Smart Supply/Demand Planning

What Pilots and Quarterbacks Can Teach Medical Groups

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Anyone running a medical group today knows that there is an elemental supply-and-demand problem in American health care. Too many patients. Never enough doctors. Patients wait long to be seen. Doctors are increasingly burned out. Is this seemingly simple supply-and-demand issue actually more complex? And can recognizing that complexity help us find new solutions?

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In this article, we look at ways that advanced mathematics and computer science using combinatorial optimization are solving some of the most challenging supply-and-demand problems. An area of applied mathematics and computer science, combinatorial optimization focuses on finding optimal solutions based on user-specified criteria/rules; much like how modern navigation systems quickly find optimal paths toward a destination based on rules such as speed limits, traffic, one-way streets, and user preference.

Learning from the airline industry, professional football, and even our own medical informatics leaders, we've identified case studies that can apply to any group practice setting. In the end, it appears that smart use of resources and efficient planning help your practice balance the needs of doctors, patients, and operations without adding new staff.

A Complicated Balance

Supply and demand is a fundamental law of economics. It is a simple balance that regulates everything from the price we pay for apples to the salaries we earn in our jobs. French economist Jean-Baptiste Say explained the law as a teeter-totter with a single fulcrum: "Demand and supply are the opposite extremes of the beam, whence depend the scales of dearness and cheapness; the price is the point of equilibrium, where the momentum of the one ceases, and that of the other begins."

In health care, however, this simple economic law becomes exceptionally complex. This will not surprise anyone even glancingly familiar with the medical sector. Few industries in the American economy are more notorious for creating complexity and gravity-defying systems that bend the minds of economists. A swirling mix of Centers for Medicare & Medicaid Services (CMS) regulations, payers, hospitals, practices, patients, pills, and procedures leaves the simplest explanation of supply and demand in health care at, "It's complicated."

What everyone in health care can easily agree on is that the sector has a supply-and-demand problem. A

widely reported physician shortage is predicted to only get much worse.[1] A flood of 20 million newly insured patients in the market is increasing demand.[2] From emergency room lobbies to specialty consultations, patients are waiting longer to see doctors, and health-care organizations are missing opportunities.

Look to the Skies

To start solving this supply-and-demand issue in health care, we can look at an example set by the airlines industry. Getting a fully loaded airliner into the sky on time involves a complex set of factors: Tickets have to be sold to passengers at the right price and time; pilots and flight attendants scheduled; gates and times arranged with airports; planes cleaned, stocked, and fueled and in the right location; weather and delay issues mitigated. This vast transportation system has long been a leading innovator in the use of data analytics and machine learning.

Look closely at just the ticket sales process. This has long been a delicate dance between supply and demand. A plane not filled to capacity costs the airline money. A plane filled to capacity too early also costs the airline money. With real-time data from online bookings, it is even trickier.

Opex Analytics reports: "With the advent of the Internet as a distribution channel, today the airlines can store not only the actual bookings but also the available itineraries offered to the customer. In addition to recording the booked itinerary, all itineraries on the "screen," i.e., presented to the customer, also called the "choice set," are stored in a database. The request (filters specified on the page), the actual booking, and the choice set are all stored and linked. The first challenge here is to store the data. The size of the data increases twenty-fold if the choice set has twenty itineraries."[3]

Imagine this kind of insight working in medical groups: Patients are presented with options for times and locations to book their appointments online. Behind the scenes, this data feeds back into the medical group models to create optimal physician schedules that serve the greatest number of patients in the highest-demand facilities. The data might reveal patient demand for more early morning and weekend appointment times. The medical group would gain a competitive advantage by building flexible physician schedules outside the nine-to-five standard.

Medical groups don't even need to rely on their proprietary data to make these kinds of predictions. Public data sources may be just as effective. In Europe, researchers put this kind of data insight to the test using online search traffic.

