Argonne NATIONAL LABORATORY

Health Information Exchange

Modeling, Simulation, and Analysis: ABMS of HIE Network

Opportunity

Ideally, the U.S. healthcare system would provide a secure, nationwide, interoperable health information infrastructure that connects providers, consumers, and others involved in supporting health and healthcare. Effectively determining the future *sustainability* of a health information exchange (HIE) network and healthcare delivery improvements requires policymakers to consider many alternative healthcare system designs. These alternative designs must be evaluated in terms of their performance, cost, and ability to meet stakeholder expectations.

Successfully testing, validating, and communicating the expected consequences of alternative business practices, processes, protocols, and policies requires an objective analytical approach.

Why Modeling and Simulation?

Quantifying the value of HIE networks for healthcare delivery involves understanding the impacts of many interrelated factors involved in patient care, clinical practices, medical outcome, and organizational structure. Modeling and simulation can be effectively employed by policymakers to gain a broader perspective on business processes across multiple areas *before any investments are made* — helping avoid costly and ineffective process changes.

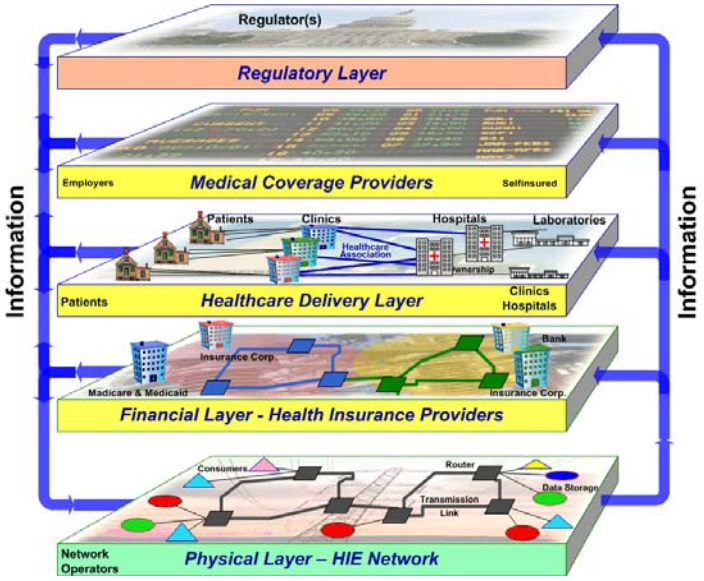
Approach

Agent-based modeling and simulation (ABMS) is a new alternative to traditional modeling techniques. ABMS models are composed of independent agents that act according to simple rules. An "agent" within the model represents any entity that takes an action.

Agent-based modeling and simulation is a technique for determining the system-level results of complex, interacting, and often conflicting individual-level decisions.

Applying ABMS to the HIE Network Model Design Process

In a healthcare system, an agent is a patient, a healthcare provider, a health insurance provider, a governmental institution, etc. All agents can have their own set of objectives, decision-making rules, and behavioral patterns. Any of them may act *intentionally* or *unintentionally;* overall outcomes may represent the cumulative effect of many thousands of individual agent actions and interactions among agents. Agents interact on several layers — HIE network, financial, healthcare delivery, medical coverage provider, and regulatory — in an overall system that may contain a fairly fine-scale representation of clinical processes and outcomes.



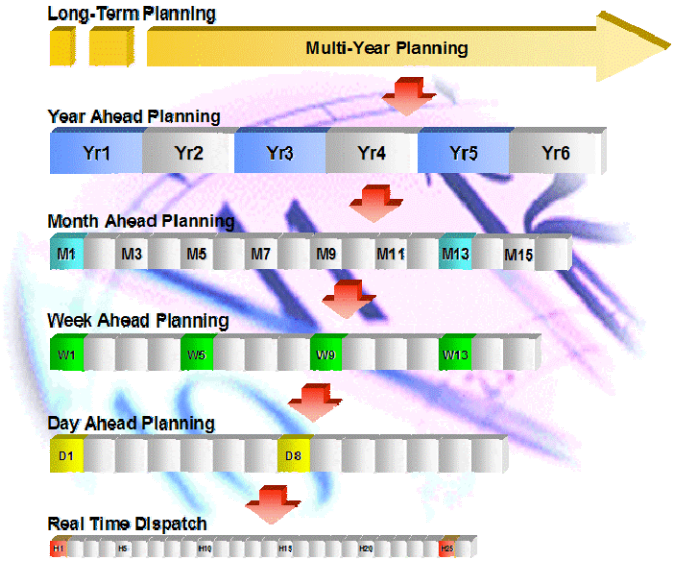
ABMS can be used to model macro-scale and micro-scale effects through the interaction of agents across these multiple layers of the healthcare system.

Benefits

An agent-based model of HIE network and healthcare delivery can provide actionable outcomes for decision makers by:

- Enabling healthcare experts to define the individual, agent-level rules of operation;

- Allowing healthcare experts to see how the agent rules play out over time in a detailed, real-world context;
- Providing healthcare experts with the tools to assess the consequences of alternative plans and avoid undesirable events; and
- Supplying a clear method for communicating the results to the broader stakeholder community.



Simulation times range from hourly dispatches to long-term planning.

Gauging Return on Investment

The return on investment in ABMS systems is determined by analyzing alternative policies (or implementation of policies) within a flexible framework and then choosing the most promising path after considering the constraints involved.

Developing an ABMS Model

The healthcare organization first identifies subject matter experts and conducts a forum to define high-priority requirements that it would like to model. To navigate this process effectively, it is very helpful to have a facilitator who is well versed in ABMS development and healthcare modeling. Argonne has played this role in several ABMS healthcare-related projects.

Applying ABMS for Nationwide Interoperability

ABMS-based planning decision aids provide excellent value by identifying, in advance, the inherent strengths and weaknesses of various alternative approaches to achieving and maintaining interoperability at various scales. One of the most valuable products of an ABMS development and implementation project can be the insight that healthcare organizations gain about the characteristics and dynamic behaviors of the key players in the problem domain. This information is very helpful in effectively scaling local projects up to broader regional and national levels.

Why Argonne?

Argonne National Laboratory *is one of the U.S. Department of Energy's largest research centers. As the nation's first national laboratory, Argonne combines scientific research and applied engineering techniques across a wide spectrum of disciplines, such as high-energy physics, climatology, biotechnology, modeling and simulation, and visualization. Argonne leverages its science and engineering leadership to support the needs of private industry and public organizations.*

Decision and Information Sciences (DIS) Division*, a multidisciplinary organization at Argonne, is focused on providing tools to assist decision makers in making informed choices that consider evolving information, increasing complexity, and continuing uncertainty. DIS's staff of engineers, scientists, software developers, operations researchers, economists, sociologists, political scientists, and lawyers work together to develop tools designed to be useful, usable, and used.*

Learn more about ABMS and other Argonne-developed models at:
http://www.dis.anl.gov/

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