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EE454

A Distributional Cost-Effectiveness Analysis of Screening Strategies for Ovarian Cancer

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OBJECTIVES

Ovarian cancer (OC) is the sixth most common cause of cancer death in women in the UK.[1]

A published cost-effectiveness analysis evaluated the cost-effectiveness of two OC screening strategies: multimodal screening (MMS) and ultrasound screening (USS) compared with no screening, using data from The United Kingdom Collaborative Trial of Ovarian Cancer Screening.[2,3]

Promoting equality and reducing health inequalities between population subgroups are key goals for the National Health Service (NHS) in England[4] and Public Health England.[5]

However, this prior cost-effectiveness analysis does not provide decision makers with information about the impact of the screening strategies on health inequality.[6]

Therefore, this work aimed to:

1. Investigate the distributional consequences of MMS and USS on the English population using a distributional cost-effectiveness analysis (DCEA)
2. Provide information on the potential impact of OC cancer screening on health inequalities in England

METHODS

The original cost-effectiveness analysis used a cohort-level Markov model from an NHS and Personal Social Services perspective. The time horizon was 40 years (lifetime) with an annual cycle length. The model comprised six health states, presented in Figure 1.

Model adaptation

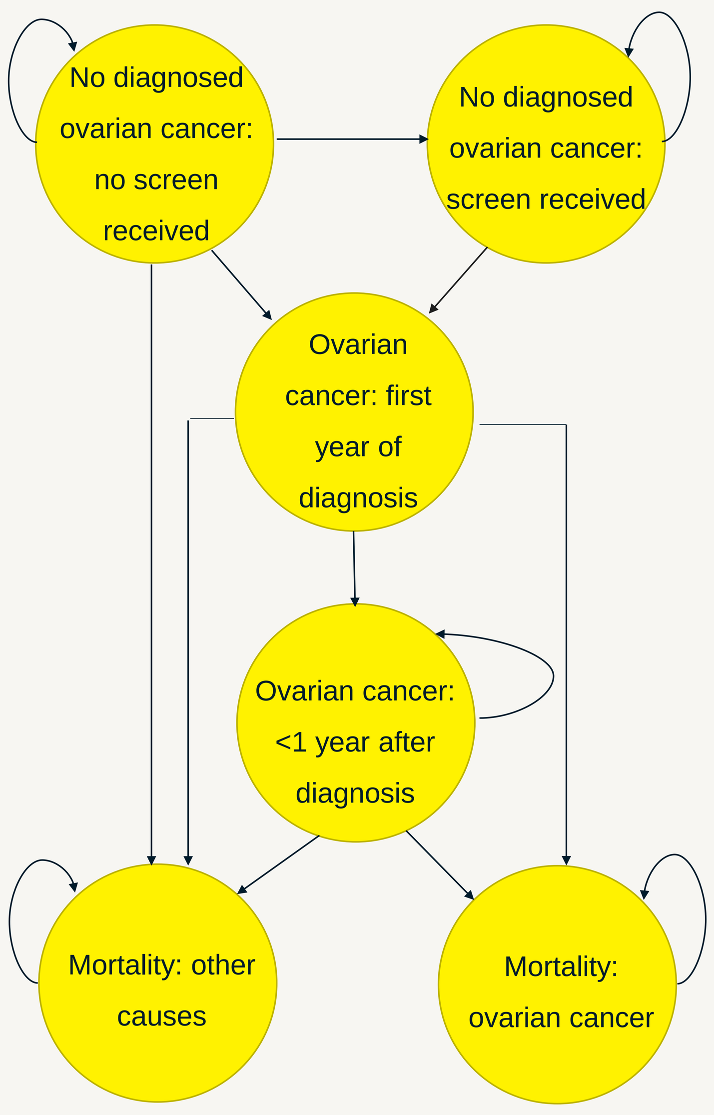
The model was extended to describe inequality across five population subgroups (quintiles) defined by the Index of Multiple Deprivation (IMD). IMD is an official measure of relative deprivation in England and is commonly used to indicate socioeconomic status (SES).

