

What is the Role of Humans in a World of Artificial Intelligence: An Exploratory Economic Evaluation of Human-AI Collaboration in Diabetic Retinopathy Screening

Authors and affiliations

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① Background

- AI is increasingly used in medicine, but human-AI collaboration in decision-making remains underexplored.
- This study evaluates human-AI collaboration strategies for diabetic retinopathy (DR) screening.
- The goal is to identify the most cost-effective strategy for clinical practice.

② Objectives

- To evaluate and compare the cost-effectiveness of different human-AI collaboration strategies for diabetic retinopathy screening in China, and to identify the most economically efficient approach for clinical implementation.

③ Methodology

- A hybrid human-AI decision tree/Markov model simulated DR screening and disease progression in China.
- The model used a hypothetical cohort of 100,000 individuals aged 18–79, followed up over their lifetime.
- Nine screening strategies (manual + 8 human-AI combinations) were compared.
- Each strategy was tested across five age groups and six screening intervals, creating 270 scenarios.
- Outcomes were measured using incremental cost-effectiveness ratio (ICER), QALYs, and cost per blindness year averted.
- Willingness-to-pay thresholds were US\$12,684 and US\$38,052 (1x and 3x GDP per capita in 2023).
- Sensitivity analyses were conducted to assess robustness.

⑤ Conclusion

- 'Copilot human-AI' screening is the most cost-effective DR screening strategy in China.
- Human participation remains crucial and economically justified, even in advanced AI settings.

④ Results

- The most cost-effective strategy was annual 'Copilot human-AI (AI·M+M2)' screening for ages 20–79, involving independent AI and human grading, with disagreements resolved by a second human grader.
- This strategy cost US\$0.9 million, prevented 426 blindness years, and gained 146 QALYs (ICER = US\$6,194/QALY; US\$2,116 per blindness year averted).
- Health benefits of this strategy were valued at US\$4.64 million per 100,000 people.
- Only if human experts reach a sensitivity of 97.9%, the 'Expert sensitive review (AI+M2[Se])' strategy would become more cost-effective.

