Improving Public Health with Industrial Engineering and Operations Research
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What Happened? Finding Patterns in Data
Organizations that have large collections of data about persons and their activities can run standard reports on these data sets to monitor their operations and support routine decision-making. In addition, users may submit queries to obtain data for answering questions that they develop. Finding patterns that are not even imagined, however, requires more sophisticated techniques such as data mining.

FluView tracks seasonal influenza activity across the United States and summarizes this activity using a variety of key indicators (CDC, 2014). ESSENCE II is a syndromic surveillance system that collects and analyzes public health indicators for early detection of disease outbreaks (Lombardo et al., 2004).

What Should We Do? Making Decisions
Although decision-making is sometimes easy, it can be difficult when the decision requires considering many alternatives, many interacting issues, multiple criteria, or uncertainty in the outcomes. Models that provide insight into what has happened and models that predict what could happen yield valuable information for decision makers.

An analysis of the costs associated with vaccinations for diphtheria, tetanus, pertussis, Haemophilus influenzae, polio, measles, mumps, and rubella, hepatitis B, and varicella showed that the current routine childhood immunization schedule results in substantial cost savings in the United States (Zhou et al., 2005).

The Clinic Planning Model Generator software creates a Microsoft Excel workbook for planning Points of Dispensing (PODs). Public health planners in 25 states have used the software to evaluate and improve their POD plans. This can be used for emergency preparedness planning or to support an ongoing campaign.

What is the Best Solution? Solving Problems with Optimization
Optimization is essentially a search technique that is most appropriate when the set of possible solutions is large and complex and evaluating a possible solution requires significant effort. Using optimization requires identifying the decision variables, formulating the constraints, determining the objective function, and then finding the optimal solution.

What Could Happen? Building Stochastic Models
Stochastic models can be used to identify the distribution of possible outcomes of a process (as in risk analysis) and to estimate the performance of a system in which the events are random (for example, queueing models). Detailed simulation models can sample the relevant random variables and evaluate the associated system performance.

A stochastic compartment model was used to estimate the number of deaths from an aerosolized anthrax attack when pre-positioned medication was used for prophylaxis. Reducing the number of potential exposures who seek prophylaxis allows those truly exposed to receive medication sooner, which saves lives.

A simulation model was used to evaluate the capacity and cost of a mass influenza (or pneumococcal) vaccination clinic to be setup in North Carolina. The results showed that staffing was sufficient for 15,000 people in 17 hours. This was used to justify reimbursement from HHS.

A Clinic Planning Model predicts the capacity and congestion in a POD based on expected staffing and arrival rate (Herrmann, 2008).