CANADIAN PARTNERSHIP AGAINST CANCER

OncoSim-All Cancers fact sheet

What is it?

The OncoSim-All Cancers Model projects the incidence, deaths and healthcare costs of 25 cancers in Canada and attributes them to various risk factors.[1-2]

How does it work?

OncoSim simulates large, representative samples of the Canadian population, one individual at a time, from birth to death. The OncoSim-All Cancers Model includes several features, including the simulation of cancer incidence, cancer-specific survival, cancer deaths, prevalence, direct health-related cancer management cost, and the population attributable fractions of cancer incidence and deaths for associated risk factors.

Model input

The model is informed by a wide range of sources including vital statistics, health surveys, cancer registry data, peer-reviewed literature, administrative databases, and expert opinion when necessary. To answer specific policy questions, users can change the model inputs accordingly.

[1] The 25 cancer sites include oral, esophagus, stomach, colorectal, liver, pancreas, larynx, lung, melanoma, breast, cervix, uterus, ovary, prostate, testis, bladder, kidney, brain/central nervous system, thyroid, Hodgkin's lymphoma, non-Hodgkin's lymphoma, multiple myeloma, leukemia, non-melanoma skin and other cancers.

[2] Risk factors in the model include active smoking, passive smoking, alcohol consumption, physical inactivity, excess body fat, inadequate fruit intake, inadequate non-starchy vegetable intake, excess red meat consumption, exposure to radon, natural ultraviolet radiation exposure, artificial ultraviolet radiation exposure, air pollution, HPV infection, H. pylori infection, Hepatitis B virus infection, Hepatitis C virus infection, Epstein-Barr virus infection, human herpes virus type-8 infection, and human T-cell lymphotropic virus type-1 infection.

Cancer incidence and mortality

Incidence and deaths for the 25 cancer types were estimated through analysis of the Canadian Cancer Registry[1]. Incidence models included the effects of province/territory, sex, five-year age groups and year, whereas mortality models were modelled separately by sex and cancer type. Several risk factors have been integrated based on their association with risk of incidence based on summary estimates from the literature.

Quality of life

The model assumes that quality of life varies by treatment phase: pre-diagnosis (3 months before diagnosis), initial phase (first six months after diagnosis), continuing care (time between initial and last 12 months of life), and last 12 months of life. The duration of each phase of care was determined from previous literature on costs of cancer which, in turn, was based on clinical knowledge of the disease and patterns in the data. Duration of phases, as well as health state utility (quality of life scores), can be adjusted in the model.

Costs associated with cancer

The model includes costs from the perspective of the public payer system: physician fees, laboratory services, hospital costs, chemotherapy, radiotherapy, and drugs. The default costs come from a case-control study in Ontario, which estimated the net healthcare costs of cancer (the difference in healthcare costs between individuals with a cancer diagnosis and those without a cancer diagnosis) to capture the publicly funded healthcare costs incurred after their cancer diagnosis (de Oliveira C et al., 2016). However, users can modify costs to better reflect treatment pattern and costs in specific jurisdictions.

What questions can this model answer?

OncoSim-All Cancers can estimate the future incidence, mortality and economic burden of cancer, attribute them to different risk factors and assess the impact (clinical and cost-effectiveness) of interventions that reduce exposure to cancer risk factors. For example, an analysis using OncoSim All-Cancers Model estimated that most cancer deaths could be attributed to tobacco smoking, accounting for approximately 28,000 deaths annually between 2024 and 2047 (Pader J et al, 2021). Another analysis using OncoSim All-Cancers Model estimated that interventions targeting inadequate physical activity and excess body

weight could save approximately $6 billion of cancer management costs (Ruan Y et al, 2021).

References

de Oliveira C, Pataky R, Bremner KE, Rangrej J, Chan KK, Cheung WY, et al. Phase-specific and lifetime costs of cancer care in Ontario, Canada. BMC Cancer. 2016;16(1):809.

Pader J, Ruan Y, Poirier AE, Asakawa K, Lu C, Memon S, et al. Estimates of future cancer mortality attributable to modifiable risk factors in Canada. Canadian Journal of Public Health. 2021;112(6):1069-82.

Ruan Y, Poirier AE, Pader J, Asakawa K, Lu C, Memon S, et al. Estimating the future cancer management costs attributable to modifiable risk factors in Canada. Canadian Journal of Public Health. 2021;112(6):1083-92.

Ruan Y, Poirier A, Yong JHE, Garner R, Sun Z, Than J, Brenner D. Long-term projections of cancer incidence and mortality in Canada: The OncoSim All Cancers model. Preventive Medicine (under review).