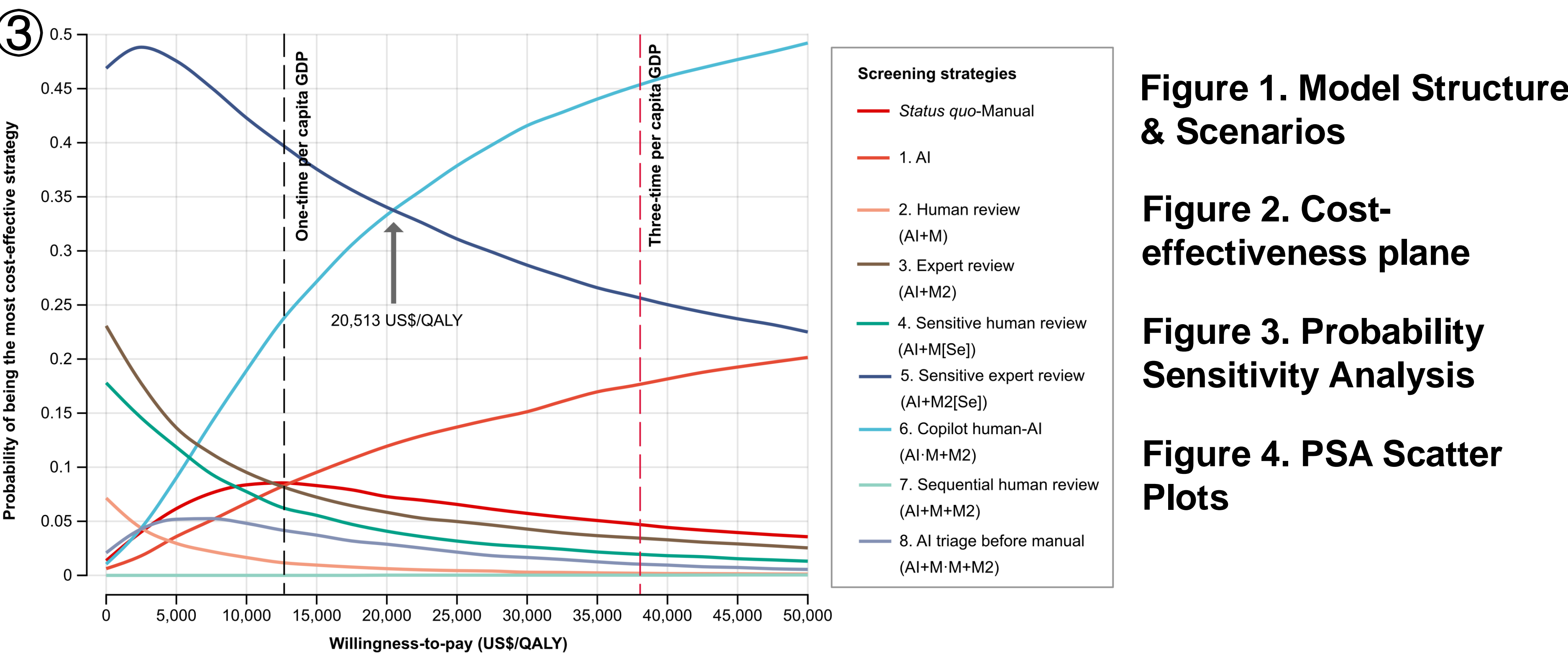
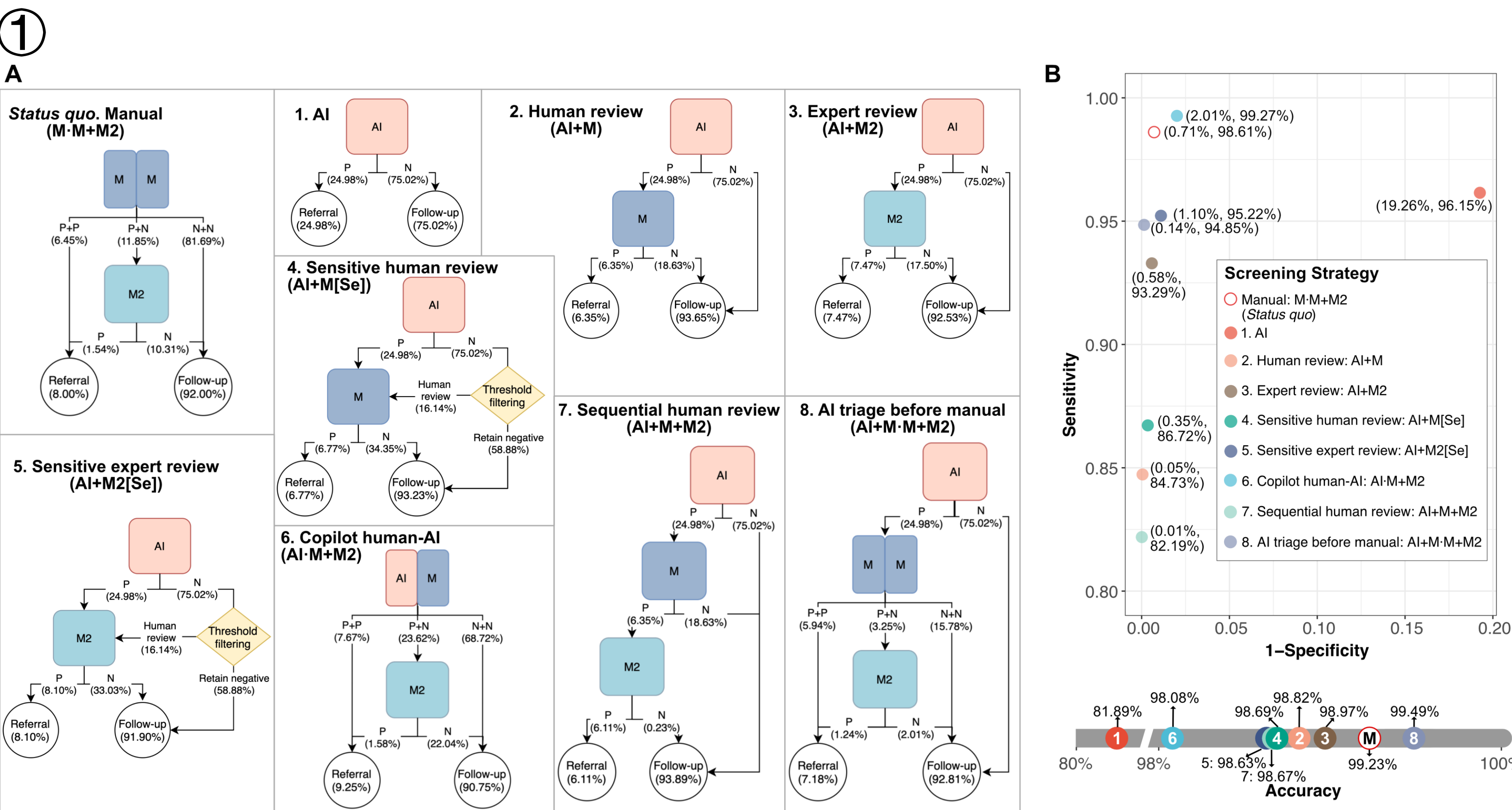
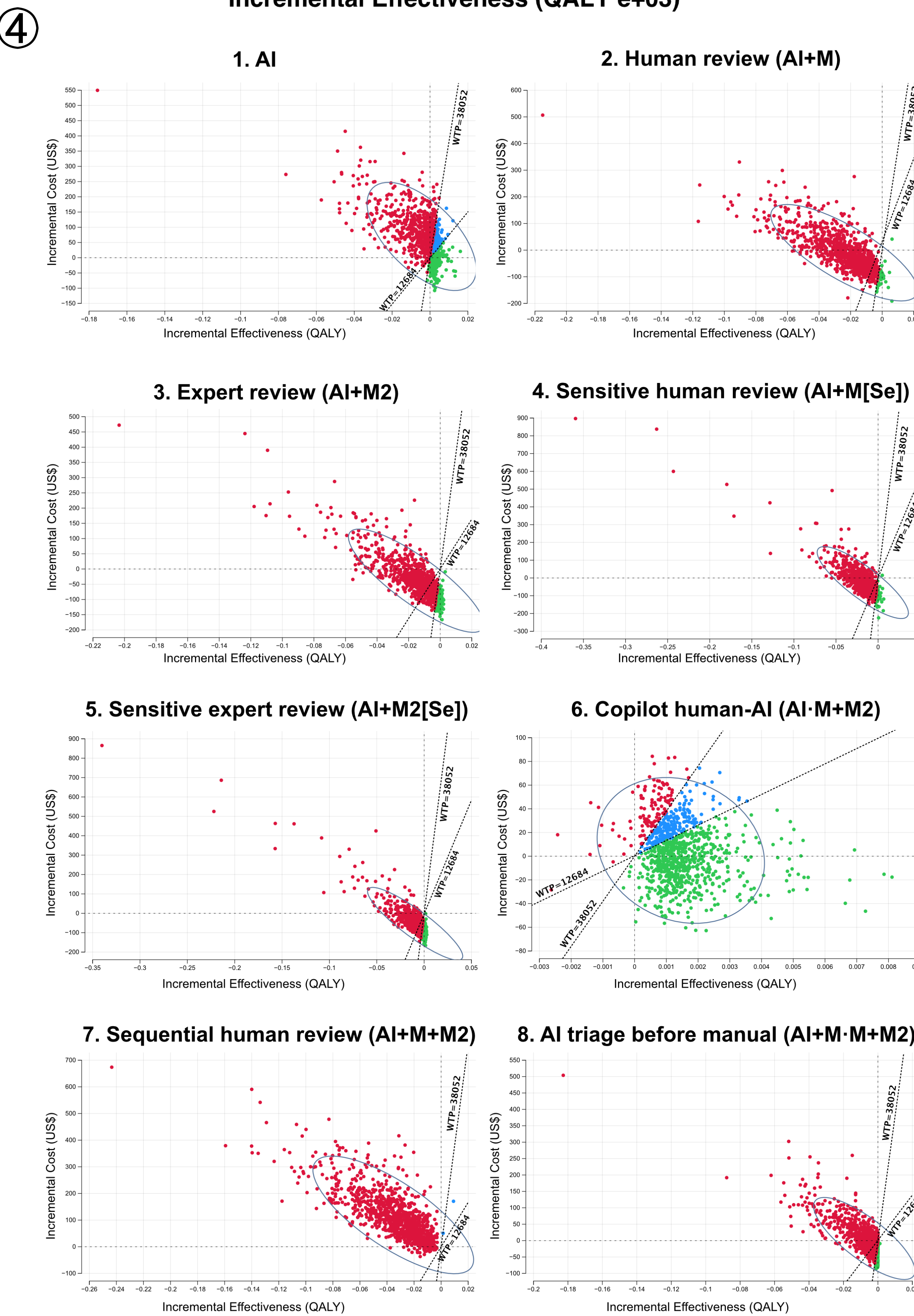
