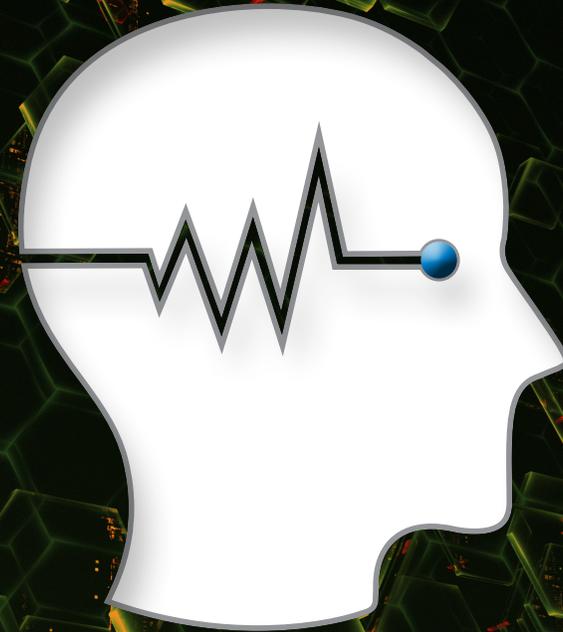




DIGITAL TRANSFORMATION IN HEALTH

# Insight



OPERATIONAL ANALYTICS

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On any typical day, a hospital's Chief Operating Officer assembles the facility's department heads to review operational issues that may have arisen in the previous 24 hours.



"Think about the cost associated with a meeting like this," said Michael Hollenbeck, CEO of Proskriptive, a Boise, Idaho company specializing in clinical and operational analytics for the health industry. "Department heads are among the highest paid staff. If you're at a large hospital, that's thirty to forty person hours consumed on a daily basis, just for this one meeting. And what have they accomplished in the end? Very expensive data gathering."

Once hospital operations recognize a problem, the time it takes to determine the problem's source, quantify its impact, figure out how it occurred, and decide how to address it can be days, weeks, or months. This inefficiency costs money, and possibly even lives. Reducing the latency in this process can have far reaching effects on an organization's effectiveness and bottom line.

"Now let's say my hospital is using real-time data, including data from sensors," Hollenbeck continued, "plus I have data sourced from electronic medical records. On the computer screen in front of me, I have a Power BI dashboard. My statistical control chart for each department displays my exceptions. The data gets collected automatically, and the BI feeds update my charts on a constant basis. I know

*before* I go to the morning staff meeting where we stand. It's important to get folks together, but now we are managing problems and action items rather than using valuable time to collect data. My meetings drop from an hour to 15-20 minutes, and the hospital has just improved its effectiveness, including freeing up a substantial amount of time to care for patients and work on other high value tasks."

## Using analytics to improve care

As health organizations digitize medical records and claims data, and as smart medical devices become capable of streaming real-time data, the amount of available health data will continue to grow exponentially. "We're moving into this digital era of more and more information coming together, so why wouldn't we use it for valued, secondary use cases?" asked Dr. Simon Kos, Chief Medical Officer at Microsoft. "If we just dump it into records, that's an asset we're not utilizing. How about we start to interrogate this information and turn it into some sort of actionable evidence?"

"Even within organizations people are struggling with their own data," said Hollenbeck. "People running the revenue cycle may have multimillion dollar systems, but they can't even get the data to understand who's paid and hasn't paid, so their receivables have gone from an average of 20 days to 50 days. It's not

enough to just produce a report. We consider ourselves successful when we help achieve the outcome." Analytics is the process of transforming raw data into information that researchers and organizations can act upon. "In health, we can produce benchmarks to shine a light into our quality and our performance," said Kos. Analysts can compare metrics among departments or between hospitals, helping identify best practices that can improve the quality and effectiveness of care.



### Clinical analytics

"Clinical analytics helps care teams examine individual patient outcomes and group quality measures," explained Kos. "For example, if I work in an emergency department, I can ask questions like, how many patients are getting complications? What's the rate of medical error?

What's the average time for someone having a heart attack to be seen by a cardiologist?"

