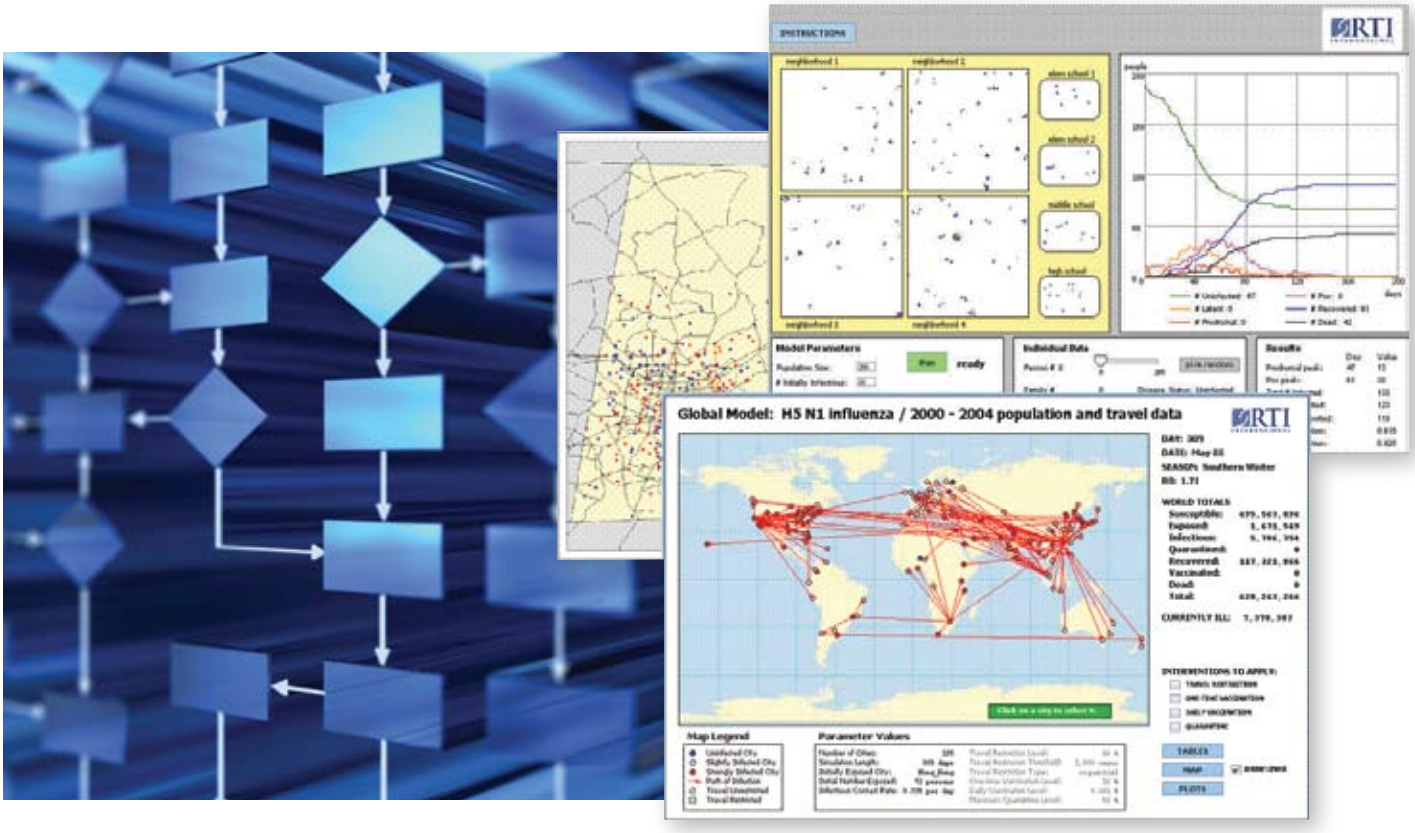
Mathematical Modeling and Simulation

RTI International uses biomathematics to provide answers to complex research questions through mathematical modeling and simulation.



