Hospital Staffing Optimizer

Forecasting patient demand for better hospital staffing
Overview
Advanced science and predictive analytics can now be applied to accurately predict patient volumes in Emergency Departments (EDs) and other areas, but few hospital systems know how to leverage this information in developing their staffing plans. In fact, more than half of all hospitals still use handwritten schedules based on the number of beds available or on historical averages for patient census. These old approaches do not effectively align staffing levels with actual patient volumes and therefore drive up patient wait times during peak periods and staffing costs during lulls.

Staffing Optimizer addresses these issues with powerful predictive analytics and optimization models that generate accurate patient forecasts and align them with even the most fragmented staffing schedules. It flexibly handles certification time, PTO requests, shift swaps, and more to generate patient-optimized schedules — all in far less time than manual approaches. We continually work directly with healthcare professionals to ensure Staffing Optimizer addresses the varied needs of nurses, directors, administrators, and patients.

While this paper focuses on ED staffing (which has a significant need for better ways to predict its unscheduled patient flow), Staffing Optimizer has a far broader purview. First, ED is the top of the funnel for the majority of patients within a hospital, so efficiencies that occur here have positive ripple effects throughout the facility. Second, Staffing Optimizer can generate staffing schedules for every department, meeting their specific patient and financial targets.

Staffing is the largest item in a hospital’s cost structure. As costs continue to increase, hospitals must seek out new tools and approaches that help manage these costs without harming patient care.

Accurate patient forecasts are the foundation of schedule optimization
Correct baseline forecasting is paramount in achieving the accurate staffing levels that will help minimize wait times and improve overall patient satisfaction. The widely accepted practice of scheduling based on the number of beds in the ED and a patient-to-nurse ratio target (with the anticipation of calling off staff if the census is light) leads to higher-than-necessary staffing costs and more dissatisfied RNs. A better way is to use advanced analytics to accurately predict the inflow of patients at a highly granular level: e.g., by hour of the day, day of the week, and month of the year.

Many staffing solutions will claim to provide a forecast but are actually calculating only historical average, which leaves out key factors. In a pilot study across seven hospitals, historical averages delivered results that were 18% less accurate than those delivered by a regression model. Staffing Optimizer forecasts patient volume using this type of model over historical patient inflow trends and external variables. It is updated via exponential decay average (which assigns greater weight to more recent data). The model is self-learning: it can adapt to changes in baseline volume, weekly and hourly patterns, and so forth without human intervention.

Because every hospital exists in its own market area, models are built and trained for each individual hospital. A baseline forecast is built based on both global and local factors, such as seasonality, holidays, location-based health alerts, or one-time events. The data is further segmented by acuity level.

“Staffing Optimizer lets us predict what our patient census will be and match the staffing to that census, thereby decreasing patient wait times.”

Ann Spade, Chief Nurse Executive, Carlisle Regional Medical Center, Carlisle, PA
Other factors are also appended, such as length of stay and admit hold. This data, combined with sophisticated algorithms, allows Staffing Optimizer to identify the expected patient demand by a defined hour block.

Once the demand forecast is in place, it’s fed into a simulation module that runs various patient arrival scenarios in four-hour slots. Staffing Optimizer simulates wait time for each scenario, also taking into consideration treatment times based on acuity and the target wait time.

The module runs all the patient arrival scenarios while increasing the number of nurses. It ensures that regardless of when the forecasted patients arrive, there are enough nurses to handle them within the acceptable amount of time.
Once all the forecasted patients have been seen by a nurse in the simulation, Staffing Optimizer determines whether or not the wait times have met the targets set by the hospital. If the wait times exceed the target, it runs the simulation again and continues to do so until the target is met. From there, it is able to calculate the optimum number of nurses for each four-hour block.

Then Staffing Optimizer feeds that number, as well as work patterns, approved days off, preferences, hours-per-week requirements, and other constraints, into the optimization models, placing nurses into shifts. The model uses a combination of local search algorithms such as tabu search and simulated annealing to find the best fit, minimizing the conflicts arising out of the hundreds of constraints that appear in a typical four- or six-week schedule. The result is a nearly complete recommended schedule for the ED director to review.

Simplifying the scheduling process benefits directors and staff alike

Building staff schedules is a highly complex process. Executing a set schedule pattern, accommodating PTO requests, incorporating education time, and avoiding overtime are all factors that need to be managed. Faced with the demands of an active emergency department, patient issues, certification training, and company meetings, directors have little time to think strategically about staff schedules.

An optimization tool that can take into consideration the characteristics of each individual staff member (e.g., his or her work agreement, weekend rotation, and PTO requests), as well as the number of full-time staff members on the floor and the preferences and available days for per diem resources can dramatically reduce the time required for scheduling. We have seen reductions from several days down to less than an hour.
Here’s how it works: with Staffing Optimizer, ED director logs into the solution, say, two weeks before the next schedule is due. She names the schedule, confirms the dates for the next scheduling period, and clicks submit. The scheduling solution generates a suggested staff schedule based on the projected patient flows, the profile of each staff member, and his or her current PTO requests.

