COMPARING THE HEALTH AND ECONOMIC OUTCOMES OF OPPORTUNISTIC LUNG CANCER SCREENING VS. ORGANIZED LUNG SCREENING USING THE CANCER RISK MANAGEMENT MODEL (CRMM)

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OBJECTIVE:

To compare health and economic impacts of pan-Canadian annual low-dose computerized tomography (LDCT) lung cancer screening in organized versus opportunistic screening settings using the Cancer Risk Management Model (CRMM v 2.2).

INTRODUCTION

Despite substantial tobacco control efforts, lung cancer continues to be the highest cause of cancer mortality in Canada. Although the Canadian Task Force on Preventive Health Care (CTFPHC) has released their guidelines for lung cancer screening, only three annual screens are recommended, and it is not clear how the jurisdictions will implement these guidelines. Historically, when jurisdictions have implemented other screening programs they do not always follow guidelines and hence screening varies greatly across the nation. We have, therefore, explored plausible scenarios to estimate the impact of implementation strategies outside of guidelines.

METHODOLOGY:

The CRMM (version 2.2) is a continuous-time, Monte-Carlo micro-simulation model that allows for the assessment of the effect of cancer control strategies on disease incidence, mortality, direct costs and economic impacts.

The CRMM simulates at an individual level and incorporates demographic data, cancer risk factors and registry data, diagnostic and treatment algorithms, health utilities and costs of care. We simulated plausible scenarios of organized and opportunistic screening using the CRMM-Lung Cancer module that is calibrated to major outcomes of the US National Lung Cancer Screening Trial (NLST).

Key Assumptions:
Organized program includes annual LDCT screening of people aged 55-74 years whereas opportunistic screening includes a wider age group of 40-84 year olds. For this current analysis, our inclusion criteria is restricted to those with a history of 30 pack years tobacco smoking. However, opportunistic screening may be offered to both low and high risk individuals.

We have modelled two participation rates: a lower rate of 30% as the rates will be expected to be low during the initial start-up of the program and a higher 60% rate using the current rate for breast cancer screening in Ontario; The scenarios assume that the participation will be reached in a linear fashion over 10 years, with 70% adherence.

NLST-based compliance and follow-up criteria;

All measures were projected 20 years (2016-2036). Incremental cost-effectiveness ratios were calculated for life-time costs and quality-adjusted life years (QALYs), from a public payer perspective and discounted at 3%. Costs are reported in $2008 CDN.
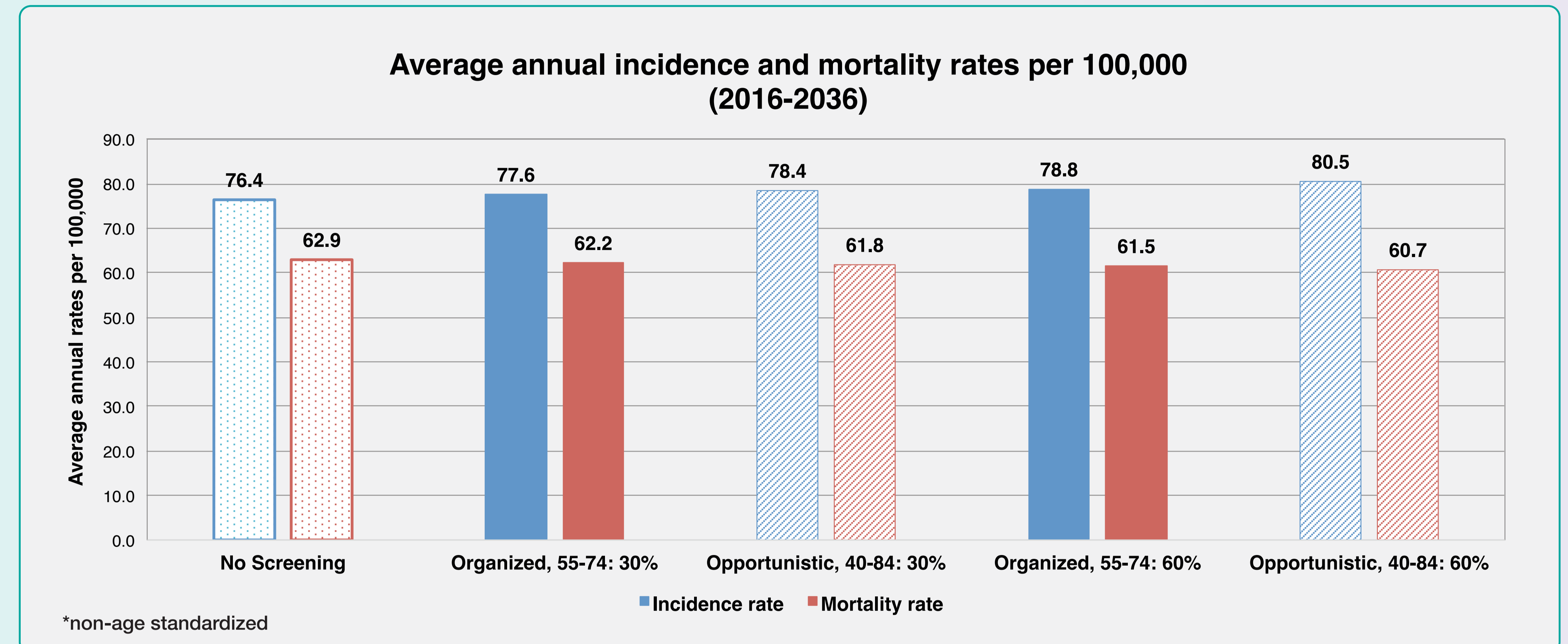
DISCUSSION:

