TRADITIONAL APPROACHES for addressing the challenges of clinical staffing and scheduling are not always effective in today’s complex and unstable health care environment. Lengths of stay in acute care settings are short, yet require a high intensity of services and nursing resources. As effective implementation of population health strategies further decrease hospital admissions and the quest for value-based care models drives operations, traditional staffing systems and processes are becoming less effective.

System chief nurses are also facing a new challenge: the need to standardize and rationalize staffing across newly formed systems and partnerships. Kutscher (2016) reports that merger and acquisition activity is expected to remain strong in 2016, driven in large part by the growth in value-based payment models. It is further reported private equity firms will continue to scout for primary physician practices with experience in the managed care environment. There will continue to be a trend toward aggressive consolidation of hospital-based medical services such as anesthesia and inpatient hospitalist care. The industry is beginning to experience merger and acquisition activity across the continuum as well, as systems take on responsibility for outcomes. Post-acute providers have operated in a fragmented market until now but, like relationships with insurers, these traditional walls are collapsing.

The implications for system chief nurse executives (CNEs) are considerable. Mergers and acquisitions are typically expected to produce economies of scale or cost savings due to centralization of services, particularly “back-office” functions such as billing and revenue cycle, supply-chain management, human resource (HR) and recruitment support, or strategic planning to name a few.

Increasingly, however, there is a trend toward standardization of clinical and administrative systems and processes, including policies, procedures, and practices. This standardization supports the movement of patients, physicians, and other clinical staff across multiple facilities and is necessary for the creation of a standardized enterprise-wide information technology infrastructure.

Whether the expanding enterprise operates within a federation model whereby there is minimal central control or with a highly centralized authority structure,
CNEs are increasingly required to benchmark staffing models and processes across the enterprise. Additionally, geographically proximate organizations are developing float pools or product line oriented staffing models to optimize clinicians and expertise across facilities. These types of staffing models arguably require a standardized compensation plan as well as personnel policies to be most effective and less confusing for staff and managers alike. The systems business unit operating agreements as well as compliance with state and federal labor laws also drive much of this standardization.

**Reconceptualizing Inpatient Staffing**

Advocate Health Care is a 11-hospital health system in Illinois and one of the largest health care providers in the Midwest. Not unlike other rapidly evolving health care systems, Advocate’s nursing leadership recognized there would be an intentional reduction in inpatient utilization across the enterprise requiring deliberate and preemptive resource planning. The system has the largest risk-based insurer relationship in the state, providing care for approximately 737,000 covered lives across its multifaceted provider organizations. Aggressive and appropriate care management is a corporate imperative as the system works to build the infrastructure to more effectively provide care in community-based settings and ensure patients are efficiently and effectively cared for in the appropriate level of care.

As an integral component of its population health strategy, the organization set about to reconceptualize the inpatient staffing model to create a more flexible workforce and construct agile models which provide the administrative infrastructure for human capital movement within and across hospitals and eventually into alternative settings as inpatient utilization declines. Specifically, over time, fewer and more flexible resources would be required in the acute care settings.

Furthermore, the system has been growing significantly over the years and recognized the standardization of staffing and scheduling practices, procedures, and workflows was a fundamental requirement in achieving the primary objective of building a flexible nursing workforce. The notion of a flexible workforce was further defined as the prudent and data-driven calculation of required core staff and the gradual transition to a higher percentage of flexible clinical resource unit staff with the clinical ability to work across several similar units within or across hospitals.

**Building a Flexible Nursing Workforce**

Utilizing a collaborative and multidisciplinary co-creative design process, a 40-member team representing nursing, finance, HR, and information technology from all the hospitals, redesigned and standardized all relevant policies, procedures, and processes across the enterprise. Additionally, demand-based staffing models were created for each unit and robust clinical resource units designed for each organization while the infrastructure was built to support regional resource units (see Figure 1).

To attempt an optimization project of this magnitude and complexity, system nursing leadership sought effective methodologies from outside of health care. It was recognized that while the problem itself was clinical in nature (providing the right nurse with the right skills at the right time for the right cost), it was, in fact, a logistics problem. Industries that rely on logistics science to manage the flow of goods, information, and people include the military, airlines, package delivery, and procurement and supply chain. There are two types of logistics: one that optimizes the steady flow of materials through a network of transportation and storage nodes, and a second that coordinates a sequence of resources such as human capital.