#### Other common clinical questions involve risk and patterns:

- Which individuals are at higher risk for re-admissions or hospital acquired infections?
- Which patients, given the same risk factors, have the highest risk of developing diabetes?
- Which patients are not following up or not compliant with their therapies?

### Operational analytics

Analytics can also illuminate the business side of running an effective health care service. "Operational analytics is about making the best use of all resources in support of care delivery processes," said Tom Lawry, Director of Worldwide Health at Microsoft. "These are resources like staff, facilities, and supplies."

#### Operational questions focus on issues such as efficiency of transactions and throughput:

- What is the right number of people needed on staff for any given shift?
- What is the optimal time to transfer a patient to or from the ICU?
- How can I fix patient bottlenecks?

“Revisiting the emergency department example, we might take measurements like how many patients we run through the emergency department and the waiting time per condition,” said Kos. “When we go to admit patients, how long does it take us on average to turn around consultations and get them up to the ward? What percentage of the time do we have to divert ambulances from the emergency department because we’re at capacity? Then we ask if we’re staffing the right way. Do we have the right number of people at the right time? Do we need to change the staffing mix?”

## Analytics 101

Both clinical and operational analytics follow a progression that starts with looking at the past and ends with shaping the future.

### Descriptive analytics

The first step is to capture “what happened.” How many hospital-acquired infections, readmissions, or payment denials are occurring? When do they happen? What kind of patients are involved? Suppose there’s an industry or government-mandated benchmark. Are you doing better or worse than the standard? This descriptive form of analytics may be as simple as drawing a chart from data in an Excel spreadsheet. More powerful tools like Power BI can

create reports or dashboards that visualize data contained in Excel or other formats, such as SQL Server databases that live on-premises or in the cloud.

Self-service is a major advantage of analytical tools. With self-service tools, knowledge workers can slice data any way they want and visualize it instantly. They can graph trends, such as revenue and expenses over time, number of patients treated month over month, readmissions rates, or number of hospital acquired infections by department. These types of reports are important not only for internal operations, but also for reporting to interested parties like government agencies charged with oversight. “When people can run their own reports, IT professionals and data scientists can spend more of their time running and interpreting advanced data models,” said Lawry.

### Diagnostic analytics

The more data you have, the more you can learn. Not only can analytics tell you what is happening, it can help you understand why. Diagnostic analytics does this by identifying and validating meaningful data correlations. For example, Internet of Things (IoT) soap dispensers are showing more frequent use while hospital acquired infections (HAIs) have gone down. Or, participation in payer-sponsored wellness programs has gone up while claims for illness-related doctor visits have gone down.

More complex analysis involves pulling data from multiple sources, which is not always easy. In most health organizations, data exists in multiple silos created by different tools that use different formats. Sophisticated analytics engines must “ingest” this data and normalize it, which means aligning the data values so that algorithms can understand them. Once this is done, algorithms can compare different sets of data, such as data from different organizations or different regions, to reveal causal relationships.

For example, researchers could compare HAI rates at hospitals using regular soap dispensers to those at hospitals using IoT dispensers to determine whether monitoring hand washing helps prevent HAIs. Perhaps one hospital, operating theater, or care team has better success metrics than another. Using data analytics to compare what’s going on in both places can help pinpoint which differences have the most impact, enabling hospitals to make improvements and provide better care.

### Predictive analytics

Traditionally, data analytics has been about looking backwards. With the amount of data available today, and the practically infinite processing power available with cloud computing to process it, predictive analytics is now possible. Algorithms can compare partial patterns with complete patterns to predict where the partial patterns are heading. The more

data an algorithm consumes, the more it can confirm its assumptions about the patterns, and the more accurately it can look into the future. This is the realm of machine learning.

Machine learning is a subfield of artificial intelligence (AI). Typical IT systems facilitate productivity and workflow. AI extends these capabilities so that IT systems can sense, learn, understand, and make informed decisions. Machine learning focuses on helping IT systems gain intelligence from specific data algorithms. For example, Microsoft has machine learning algorithms that analyze patterns for cyberattacks so they can identify when a potential attack is in progress and help organizations take automated, preemptive action.