As the jurisdictions start their deliberation on implementation of a lung screening program, the Cancer Risk Management Model can help support policy makers with their decision. Jurisdictions will have to consider the health outcomes, cost to the health system as well as weigh the harms and the benefits of screening. The CRMM projections show that increased screening rates in both organized as well as opportunistic screening adds to the overall costs but an opportunistic program carries an additional cost of $45-$90 million compared to an organized program due to a wider range and number of additional screens. The incremental cost-effectiveness ratio varies between $55,000 - $56,000/QALY for organized screening and $70,000-$72,000/QALY for opportunistic screening, for participation rates of 30% and 60%, respectively. Cost-effectiveness varies with the screening program option but not substantially with participation rates. The CRMM projections show that organized screening also results in fewer invasive diagnostic procedures compared to opportunistic at either participation rate which is due to fewer number of screens as well as fewer false positives. This suggests that financial and social cost savings can be realized by minimizing unnecessary procedures.

The implications of the current CTFPHC's guidelines are not known. The simulation results presented here show some of the potential health outcome implications. However, further research would be required to study the impact on patient reported outcomes.

RESULTS

Average annual incidence and mortality rates per 100,000 (2016-2036)

*non-age standardized

Over a period of 20 years, there is no appreciable difference in the incidence and mortality rates between the 2 scenarios at either participation rates

Average number of invasive diagnostic procedures for false-positives screens (2016-2036)
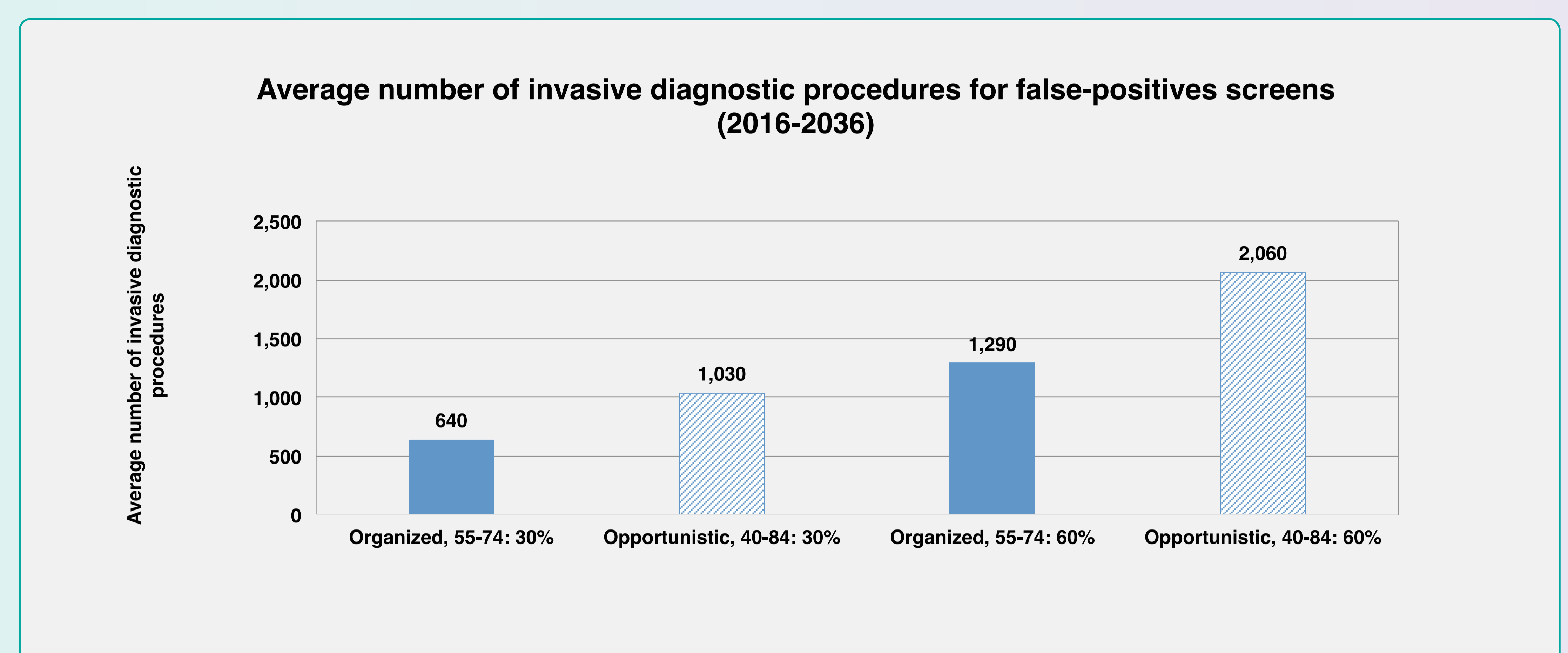
On average, organized screening results in fewer invasive diagnostic procedures for false-positives annually than does opportunistic screening resulting in financial cost-savings.