In studying the experiences of other logistics-oriented industries, several unique planning approaches were identified. These organizations spend a great deal of time studying and modeling their demand and core business processes; specifically those that drive revenue or conversely, those that account for an appreciable propor-
tion of expense. This analysis, of both supply and demand, suggest these are not static variables, but they fluctuate in predictable and unpredictable ways (Fitzpatrick & Brooks, 2010). When applied to the clinical environment, consideration must be given to how patient demand fluctuates seasonally, by month of the year, week of the month, day of week, and even hour of day. Arguably, in highly transaction-oriented units such as operating rooms and emergency departments, understanding demand at the 15-minute increment may be required.

Demand, in and of itself, is not sufficient to drive the staffing model. To budget and plan correctly for the required human capital, processes, practices, and procedures that determine the availability of resources must also be considered. These include staffing and scheduling practices, time off policies, vacancy and turnover patterns, HR position time-to-fill data, and, when appropriate, labor contract terms, to name a few. The antiquated technique of applying an hours per patient day (HPPD) target against an average daily census, often marked at midnight, is woefully inadequate in today’s environment. A simple practice such as a weekend work requirement may lead to a significantly different model result; an organization that requires every third vs. every other weekend will have significantly different resource requirements and require a different configuration of positions to assure adequate staffing while minimizing overstaffing.

Two distinct levels of optimization modeling were required to meet the business objectives. In the first phase of modeling, the organization solved to the optimal number and exact configuration of staff required to meet both the demand and the exacting system constraints or standard staffing practices. The second optimization exercise produced mathematically optimal schedule patterns; again, mindful of the various system constraints and variables.

### How Optimization Modeling Works

The historically intractable and multifaceted staffing problems the health system faced could not be solved using averages or simple algebra. There are multiple dimensions to each staffing subprocess that interact with or are somehow impacted by other extant processes. Powerful mathematical models are required to simulate solutions for these complex staffing and deployment problems, allowing for examination of these complex interactions three dimensionally. Optimization modeling based on linear programeing is a computational methodology that not only solves difficult problems with a single solution, but provides the best solution from a myriad of possibilities. Based on earlier work described by Fitzpatrick and Brooks (2010), the process of modeling is best described as mathematically representing every nuance or constraint and variable in the scheduling process, including demand, at least at the hourly level.

To mathematically represent the staffing business problem, the optimization model (see Figure 2) included the following:

- The business objectives including maximizing coverage at

### Figure 2. Workforce Optimization Model

<table>
<thead>
<tr>
<th>Multiple Objectives</th>
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</thead>
<tbody>
<tr>
<td>Minimize costs</td>
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<tr>
<td>Maximize preferences</td>
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<td>Perfect coverage</td>
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</table>

<table>
<thead>
<tr>
<th>Millions of Variables</th>
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<tbody>
<tr>
<td>Demand fluctuation</td>
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<tr>
<td>Skill and staff mix</td>
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<td>Cost differentials</td>
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</tbody>
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<table>
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<tr>
<th>Lots of Constraints</th>
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<tr>
<td>Staff availability</td>
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<td>Staffing and scheduling practices</td>
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**Optimization Engine**

**Best Solution**

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**Key Components of Mathematical Optimization**

- Effective Staffing Takes a Village: Creating the Staffing Ecosystem

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the desired nurse:patient ratio while minimizing costs.

• The decision variables such as skill mix, demand fluctuations, and cost differences.

• Business constraints such as staff availability, time off requirements, and various staffing and scheduling practices.

These are complex mathematical processes. To assist in communicating the methodology to unit managers and directors, executive nursing leaders asked the staff to envision a giant Rubik’s Cube whereby every small square on the cube represented a distinct demand value or individual work rule, practice, policy, or process component. The model was then dropped into a solver which essentially arranged the cube, in this case, 10,000 times/unit to produce the best answer to the business objective. For example, if a nurse could work no more than three consecutive 12-hour shifts, needed to be scheduled every other weekend, and needed to be paid overtime for hours over 40 each week, what is the optimal size and configuration of the position roster for this particular unit? Imagine the complexity of the model when considering the variation in hourly census.

Step 1: Creating the Model

The actual problem is defined as a set of mathematical equations (see Figure 3). All of the inputs, requirements, assumptions, and constraints as well as the objectives of the solution are defined. As an example, when modeling for the optimal numbers of staff to schedule for a particular period, the inputs would likely include the desired nurse:patient ratio or staffing target, weekend rotation requirements, unit’s nonproductive utilization, staff preferences, etc. In this case, the requirement was defined as an optimal and work rule compliant schedule which met the patient demand at the hourly level.