The following inputs were varied by IMD quintile: (i) OC screening uptake and compliance; (ii) stage of OC at diagnosis; (iii) health state utilities; (iv) mortality.

Modelling health inequality impacts

- Baseline health distribution: Simulated using the quality-adjusted life expectancy (QALE) estimates for people in England stratified by IMD quintile by Love-Koh et al[7]
- Direct health benefits: Costs and QALYs were estimated for each strategy for each subgroup. Population-level estimates were derived by multiplying the subgroup estimates by the number of women per IMD quintile assumed to participate in screening in England
- Health opportunity cost: The population-level incremental cost of each strategy versus 'no screening' was divided by the estimated cost-per-foregone QALY (£12,936/QALY)[8] to quantify the total number of QALYs expected to be displaced by each strategy. The displaced QALYs were apportioned across IMD quintiles using the distribution estimated by Love-Koh et al[9]

Figure 1: Cost-effectiveness model schematic



Note: Adapted from: Kearns et al.[2]

- All other model inputs were assumed to be equally distributed by socioeconomic subgroup given the paucity of evidence in the literature search. This is a limitation of this analysis

Table 1: Model inputs varied by IMD quintile*

Input	IMD Q1	IMD Q2	IMD Q3	IMD Q4	IMD Q5
No OC utility	0.850	0.885	0.899	0.922	0.943
HR applied to cancer mortality	1.44	1.23	1.00	1.04	0.89
Screening uptake	9%	13%	19%	20%	25%
Probability of diagnosis:					
Stage 1					
MMS	16%	21%	24%	26%	28%
USS and 'No screening'	10%	13%	14%	16%	17%
Stage 2					
MMS	9%	11%	12%	12%	13%
USS and 'No screening'	6%	8%	9%	9%	10%
Stage 3					
MMS	52%	52%	52%	52%	52%
USS and 'No screening'	58%	59%	28%	58%	58%
Stage 4					
MMS	16%	13%	11%	10%	10%
USS and 'No screening'	26%	21%	19%	17%	16%

Key: HR, hazard ratio; IMD, Index of Multiple Deprivation; MMS, multimodal screening; OC, ovarian cancer; Q1, Quintile 1; USS, ultrasound screening.
Notes: *Q1, most deprived – Q5, least deprived.