Again, from Opex Analytics: "Researchers in Stockholm, Sweden, posited that visits to a specific regional medical advice website could foreshadow emergency department activity the following day. The researchers examined Internet activity between six in the evening and midnight, then correlated the number of visits to ED visits the next morning.[4] At the county level, the team saw an absolute percentage error of just 4.8%. For individual hospital predictions, the error rate ranged between 5.2% and 13.1%."[5]

Suddenly, we're looking at the physician shortage issue in a different light. It may not be that a medical group needs to add physicians to meet patient requests. Instead, developing a smart schedule that allocates its existing physician resources across multiple facilities in a way that is predictive of patient demand could be the solution. Does your practice know when patients want to be seen, and where? Optimization technology, such as that used in the airline industry, excels at finding creative solutions to these kinds of complex issues.

Look to the Fields

A second example of using data to solve supply-and-demand issues involves different kinds of jets—specifically, the New York Jets football team. The National Football League (NFL) tackles a massive scheduling challenge each year with the help of optimization technology, according to Gurobi Optimization:

"Four people have 10 weeks to schedule 256 games over the course of a 17-week season. To some, that may seem like a lot of planning time available for seemingly few decisions. However, when you work it out, the number of possible schedules is well into the trillions. Imagine the number one followed by 19 zeros."[6]

Geography, travel time, facilities, weather, TV time slots, and other constraints (even the Pope[7]) make the scheduling of a single NFL season far too complex to be managed manually. In fact, the NFL now relies on a supercomputing hardware system of 750 processor cores to evaluate their options over several weeks. Data modeling drives a $13 billion-a-year business involving 1,800 professional athletes.

Can health care learn from the NFL example? Medical groups should recognize that complexity is an advantage, not a liability. Embracing hundreds or even thousands of scheduling rules allows a medical group to build a sophisticated schedule that optimizes physician requests, patient demand, facility rules, and other details. Does your medical group know when physicians want to work, and where? Just as an NFL team can request certain travel rules, medical groups can listen to the preferences of teams and even individual

physicians when developing complex schedules optimized for their operational goals.

Look to the Patients

Some healthcare organizations have already made tremendous strides with predictive analytics in other areas of medical practice. As medicine continues its shift to value-based care models, healthcare informatics teams have found ways to predict the chances of sepsis with hospitalized patients, to reduce readmission rates, and to screen for suicide risk among veterans.[8]

"We could save four lives for every hundred people we treated" with better data-driven care coordination and follow-up after a hospital stay for a psychiatric episode, Lt. Gen. Eric B. Schoomaker, former Army surgeon general and professor of military and emergency medicine, Uniformed Services University of the Health Sciences, told *Predictive Analytics World*. "This would be unparalleled, compared to almost any other intervention we could make in medicine. This study begins to show the positive effects data insights can have when combined with administrative health records."[9]

Yet, today only 15% of hospitals use a predictive analytics infrastructure for either clinical or operations improvements—with the highest rates of adoption in midsize nonacademic hospitals or hospital systems.[10] Data technology clearly has matured to create sophisticated insights. It is also clear that the future of healthcare success will be data-driven. So, why aren't medical groups and hospitals embracing optimization technology?

Neutralize Change

One of the greatest advantages to applying complex predictive analytics and data insights in health care is the neutrality it brings to change management. Driving major operational changes in any organization can be difficult, and this is especially true in medicine, where the stakes for patient safety are high and the professional authority of specialized physicians is strong.

Numbers don't lie. Data doesn't play favorites. Algorithms aren't vengeful. By embracing optimization technology, medical group leaders can create complex systems that listen to hundreds of stakeholders to deliver an unbiased solution with measurable results. As we've seen in the airline and NFL examples above, the return on investment around optimization is significant. Does your medical group use data to its best advantage?

Medical group leaders should be thinking about new ways to use their existing resources effectively to solve supply-and-demand issues. Crunching the numbers using sophisticated combinatorial optimization technology reveals new ways to balance the professional needs of doctors, improve patient access, and streamline operations in your practice.

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