Model constraints included, for example, the need to schedule every nurse to his or her required full-time equivalency, the need to meet consecutive days worked requirements, and assuring the nurse was not be scheduled on a planned day off. Each of these qualitative requirements can be represented mathematically and, therefore, became part of the optimal solution. The objective of the model was a schedule with no holes that met the hourly demand but was mindful of the numerous work rules.

Step 2: Solving the Model

One hundred ten individual nursing units were optimized as part of this work. An individual

Figure 3. Quantitative Components of the Model

NOTES: ADT = admissions, discharges, and transfers; HPPD = hours per patient day; UoS = units of service; FTE = full-time equivalent; FMLA = Family and Medical Leave Act; LOA = leave of absence
model as described previously was created for each unit, facilitated through the standardization of staffing and scheduling processes across the enterprise. The model was solved utilizing advanced optimization algorithms and solver technology which permitted the ability to run 10,000 scenarios per unit. Without such advanced mathematical modeling capability, this would have been humanly impossible. A solution would have been produced, though not necessarily the best solution. Producing the best solution from the start eliminates much of the chaos felt each day as managers and staffing offices scramble to correct scheduling errors and unfilled shifts.

**Step 3: Interpreting the Solution**

Once produced, the answer is interpreted by the unit leadership. Each unit manager possesses unique knowledge regarding the operations of his or her particular department; therefore, it is critically important for his or her to review the results of the model, balancing the mathematical result with real world expertise. The benefit of creating the model, however, is the ability to run multiple alternative scenarios with different assumptions and understand the financial and coverage impact of each.

For most health care organizations, the time between operational best practice knowledge discovery and broad adoption is often measured in years. Lack of a systematic approach can hinder an organization’s ability to execute on known best practices and achieve desired outcomes. To migrate effectively to the optimal mix of core and flexible registered nurse staff as determined by the models and to effectively build and deploy local and enterprise float or clinical resource unit staff, standardization of key staffing and scheduling practices were required. A multidisciplinary design team was created comprising system and local site representatives from each part of the Ecosystem (see Figure 4) including clinical leadership, finance, HR, information technology, and clinical education. The design team met in three 8-hour sessions and standardized practices in scheduling and staffing for the entire system using current literature as a foundation for decision making as well as looking to improve employee work-life balance wherever possible. Three hundred and fifty disparate practices became 75 standardized practices to support a systematic approach that will assist in ensuring organizational change happens and is sustained over time.

**Building the Models**

Once the practices and processes were standardized and stabilized, leaders within the 11 hospitals began building the models by thoroughly assessing various qualitative elements within the Staffing Ecosystem. All functions – clinical leadership, finance, information technology, HR, and clinical education – have a significant impact on the ability to staff a nursing unit effectively. Whether that impact is a cultural expectation or an operational decision, the focus was on discerning the qualitative elements that created barriers to effective staffing. These qualitative characteristics included information on unit demographics, clinical education processes influencing orientation cycles, and current patient populations. In fact, the physical layout of the unit was also considered as geography has a significant impact on staffing. Key to the optimization process was the identification of the current model of care, including the expected nurse-to-patient ratios for the respective population on each unit.

Combined with the quantitative historical demand data, a powerful and holistic model was created. The ability to predict the future behavior of a system or process more accurately is best facilitated through the analysis of past performance and more data are better than less, presuming a
reasonably stable process. Accordingly, in an effort to understand and better predict future performance, the decision was made to analyze 3 years of hourly demand and payroll data for each of the 110 units across the 11 organizations. This “big data” approach involved more than 1 terabyte of data. Though more than a trillion bytes of data may have appeared overwhelming at first, it would have been impossible to plan resources across an enterprise of this size and relative complexity without a thorough understanding of the interplay of supply and demand holistically.

In preparation for implementing the optimal models and new processes, the staffing office functions at each of the facilities, as well as the extent of integration between the units and the staffing office, were examined and standardized. Understanding the current approach to staffing and scheduling allowed the project team to determine the magnitude of change required to migrate to the new optimized model. A fundamental object of this work was the production of schedules with no holes. The schedules were compliant with the objective functions described as standardized staffing and scheduling practices and procedures, essentially migrating staffing and scheduling precision upstream, thereby eliminating or minimizing the daily chaos related to staffing. This meant a more proactive and collaborative role for the staffing offices.

