The Potential of Hospital-wide Patient Flow Forecasting, Admission Control and Capacity Planning

Background
Most hospitals have little understanding of how patients flow through their facilities, making it difficult for them to predict the effect of a change (e.g., admission control for scheduled patients) on the entire hospital. Key areas of concern include:

- Bed block issues (ambulance diversions, lack of inpatient beds for medical admits, long waiting room delays)
- Census variability that generates congestion, making nurse staffing costly while detracting from quality of care
- Cancelling scheduled OR patients
- Having proper ICU access for needy patients

Goals
Develop methods to transform a hospital’s historical data into a dynamic model of patient flow.

Given a proposed weekly admissions schedule, predict the means and variances of census by day of the week and optimize the weekly elective admission targets by service area. Objectives include increasing throughput, decreasing bed blocking and reducing variations in hospital census.

Interventions
Researchers used stochastic process modeling to summarize how different types of patients flowed through four hospitals in four countries. Then, they used an optimization model to select the best weekly elective admissions plan, while considering the stochastic dynamics for bed blocking and cancellations. Researchers validated the model using historical performance and detailed simulation models.

Results
This modeling method identified the best possible solution for any tradeoff of increased admissions versus bed blocking. The hospital census prediction approach was accurate to less than 4 percent error for medium-sized hospitals and better for larger ones. The model projected throughput improvements of greater than 7 percent and cancellation/blocking reductions of greater than 25 percent.

Recommendations/Observations
Hospital culture must embrace the power of science-driven engineering methods, marrying them with the more hands-on methods of operational improvement.

By using improved technology and methods, there are many opportunities for system planning, forecasting, control and capacity optimization.

A key challenge is the autonomy of surgeons to manage their own schedules and case mix without any ability to consider the impact on hospital flow.