

Cost-effectiveness alongside the cascade of HIV care

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Background

- Interventions to improve the cascade of HIV care at its various stages may vary substantially in their ability to deliver good value for money
- There is an urgent need to maximize the value of health spending by prioritizing cost-effective interventions and more broadly, identifying an optimal mix of interventions given available resources.
- We consider hypothetical scenarios of increased uptake of HIV testing and treatment, and improved treatment retention to illustrate a decision-making framework to identify the most cost-effective public health strategies to optimize the cascade of HIV care.

Methods

- We used a previously-validated (Nosyk et al, Lancet HIV. 2015) dynamic compartmental HIV transmission model to project the costs, benefits and epidemiological outcomes of the HIV/AIDS epidemic in BC from 2015 to 2035 (Figure 1). Analyses were executed from a third party payer perspective.
- We tested 8 hypothetical scenarios: (1) current practice, or 'Status Quo' characterized using all available population-level epidemiologic and economic data, including current HIV testing, ART uptake and retention rates; (2) a 10% increase in the HIV testing rate; (3) a 10% increase in ART access, or ART uptake; (4) a 25% increase in ART retention (or decrease in the rate of discontinuation); (5) increased HIV testing and ART access; (6) increased HIV testing and ART retention; (7) increased ART access and retention; and (8) increased HIV testing, ART access and retention.
- As a hypothetical exercise designed to illustrate a decision-making framework for interventions along the cascade of HIV care, a number of simplifying assumptions were made, including: (i) all interventions were assumed equally effective, and scaled to the same extent across HIV risk groups and across the province; (ii) all interventions were scaled to the full population of PLHIV, and the effect of the interventions was maintained for the full study period; (iii) we assumed no fixed or incremental costs of delivering or maintaining the interventions; the costs of the interventions were thus restricted to resulting medical care.
- Total HIV incidence, mortality, present-valued costs (in 2014\$CDN) and quality-adjusted life years (QALYs) were estimated for each scenario, while incremental cost-effectiveness ratios (ICERs) were calculated against the status quo, as well as the next-most resource intensive strategy in the interest of identifying the most efficient strategy.
- The health production function was plotted to highlight the highest-valued scenarios for a given incremental funding level. All figures are incremental, compared to the 'status quo' scenario.

Table 1. Incremental cost-effectiveness of hypothetical HIV care intervention scenarios: British Columbia, Canada: 2015-2035

Public Health Intervention strategies, ordered on cost	Population Costs (2014\$CAN, Millions)	QALYs (Millions)	ICER (vs. status quo)	ICER (vs. next most intensive strategy)
Status Quo	\$ 138,476	141.531		
Increased ART access	\$ 138,480	141.533	\$ 1,581	\$ 1,581
Increased ART retention	\$ 138,506	141.532	\$ 23,335	\$ (18,427) DT
Increased HIV testing & ART access	\$ 138,510	141.535	\$ 8,633	\$ 1,575
Increased HIV testing	\$ 138,556	141.534	\$ 27,668	\$ (43,632) DT
Increased HIV testing & ART retention	\$ 138,561	141.536	\$ 15,793	\$ 1,952 wDT
Increased ART access & retention	\$ 138,582	141.535	\$ 26,491	\$ (14,683) DT
Increased HIV testing, ART access & retention	\$ 138,586	141.537	\$ 17,074	\$ 1,949
Following elimination of dominated, weakly dominated strategies				
Status Quo	\$ 138,476	141.531		
Increased ART access	\$ 138,480	141.533	\$ 1,581	\$ 1,581
Increased HIV testing & ART access	\$ 138,510	141.535	\$ 8,633	\$ 23,417
Increased HIV testing, ART access & retention	\$ 138,586	141.537	\$ 17,074	\$ 30,351

DT: Dominated strategy: comparator features lower costs and higher QALY gains; wDT: weakly dominated strategy; subsequent, more resource-intensive strategy is more cost-effective (ie. lower ICER).