Health inequality impact measures

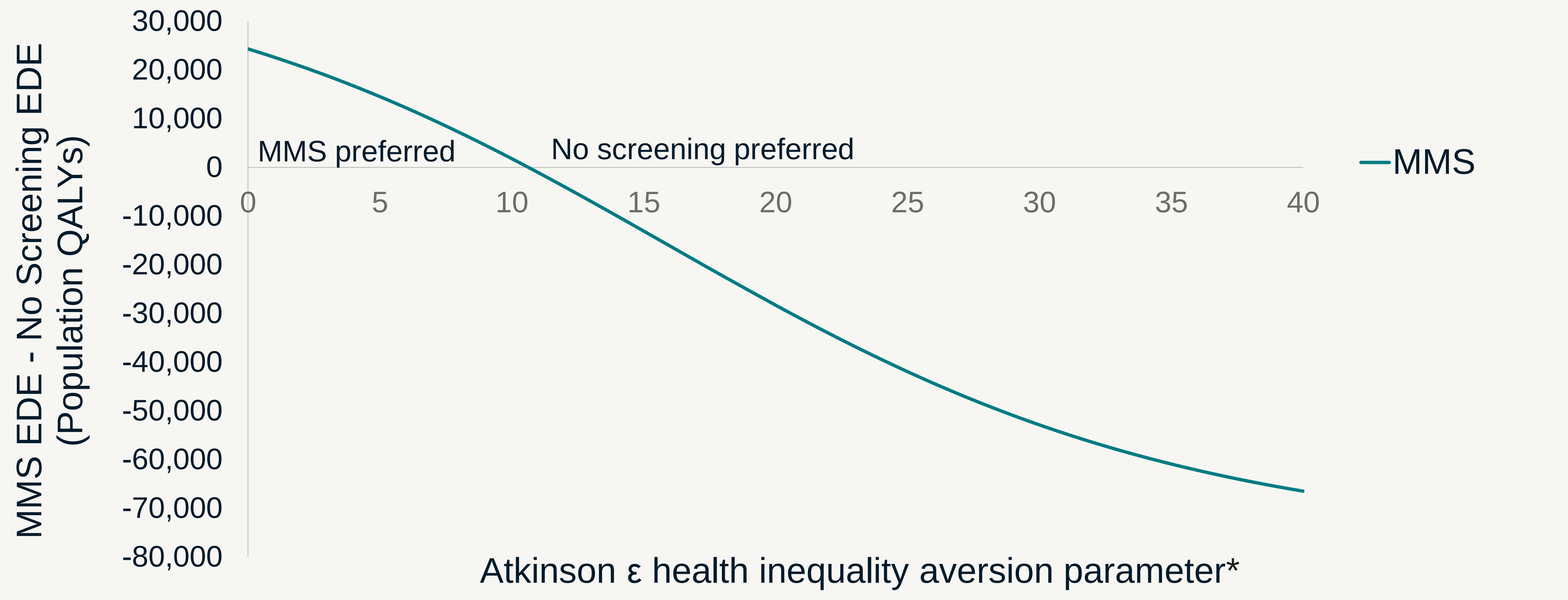
The net health benefit (NHB), estimated as: QALY gain - health opportunity cost, was added to the baseline QALE for each subgroup to yield the post-intervention distribution of QALE across each IMD quintile. This was compared with the baseline distribution to evaluate how each screening strategy impacted total health and health inequality.

- Inequality in the resulting health distribution was measured using the slope index of inequality (SII)
- Social welfare analysis was conducted using the Atkinson social welfare index. This analysed the trade-offs between the post-intervention population-level QALE and health inequality over different levels of relative inequality aversion
- Sensitivity to the cost of foregone QALYs and the extent of inequality aversion were assessed
- The impact on the results of excluding socioeconomic variation in different parameters was explored in scenario analyses

RESULTS

- MMS has a positive incremental population NHB compared with 'no screening' (24,332 QALYs). USS has a negative incremental population NHB compared with 'no screening' (-58,792 QALYs)
- MMS improves population NHB compared with 'no screening' but reduces health equity. USS reduces both population NHB and health equity and is dominated by MMS
- MMS produces higher social welfare than 'no screening' for Atkinson inequality aversion parameters below 11. Above this threshold, 'no screening' was preferred (Figure 2)