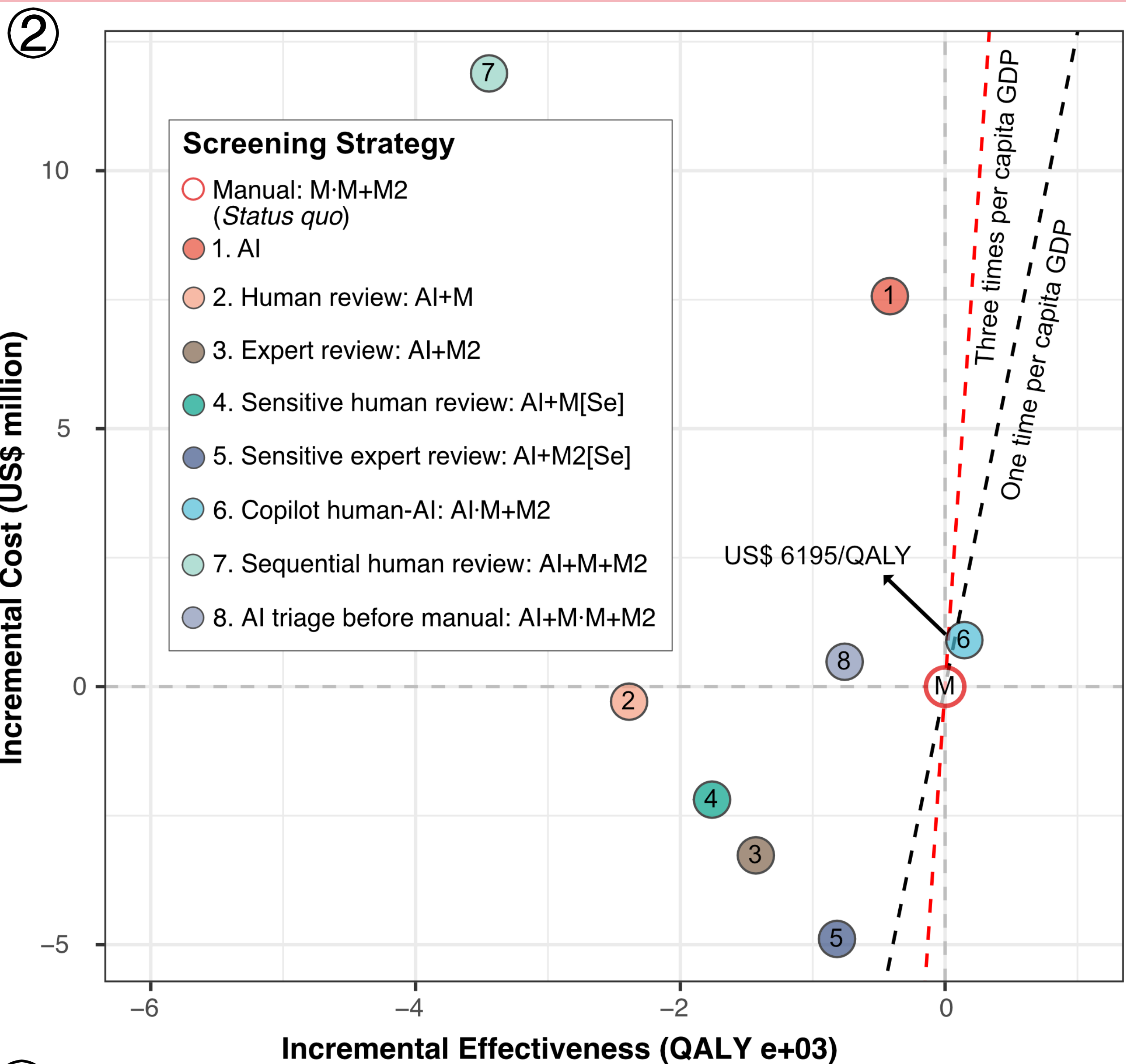


Figure 1. Model Structure & Scenarios

Figure 2. Cost-effectiveness plane

Figure 3. Probability Sensitivity Analysis

Figure 4. PSA Scatter Plots

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