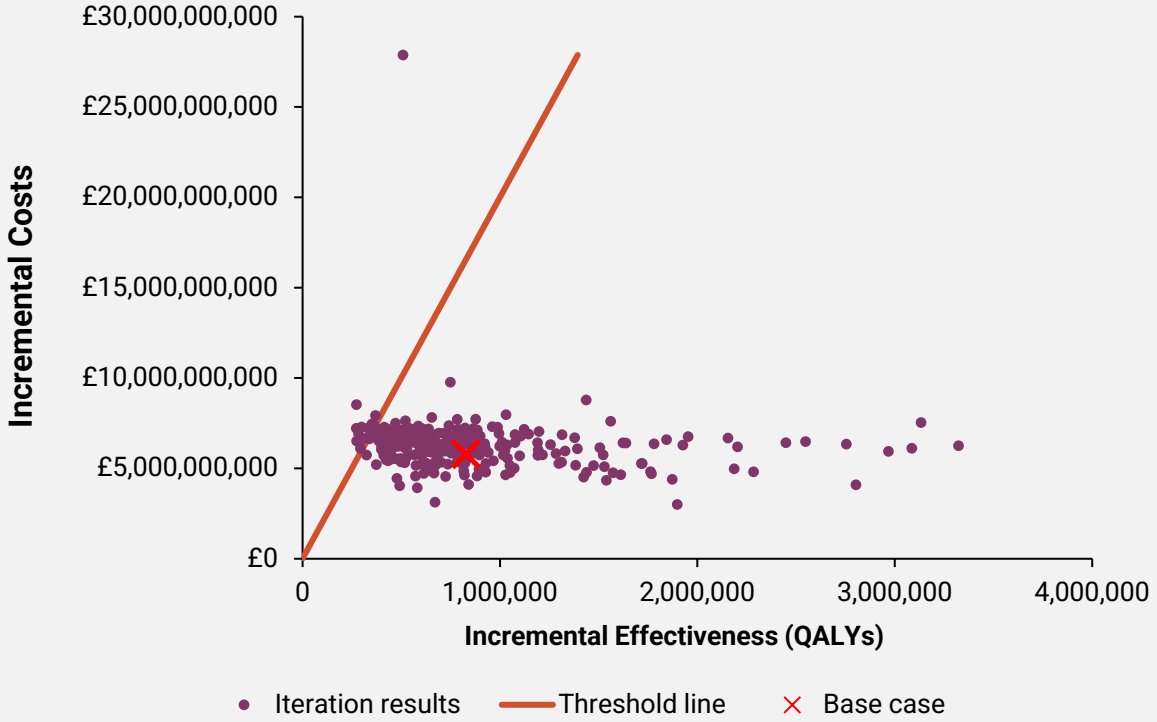


Note: Analysis based on original model with QALY adjustment for disease severity (QALY weight *3)

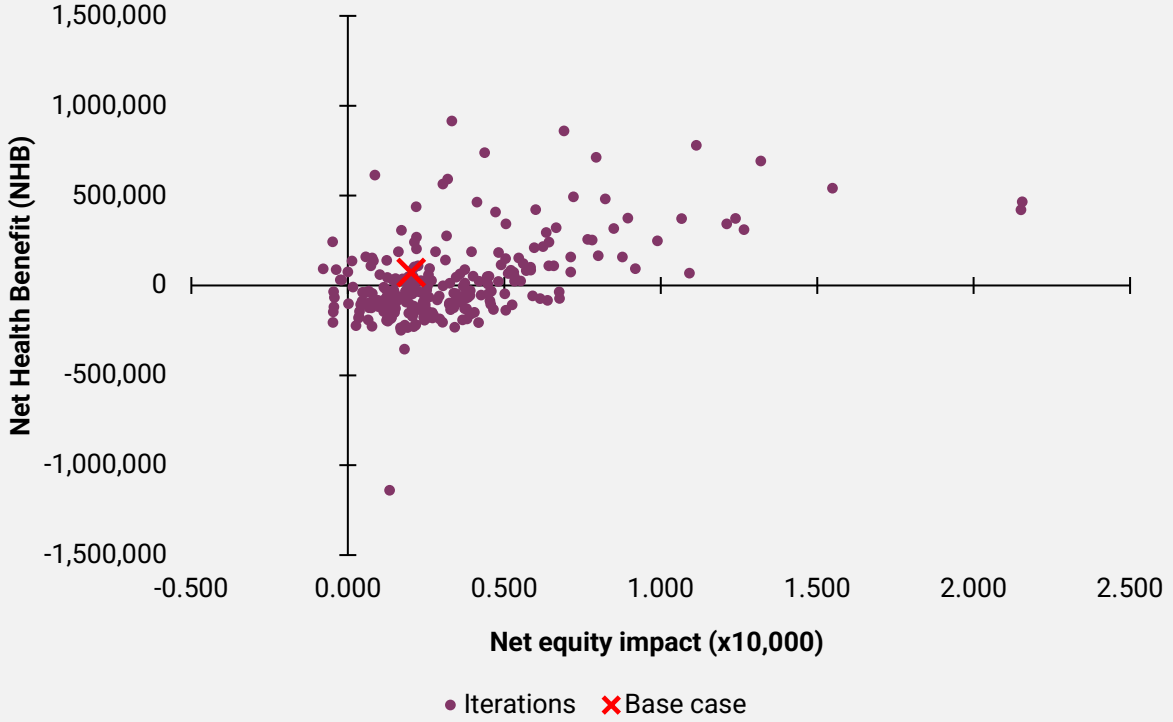
APPENDIX: PROBABILISTIC SENSITIVITY ANALYSIS

Probabilistic sensitivity analysis (PSA) showed 4CMenB vaccination having positive net equity benefit and being cost-effective across majority of simulations (n=250).

Incremental Costs vs. Incremental Effectiveness (weighted) - Atkinson



Equity efficiency impact plane - Atkinson index



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