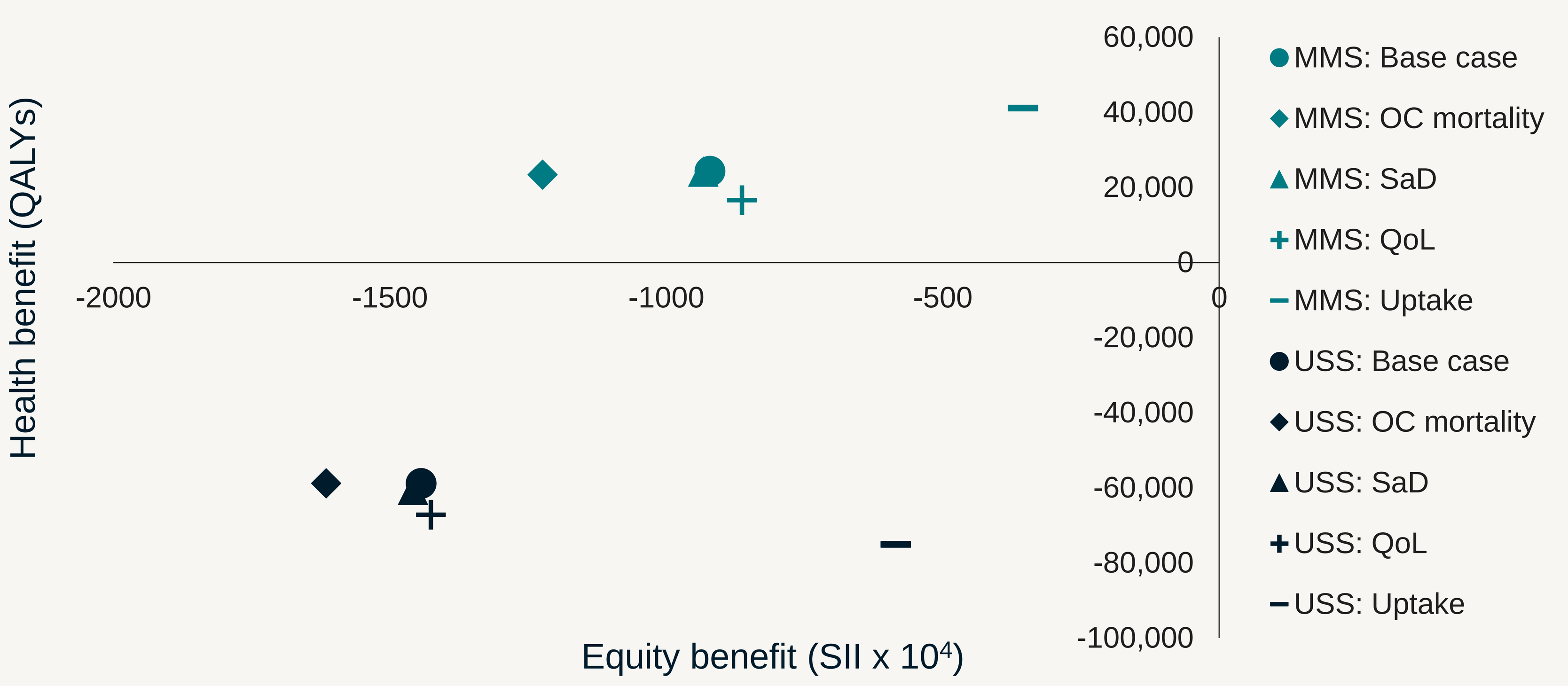
Figure 2: Population-level difference in EDEH between MMS and 'no screening' at different levels of inequality aversion, measured in QALYs



Key: EDE, equally distributed equivalent; EDEH, equally distributed equivalent health; MMS, multimodal screening; QALY, quality-adjusted life year.
Note: *Higher levels denote higher aversion.

- Sensitivity analysis showed that an increase in cost-per-forgone QALY reduced the negative equity impact that results from both the MMS and USS screening strategies compared with 'no screening'. USS achieves a positive population incremental NHB compared with 'no screening' at a cost-per-foregone-QALY of £85,000
- Scenario analysis showed that applying an uptake rate of 25% to all IMD quintiles reduced the negative equity impact of screening most substantially of all the varied parameters (Figure 3)

Figure 3: Equity-impact scenario analysis



Key: MMS, multimodal screening; OC, ovarian cancer; QALY, quality-adjusted life year; QoL, quality of life; SaD, stage at diagnosis; SII; slope index of inequality; USS, ultrasound screening.
Note: Equity-efficiency impact plane of MMS and USS compared with 'no screening' when accounting for all socioeconomic variation in all available model parameters (base case), excluding variation in OC mortality (OC mortality), excluding variation in probability of SaD, excluding variation in other-cause mortality (Other mortality), excluding variation in 'no OC' QoL (QoL), and increasing uptake of screening equal to uptake in IMD Q5 (Uptake).

CONCLUSIONS

- Both screening strategies are predicted to increase health inequalities across the population compared with 'no screening'
- The preferred strategy depended on the degree of aversion to inequality
- Greater uptake of screening in the more deprived socioeconomic groups could potentially reduce the negative impact of screening on health inequality
- Capturing health inequalities in economic evaluations and providing information of the distributional consequences of interventions can impact conclusions of cost-effectiveness

Acknowledgements

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