Figure 2. Estimated annual HIV incidence under hypothetical HIV care intervention scenarios: British Columbia, Canada: 2015-2035

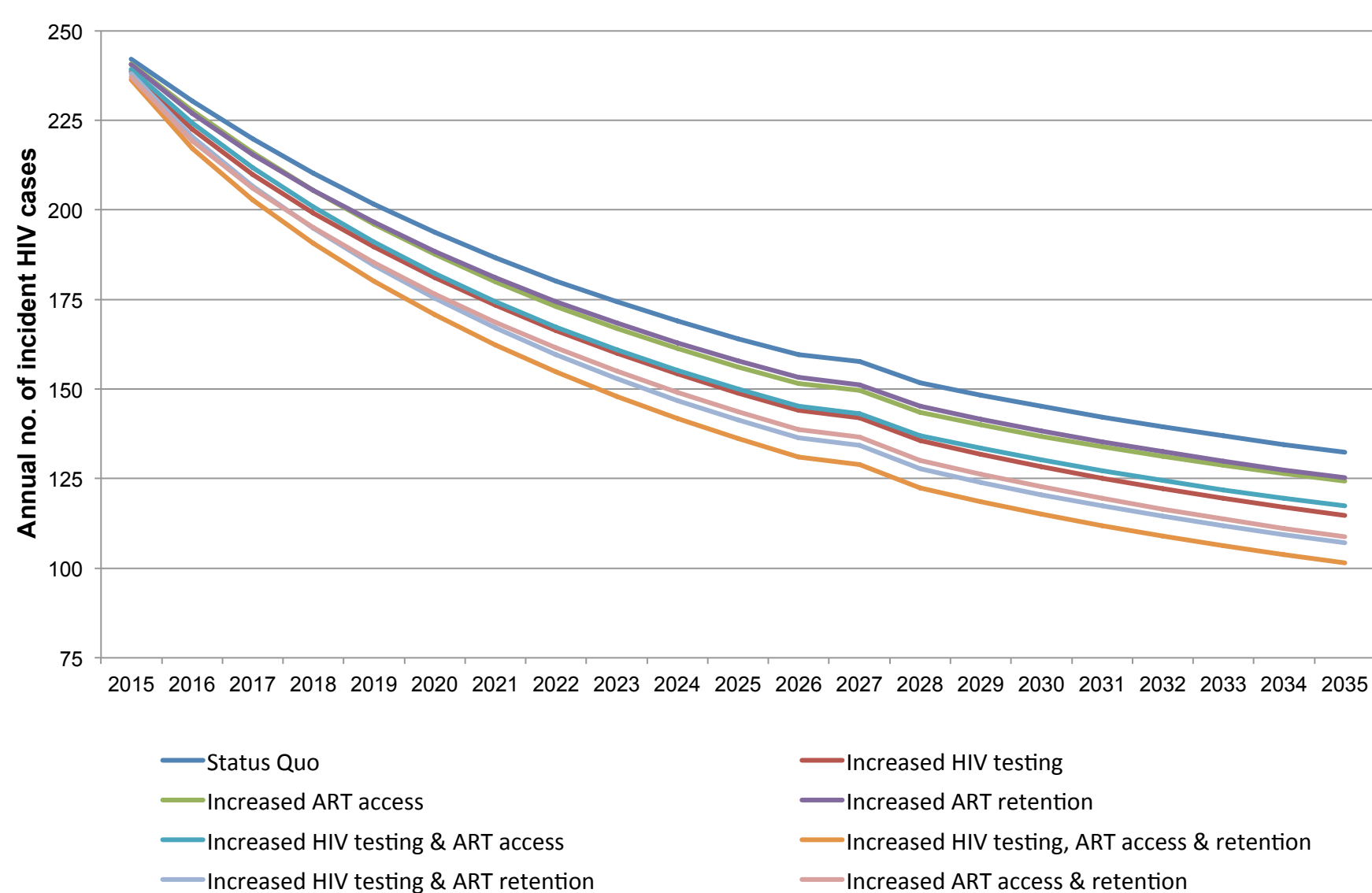
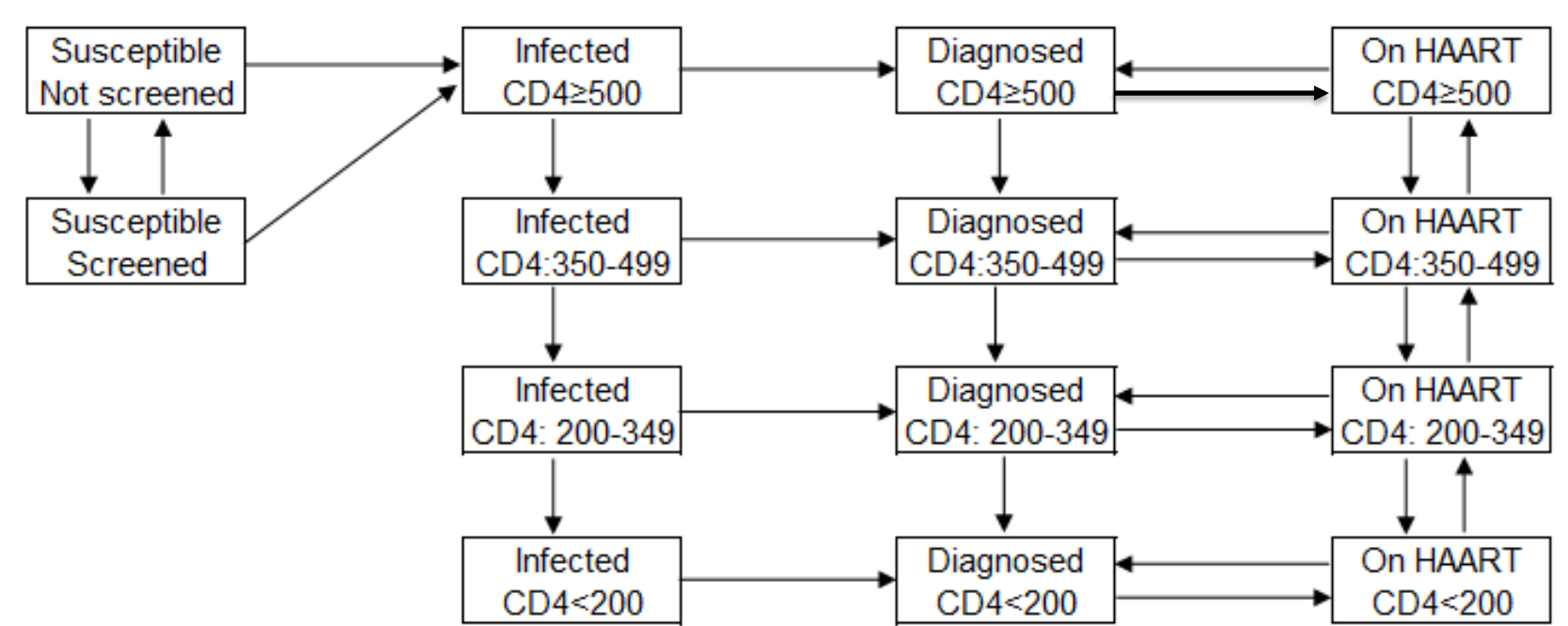


