Probabilistic Cost-effectiveness Comparison of Screening Strategies for Colorectal Cancer

A stochastic discrete-event simulation model of the natural history of Colorectal Cancer (CRC) is augmented with screening technology representations to create a base for simulating various screening strategies for CRC. The CRC screening strategies recommended by the American Gastroenterological Association (AGA) and the newest screening strategies for which clinical efficacy has been established are simulated. In addition to verification steps, validation of screening is pursued by comparison with the Minnesota Colon Cancer Control Study. The model accumulates discounted costs and quality-adjusted life-years. The natural variability in the modeled random variables for natural history is conditioned using a probabilistic sensitivity analysis through a two-stage sampling process that adds other random variables representing parametric uncertainty. The analysis of the screening alternatives in a low-risk population explores both deterministic and stochastic dominance to eliminate some screening alternatives. Net benefit analysis, based on willingness to pay for quality-adjusted life-years, is used to compare the most cost-effective strategies through acceptability curves and to make a screening recommendation. Methodologically, this work demonstrates how variability from the natural variation in the development, screening, and treatment of a disease can be combined with the variation in parameter uncertainty. Furthermore a net benefit analysis that characterizes cost-effectiveness alternatives can explicitly depend on variation from all sources producing a probabilistic cost-effectiveness analysis of decision alternatives.