The ED director reviews the recommended schedule and fills any potential holes with existing staff. She can present these shifts as “open” and allow staff members to apply for them via an easy-to-use interface. As a last resort, she can leverage overtime hours. After these final adjustments, she publishes the schedule and a notification automatically goes out to staff that the next schedule is available online for review. The whole process is complete in a fraction of the time that traditional methods require.

Working online, a staff member can view the schedule, submit future PTO requests, track expiring certifications, apply for any open shifts, and request shift swaps — all in an automated and efficient manner. Allowing staff the control to manage many aspects of their schedules creates more engaged employees and subsequently increases job satisfaction while reducing turnover.

“The staff loves it. They’re able to get onto the system from home, and it’s much less of a paper trail for me.”

Tracey Rush,
Director, Emergency Department,
Carlisle Regional Medical Center,
Carlisle, PA

The recommended schedule has color-coded shifts, based on length of the shift, and open shifts for the director to fill in.
Set targets — and be alerted when you’re at risk of missing them
100% of the hospitals that have installed Staffing Optimizer are now consistently meeting their target wait times. When administrators set clear, specific targets, Staffing Optimizer ensures that those targets are met. It alerts directors to changes in patient census and wait times, excessive PTO utilization, dips in patient satisfaction, and more.

The ability to aggregate data from disparate sources allows all of these factors to be incorporated into scheduling decisions. Alerts link hospital administrators to a dashboard with access to each metric, a comparison to the department target, and historical trends. These metrics are also incorporated into the model as foundational components to ensure staffing guidelines align to patient and financial targets.

With all of these tools, targets, and metrics in place, the ED Director now has the ability to adjust the schedule for lighter periods, level out non-productive hours across the weeks, and minimize overtime. Staffing Optimizer benefits the organization at every level.

“Staffing Optimizer is a win for our directors, and it’s a win for our staff. And most importantly, it’s a win for our patients.”

Matt Stapleton,
Atlantic Division
Emergency Department Manager,
Health Management Associates

Nurses and other staff can control shift swaps on their own. They choose the shift they’d like to swap out and select those they’d be willing to accept in return.

Incorporating Staffing Optimizer is easier than you think
This type of staffing solution doesn’t require a heavy IT investment or an overhaul of your existing system. Staffing Optimizer can incorporate analytics-based forecasts with machine learning scheduling solutions, customize each model based on an individual hospital’s patient data and be delivered as a cloud-based solution. This means no changes to IT or infrastructure. It uses data already in the hospital system, and the implementation process is done in just a few months.

By consistently keeping patient wait times below target, avoiding costly overtime, and reducing personnel hours by 3–8 percent, Staffing Optimizer can generate a 400 percent ROI over three years. Designing an advanced analytical solution that can predict how many patients a hospital will have at any given hour is a complicated endeavor — but making the decision to implement it is not.

With 200+ advanced-degree scientists specializing in machine learning, plus deep domain expertise in healthcare, Opera Solutions is breaking new ground in applying analytics to drive operating and performance improvement in the industry. And since our solutions are designed to integrate easily within existing processes, they deliver bottom-line impact right away.
# Opera Solutions Healthcare Products

Opera Solutions’ offerings to healthcare providers use advanced analytics to significantly improve hospitals’ operating efficiencies, increase revenues, reduce expenses, and even improve patient care.

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<th>Product</th>
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<td>Hospital Revenue Leakage</td>
<td>Find missing charges and present them to auditors in a prioritized list.</td>
<td>Finds an average of 25–75 bps of revenue — on top of existing solutions; reduces auditor expenses by 50–85%.</td>
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<td>Hospital Staffing Optimizer</td>
<td>Predicts patient inflows and staffing needs; creates schedule accordingly.</td>
<td>Reduces patient wait times, increases scheduling manager’s productivity, improves nurse job satisfaction, provides oversight into department performance.</td>
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<td>Hospital Supply Chain</td>
<td>Identifies and presents buyer non-compliance, rebate underpayments, and incorrect tiers and pricing.</td>
<td>Has generated over $1 billion in sustainable profits for a major hospital group. Staff are trained to use the software in a way that allows additional savings capture over time.</td>
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<td>Hospital Compliance</td>
<td>Detects statistical outliers in admissions, referrals, and coding as they emerge.</td>
<td>Alerts auditors to errors, abuse, and fraud early on, increasing productivity and reducing risk for the hospital.</td>
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<td>Hospital Collections</td>
<td>Provides visibility into bad debt and recommends solutions upstream and downstream in the collections process.</td>
<td>Finds collections opportunities and presents strategies for improving collections rates in both pre- and post-bill environments.</td>
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