Many studies today require comprehensive and complementary approaches to uncover underlying biological mechanisms, behavior patterns, and population dynamics. Mathematical models help answer "what if" questions when a quantitative or qualitative answer is needed.

RTI researchers combine functional and mechanistic knowledge with data to conduct virtual experiments for situations where real-world experiments are too difficult or impossible. Combining mathematical simulations with partial experimentation and feedback, which informs both the models and the decision makers, creates better grounded and informed decisions. RTI also has a unique capacity to build mathematical models for health outcomes.

Global spread of pandemic influenza

RTI developed the Global Epidemic Model (GEM), a stochastic, equation-based epidemic model to study global transmission of pandemic influenza for the National Institutes of Health/National Institute of General Medical Sciences. GEM studies the planning of vaccination, quarantine, travel restrictions, and other containment scenarios, including both worldwide and U.S.-specific monitoring of the dynamics of the disease.

In this study, RTI researchers found that if travel restrictions and vaccination were instituted worldwide, there would be a significant reduction in cases throughout both the United States and the world. However, if travel restrictions alone were used, epidemic severity in the United States could increase because outbreaks might be

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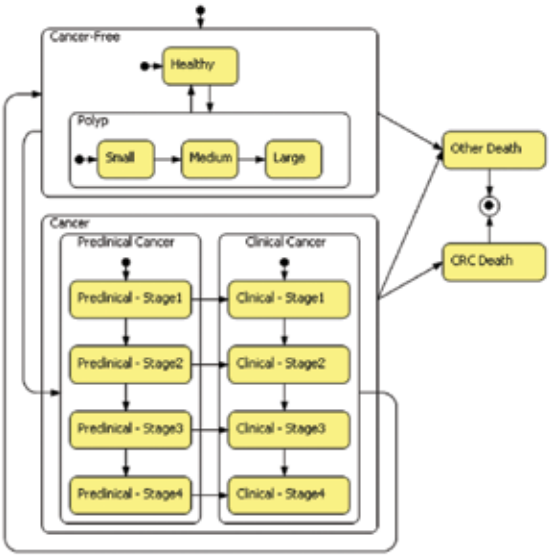
pushed from low epidemic season, such as summer, to high epidemic season, such as winter.

Another of GEM's highlights is that the study accounted for the economic costs of a global flu epidemic. Results showed that the per annum cost of international and major domestic air passenger travel restrictions to the U.S. economy would only be 0.8% of gross national product.

Cost-effectiveness of colorectal cancer screening

RTI's mathematical model of colorectal cancer (CRC) simulates morbidity and mortality under realistic conditions that account for differential compliance. The model includes a comprehensive hierarchy of components: a natural history of CRC, screening and testing, compliance, epidemiology, and economics.

Calibrated on cohort-based data and validated on national epidemiologic mortality and morbidity data, the CRC model was written using AnyLogic software so it can be disseminated as an applet with appropriate documentation.



Virtual census populations

RTI has developed virtual census population models ranging from the national to the county level that match the 2000 U.S. Census on age, race, sex, socioeconomic status, and household size. Virtual populations allow for precise estimates for small geographical areas without breaching confidentiality of the subjects.

These virtual populations can be used in a variety of studies where the details of local demographics are critically important.

Spatial/spillover effects models

Spatial models allow for robust analysis of risk factor impacts on outcomes and also for direct modeling of spillovers (peer effects) between individuals or institutions and their neighbors. For example, RTI researchers have developed spatial models of hospital competition in California and have demonstrated that hospitals are aware of and influenced by neighboring hospitals' prices for inpatient services.

RTI is also examining peer effects in the perception of cancer risk (with peerage among family members) and how this perception impacts behaviors associated with cancer risk. Other models, including one of preventive health services by the elderly, also contain spatial spillovers because of resource constraints that overbound the small areas used in the analysis.

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