“It’s quite clear that machine learning is going to be very critical in the future,” said Hollenbeck. “As population health becomes a larger topic, machine learning is a critical technology used to identify at-risk people, at-risk situations, or, maybe put a different way, to find opportunities.”

“Twenty-five years ago, to get somewhere, you either drew a map on a napkin or you asked somebody directions,” said Dr. T. Greg McKelvey Jr., Head of Clinical Insights at KenSci, a health analytics company based in Seattle. “That’s where medicine is right now. It’s a picture. We don’t need to move to



automated diagnoses. We need the equivalent of something like Bing Maps, something that is integrating the information you have about where you are right now to tell you a little bit about where you are going, so you can make a decision.”

[Learn how KenSci helps health organizations identify cost risks, and ways to optimize cost of care delivery.](#)

One delicate decision area is end-of-life. “Intuitively physicians are not very good at telling terminal patients how much longer they have to live,” said Dr. Tom Louwers, KenSci’s Associate Medical Director for Clinical Insights. “There is a role for machine learning in teaching physicians truly how much time a patient has. Studies show that we doctors are very bad at that. Terrible. We spend the vast majority of our healthcare expenditures at the very end of our lives, often doing things to people they would never have agreed to given the opportunity to make an informed decision.” KenSci has an algorithm that can accurately determine, 300 days in advance, when an ill patient will die. “While this may sound morbid to the average person, it’s really about patient empowerment,” said McKelvey. “People want control over their care.”

## Prescriptive analytics

When people know what has happened, why it happened, and what is going to happen, they can better plan their next course of action. This is the domain of

prescriptive analytics. To give a simple example, an equipment sensor can continually report on the health of a part. Based on past data readings that correlate to part failures, an analytics algorithm can “learn” when a part is about to fail, send a warning, and recommend corrective action. The person responsible for maintaining that piece of equipment can then proactively repair or replace that part. “The question is how we interpret and combine what we have learned through analytics algorithms with other knowledge to determine what action or series of actions should be taken,” said John Doyle, Senior Industry Solutions Manager, Microsoft Worldwide Health Marketing. “A customer specializing in genomics once told me, ‘It’s great that we’re sequencing all these genomes, but without the clinical interpretation to tell me what I should do based on all of this new data, it’s just more data.’”

**“If analytics can’t help in the decision making process, then simply having more data available more quickly only adds to the problem.”**  
– John Doyle, Senior Industry Solutions Manager,  
Microsoft Worldwide Health Marketing

Predictive analytics can help determine clinical and operational strategies. “Suppose I have a sick patient with a set of symptoms who is a certain gender, ethnicity, age, height, and so forth,” said Lawry. “Now say I have data on the success or failure of specific treatments for other patients with the same symp-

toms who are the same gender, ethnicity, age, and body type. I have information on which treatments have worked for similar patients, so those are the first ones I’m going to try. Then I’ll be able to track whether that treatment is successful for this patient, and feed that information back into the data pool so it can help other patients.” Less trial and error leads to better outcomes, which reduces wasted effort as well as costs, and enhances patients’ lives.

[Learn more about Microsoft’s vision for artificial intelligence in health.](#)

## Reining in cost

Countless initiatives have focused on improving both the cost and quality of healthcare delivery. Health organizations must measure and report on the care they provide to those who are paying for care. The shift from the traditional fee-for-service (FFS) business model to value-based care in the United States and other countries is making analytics attractive for monitoring operational effectiveness. “Changes to risk bearing payment models are providing the incentive and driving the need for analytics from vendors like Proskriptive,” Hollenbeck said.

“CFOs are under tremendous financial pressure with regulations,” said Louwers. “Our work at KenSci is



bending the cost curve down for them. This is also an opportunity for them to improve their quality of care and patient safety numbers. Bottom line, they're going to improve their patient satisfaction and reduce their costs."

"Financial improvement is a byproduct of operational improvement," said Lawry. "In hospitals today, adding inpatient beds to manage growing demand is cost prohibitive. A better approach is to use advanced analytics to identify and predict where bottlenecks in patient flow occur and make changes to reduce or eliminate them."