Average annual costs of screening and treatment (2016-2036)

*2008$ CAD undiscounted

Compared to a "No Screening" base case, average annual screening and treatment costs (calculated over 20 years) increased by $70 million in organized screening compared to $120 million in opportunistic screening at 30% participation. At 60% these costs rose to $140 million and $230 million respectively

Incremental cost-effectiveness ratio (ICER=ΔCost/ΔQALY)*

*3% discount

The incremental cost-effectiveness ratio (ICER) at 30% participation was $72,000/QALY and $56,000/QALY for opportunistic and organized screening, respectively. At 60%, ICERS were $70,000/QALY and $55,000/QALY respectively.

CONCLUSION:

In the scenarios modelled in the CRMM- Lung Cancer Module, opportunistic lung cancer screening is projected to be more costly and less cost-effective than organized screening in Canada in the next 20 years. If indirect costs and harms were to be incorporated, opportunistic screening may be even less cost-effective than projected here.
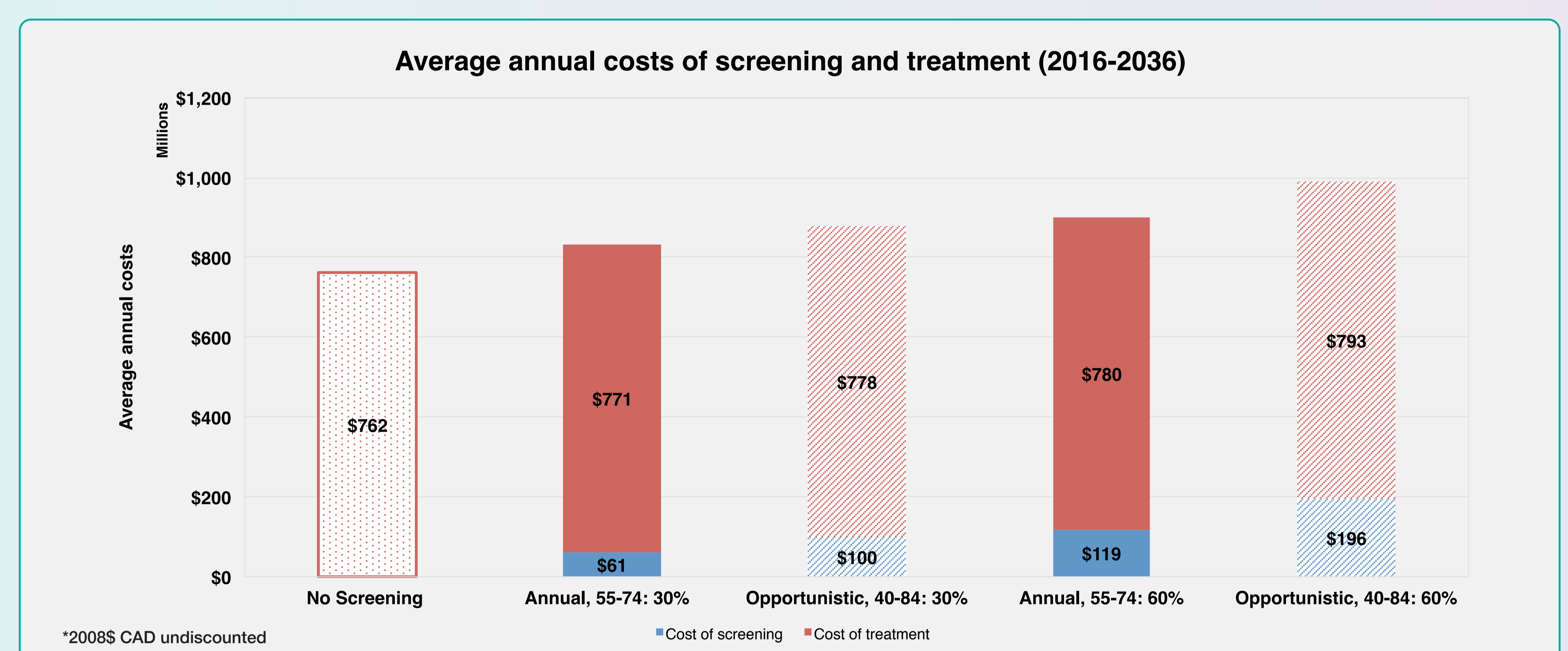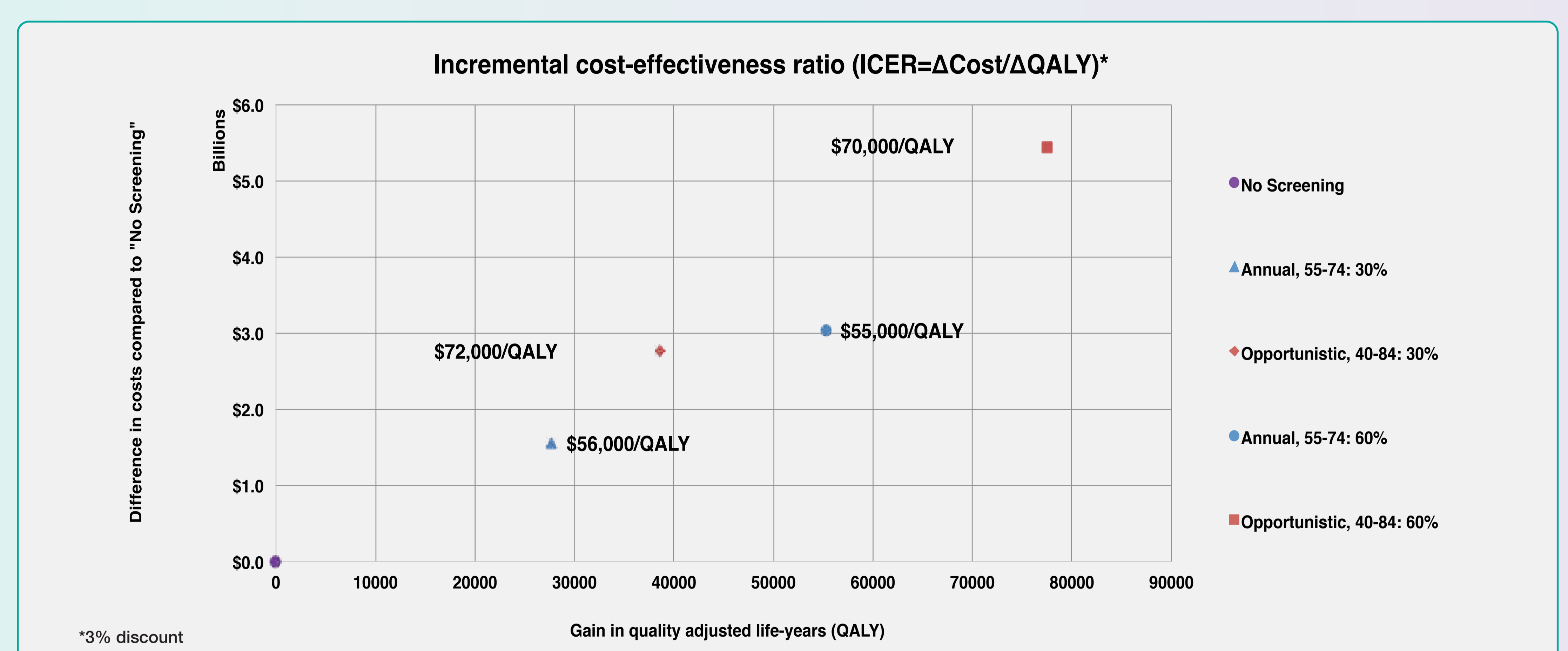
LIMITATIONS:

- The costs for screening and management of lung cancer are largely based on Ontario practices and costs. Resources used and costs will not be identical across all Canadian provinces.
- The model only utilizes the public payer perspective. Indirect costs and harms have not been incorporated in the calculations.

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