Figure 1. The dynamic compartmental transmission model

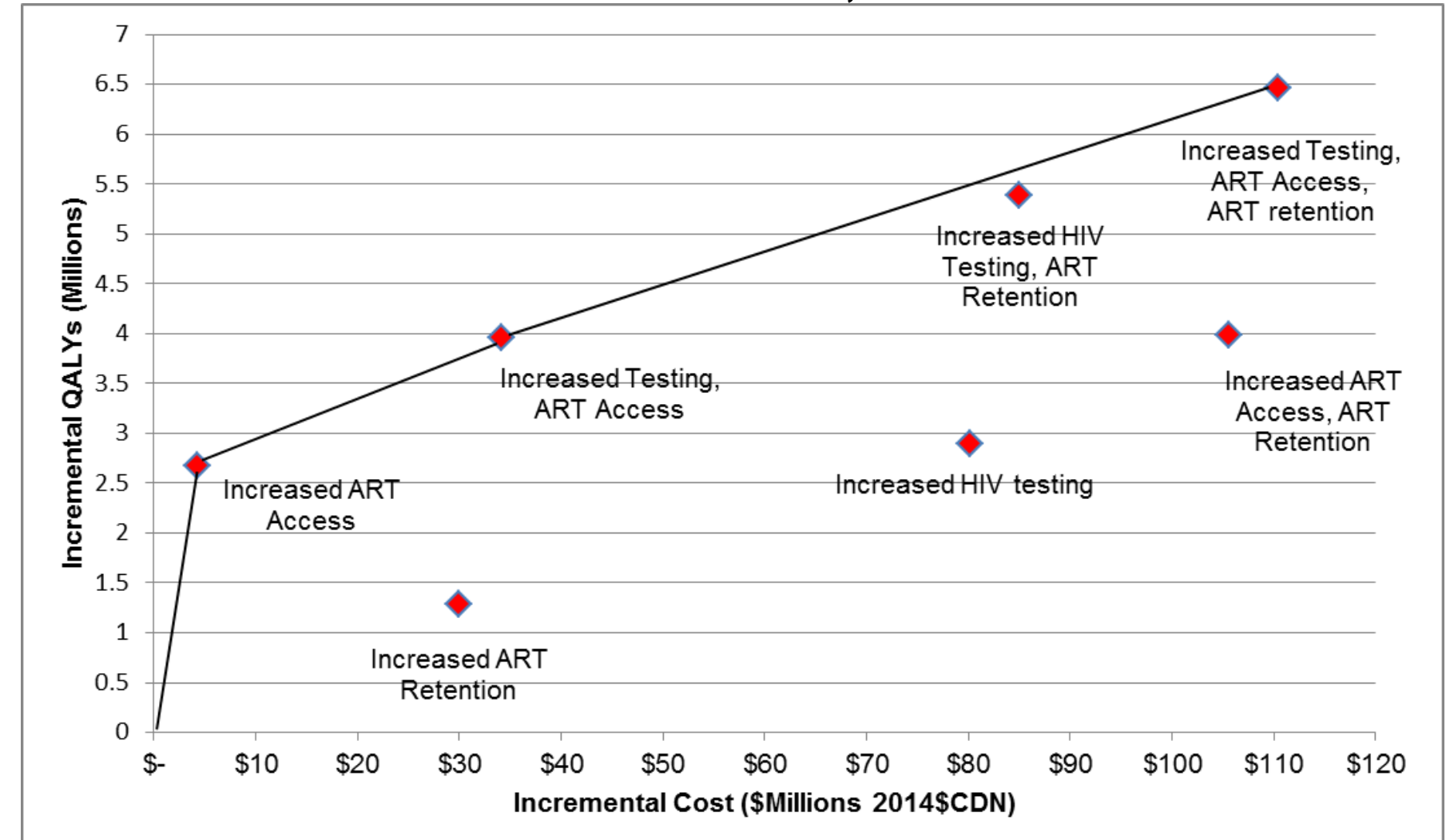


The model schematic represents movement of the population of BC aged 15-64, both susceptible and HIV-positive. The population was stratified into four complete and mutually-exclusive groups: [MSM, IDU, MSM/IDU and Heterosexual]; the model diagram demonstrates movement for individuals in each of these strata. Further, individuals can transition to mortality from any of the model states (transitions not shown).

Results

- The effect of each of the 8 HIV intervention strategies on annual HIV incidence are presented in (Figure 2).
- While we project annual HIV incidence will fall from 240 cases per year to 132, with current levels of testing and treatment intensity, jointly intervening on HIV testing, ART access and retention may result in an additional 31 cases averted in 2035, and 531 during the study period.
- Incremental cost-effectiveness results are presented in (Table 1).
- After removing dominated and weakly dominated strategies, we found 'increased ART access', 'increased HIV testing and ART access', and 'increased HIV testing, ART access and retention' remained. These strategies are illustrated as being the highest-value strategies for a given level of funding in the health production function (Figure 3).
- 'Increased ART access' resulted in an increment of \$5M (\$0.25M/year) over the study period, for an ICER of \$1,581 per incremental QALY gain compared to the Status Quo.
- Compared to 'Increased ART access', 'Increased HIV testing and ART access' cost \$23,417 per incremental QALY gain, and an increment of \$35 million (\$1.75M/year) compared to the Status Quo over the study period.
- 'Increased HIV testing, ART access & retention' represented a \$110M (\$5.5M/year) increase in funding compared to the Status Quo. Compared to the next-best strategy, implementing this strategy would cost \$30,351 for each additional QALY gain.

Figure 3. Health Production Function for hypothetical HIV care intervention scenarios: British Columbia, Canada: 2015-2035



Conclusion

- This illustrative example demonstrates a pragmatic decision-making mechanism to optimally allocate funding for HIV care along the care continuum.
- While we project substantial decreases in HIV incidence over the study period with the current level and allocation of funding for HIV care, further gains can be made with effective health system intervention.
- Orienting strategies catered to localized microepidemics across the regions of BC is likely to result in greater health benefits for similar levels of investment.
- Aside from underlying structural and epidemiological conditions within a given context, the scalability, costs and effectiveness of HIV care interventions – across geographic and demographic domains – need to be established prior to implementation. Incorporating these data represent the next steps in this line of research

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