By producing results that have had positive impact on cost savings and the quality of care, simulation modeling is becoming widely recognized as a valuable application in the healthcare industry. Prior to the introduction of simulation modeling, healthcare administrators relied on rough estimates and guidelines from previous projects in order to make planning and investment decisions. Today, however, simulation modeling enables administrators to make more accurate decisions based on detailed discrete-event analyses that accommodate more variations and complexities than traditional spreadsheet analyses. Simulation modeling also presents physical movement not available in traditional analysis. This dynamic animation allows the simulation concept to be easily presented, providing decision makers with a better understanding of the variations and complexities involved in the model.

Simulation modeling is used in the healthcare industry to analyze:

- Patient flow
- Length of stay
- Resource staffing
- Capital equipment investment
- Planning, building or renovating a particular department
- Process improvement and scheduling

The level to which simulation modeling is applied depends on the maturity of a facility or process. Macro-level simulation is used for high-level strategic planning and concept development, such as determining room capacity in facility planning. Micro-level simulation is used to analyze processes such as patient flow or process/technology tradeoffs.

**Benefits of Simulation Modeling**

Simulation modeling begins with the identification of a specific problem. Once the problem is identified, the process flow is determined. Through onsite observation, a simulation expert can establish how a department operates on a daily basis, how data is collected, and how various processes are managed.

These data points are used to build the simulation model, which is then applied in order to determine the best process change, facility plan, equipment set-up, or other solution.
Simulation modeling is a valuable tool in a hospital environment, where intricate processes and multiple variations make analysis difficult. In fact, simulation is the only tool that allows for complex interactions within processes. For example, patient treatment pathways are affected by many factors such as acuity level, test results, facility and staff schedules, equipment availability, care giver skills and competition with other patients for resources. Simulation modeling allows for the analysis of this variable routing path that impacts facility, staffing and capacity.

Simulation is especially useful for facility planning and development. Planners, for instance, can use simulation to determine sufficient bed capacity. The model can then be enhanced to determine if departments have been properly designed to minimize travel distance throughout the process flow since travel time ultimately affects overall hospital performance. With efficient facility layout and processes determined, administrators can then use the simulation model to analyze the capital investment required.

Since the September 11, 2001 tragedy, there has been greater demand for simulation modeling in disaster management and emergency planning. At the hospital level, simulation exercises are performed to determine how the wing of a hospital could be evacuated and transformed into a triage unit. At the metropolitan level, simulation modeling is used to analyze how major disasters would impact the performance of several local hospitals and how unaffected hospitals can be better utilized.

Over the last five years, there has also been a greater appreciation for simulation in the analysis of transactions within the emergency room (ER), which receives 25%-50% of patient flow. The most prevalent issues that affect the ER are bed availability, the need to divert patient traffic when the ER is full, and managing the overflow caused by backups in ancillary services such as clinical laboratories and radiology.

New Approaches

With the rising demand for simulation analysis in the healthcare industry, consultants such as Automation Associates, Inc. are building customized toolsets and templates tailored to the needs of the healthcare administrators and providers. AAI’s Healthcare Modeling Studio™ toolset, for instance, utilizes user interfaces that are simple enough for inexperienced clients to interact easily and smoothly with the model.

Simulation experts are also developing tools to expand the capabilities of traditional discrete-event models. Another form of simulation modeling, agent-based modeling can help analyze physical flow. It is being used to model interactions between patients and their environments and enhance their autonomous decision-making capabilities. This modeling approach enhances the provider-patient relationship in that it provides the patient with greater flexibility in making health-related decisions.

To learn more about the applications and benefits of simulation modeling, healthcare administrators can:

- Review healthcare simulation papers from the annual Winter Simulation Conference (WSC) at http://www.informs-sim.org/wscpapers.html
- Attend conferences such as the WSC and Society for Health Systems Management Engineering Forum
- Call AAI and asking to speak with a healthcare simulation specialist