A028 · From Evidence to Simulation: Multi-Agent AI for Cancer Screening

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Individual-level simulation models can compare potential cancer-screening strategies before prospective evaluation by first representing how cancer would progress and become clinically diagnosed without screening, and then overlaying screening schedules to estimate how much earlier disease might be detected and at what cost in false positives and testing burden. Adapting these models to a new setting, however, requires substantial evidence synthesis. Researchers must identify clinically relevant tests and schedules, locate estimates of disease natural history and test performance, reconcile heterogeneous sources, and translate the evidence into simulation-ready inputs.

I present a multi-agent AI framework that connects literature-grounded evidence acquisition with cancer-screening simulation. Specialized Proposer, Critic, and Summarizer agents propose and refine candidate strategies—defined by tests, eligibility ages, and screening intervals—and identify supporting parameters, including the duration of the asymptomatic detectable phase, sensitivity, and specificity. The agents iteratively review their outputs while preserving citations and interaction records for expert evaluation. An integrated Python–R implementation links agent-based evidence synthesis and strategy generation to simulations that compare disease progression without screening with outcomes under the proposed schedules.

The framework is evaluated in an end-to-end case study in which agent templates select two clinically relevant tests, propose separate screening schedules, retrieve literature-based parameters, and pass the resulting inputs to simulation. Outcomes including detection age, lead time, screening burden, and false-positive results reveal the downstream consequences of agent-generated inputs.

From Evidence to Simulation: Multi-Agent AI for Cancer Screening

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