Effective Monitoring of Model Implementation

In addition to the standardization of practices, work processes, and tools, oversight teams were developed at each organization to support a systematic approach and ensure the achievement and sustainment of targeted outcomes. A Workforce Optimization Executive Ecosystem Oversight team was chartered at each hospital led by the hospital CNE. Membership included each hospital’s vice-presidents (VPs) of HR and finance, director of nursing finance, and clinical education leader. These teams meet monthly and ensure all elements of the Staffing Ecosystem are achieving their functions to assure optimally staffed patient care units. Each team will accomplish their mandate through the following activities:

- Develop and implement mechanisms to gauge progress towards successful implementation of the Workforce Optimization Model’s goals.
- Review the staffing issue trends from consolidated unit-based root cause analyses, vacancy reports, the hospital’s staffing configuration plan, and Registered Nurse (RN) Associate Pulse Surveys regarding satisfaction with scheduling and staffing practices.
- Identify common cause vs. special cause variation which may necessitate remodeling (a significant change in demand, a sustained increase in the use of nonproductive time, or a change in staffing model).
- Problem-solve opportunities to remove barriers for nurse managers and nurse finance directors to achieve optimized staffing.
- Effectively communicate the activities of the Workforce Optimization efforts to multiple internal audiences including the hospital and system executive teams.
- Review the outcomes metrics for the Workforce Optimization Model. Table 1 illustrates the metrics reviewed at each Ecosystem meeting and the responsibility for each metric. The leader of each function will bring current and year-to-date results and additional information to that meeting as a means to explain variances to target.

In addition to standard metrics and oversight team roles and responsibilities (see Figure 5), standard work was designed for the role of the director of nurse finance. A standard agenda was created with critical information assigned to each leader within the Ecosystem, which ensures a systematic approach to achieve optimal outcomes with staffing across the entire enterprise.

Standard Change Management

The organization embarked on this enterprise-wide transformation to improve performance on staffing, build the workforce needed to meet present and future patient needs, and to thrive in today’s changing health care landscape. A critical piece of the work to drive adoption of the models and deliver expected results across
the enterprise was to have a standard change management approach. This process was developed by System HR Organizational Development (OD) leaders and deployed individually to each hospital. Through this process, the organization could align and address system and local hospital change management and transition needs focusing on:

- Standard staffing and scheduling practices.
- Staffing model changes.
- Shifting to a flexible workforce addressing potential changes in hiring, unit perception, and patient assignments.

As environmental complexity intensifies and interdependencies within and between organizations and disciplines evolve, the methods of analysis and the magnitude of data required to make decisions must advance as well. Visualizing, querying, processing, and harnessing big data related to understanding supply and demand is the first step in using predictive analytics and other advanced methods to extract value from data. This will lead to more confident decision making resulting in greater operational efficiency, cost reduction, and reduced risk. While insurers and health systems are now analyzing these big data sets to drive clinical decision making, workforce optimization has demonstrated the impact of this level of sophisticated data analysis on the critical task of right-sizing, right-configuring, and deploying nursing resources. The daily fire drills that occur in staffing offices are completely unwarranted and an imprudent misplacement of precious management time and effort. More precise and data-driven modeling will significantly improve these processes, permitting managers to refocus attention and expertise on value-added activities important to patients. While we often discuss the necessity of clinical staff working to top of license, the Advocate Healthcare system is working to provide the same advantage to leaders—performing work at the highest levels where their unique contributions will provide the greatest benefit to patients and associates alike.

REFERENCES

ADDITIONAL READING
Instructions For Continuing Nursing Education Contact Hours

Effective Staffing Takes a Village: Creating the Staffing Ecosystem

Deadline for Submission: April 30, 2018  

To Obtain CNE Contact Hours
1. To obtain CNE contact hours, you must read the article and complete the evaluation through the Nursing Economics® website at www.nursingeconomics.net/ce
2. Evaluations must be completed online by April 30, 2018. Upon completion of the evaluation, your CNE certificate for 1.3 contact hour(s) will be mailed to you.

Learning Outcome
After completing this learning activity, the learner will be able to recognize the need for more precise data-driven inpatient staffing models.

Fees — Subscriber: 10  Regular: $15

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