[Learn how Proskriptive can help health organizations achieve efficient management of resources.](#)

### Reducing risk

The goal of risk management is to increase safety and reduce costs from incidents such as accidents, illness among staff members, and power outages. Organizations can use analytics to identify and reduce risk so they can improve operational practices and meet regulatory standards.

One of the biggest areas of risk is readmissions, particularly for hospitals that get fined if readmission rates are too high. "Preventable readmissions is both a quality and cost issue," said Lawry. "Today, we see innovative hospitals 'risk rating' patients for readmissions as they are admitted and go through the care process. When care managers identify at risk patients, they can incorporate ways to mitigate this risk up front." Risk mitigation also allows for more optimal use of staff such as care coordinators and discharge planners.

The same principle of using predictive analytics to risk rate patients is also being applied to other "risks" such as falls and hospital acquired infections. Analytics becomes a platform to identify and address any type of risk, which can have far reaching effects on care outcomes and cost.

Since 2009, Epimed Solutions has worked to better manage the influx of chronically ill patients into Brazilian ICUs and long-term care facilities. Epimed developed an operational analytics solution using Azure Machine Learning that monitors quality assurance and clinical performance in near real time. The solution has helped reduce hospital acquired infections (HAI) by 21 percent and ICU deaths by 30 percent. Improved ICU efficiency has increased hospital throughput to the equivalent of adding 30 percent more beds.

[Learn more](#)

### Optimizing staff scheduling

The critical issue of staffing, the most expensive cost in healthcare, falls squarely into the wheelhouse of operational analytics. "Ideally, as with any service business, you want the right number of people, with the right level of skills, positioned exactly where you need them at precisely the right time," said McKelvey. "The real world rarely allows scheduling perfection." A major unexpected happening—the very definition of an emergency—could overwhelm an emergency

department staff. How do you anticipate multiple car accidents and other surprise events?

"If you think about it, when are violent injuries most likely to happen?" McKelvey continued. "Probably 2:00 AM. on a weekend when the bars close. There's temporality involved, and social events with people in crowded places and lots of alcohol. These impact emergency admissions. We capture these signals by looking at fluctuations around the date and the time. Emergency docs say that when there's a Seahawks game on in Seattle, no one comes in. But later, after everyone's had their drinks, the ER gets crowded. We integrate the temperature, the weather, the flows of the season, words, patterns, and all kinds of information, into our predictive algorithms. I may have a hospital in one part of a city, and another nearly next door, which may have completely different geographies and populations around them. The risks of medical emergencies are different for each location. Our algorithms learn to differentiate."

### Discharge planning

Discharge planning can involve significant costs that are too often difficult to control. "This is a great opportunity for applying analytics," said Hollenbeck. "I can't tell you how many meetings I've attended where staff agonized over the causes of nonclinical delays in patient discharge."



Recovery from illness or high risk of readmission does not always determine when a patient leaves the hospital. A patient may be several days past their anticipated discharge date because they have no care facility to go to once they leave the hospital. "Typically, a scheduling nurse will call facilities to find a bed for that patient," said Hollenbeck. "Maybe the nurse can't get some facilities on the phone. Maybe others don't have beds available. Others may have space, but can't accommodate this particular patient's needs."

Just as a hotel reservation service keeps track of available rooms and their amenities, operational analytics tracking vacancies in real time could automatically pair patients with appropriate, available

facilities. "Say I have ten places I can send the patient, each one with different quality of care," said Hollenbeck. "Which specializes in the type of follow-on care this patient needs? Which is closest to the patient's home?" The right type of analysis could also plot long-term trends that are not easy to extract manually, which could help skilled nursing facilities with staffing and capacity planning.

### Insight drives foresight

The goal of healthcare has always been to figure out what ails the patient and then help them get, and stay, healthy. Harnessing data to provide clinical and operational insights can help improve patient diagnoses, treatments, and outcomes. "For health and care professionals, having timely access to all relevant information from across health and care services is essential to delivering a high-quality care, ensuring the best possible outcomes for patients," said Doyle. "Empowering operational analysts with end-to-end analytics capabilities improves operational performance and drives efficiency throughout the care continuum."

**"The problem isn't lack of data, but getting ready access and pulling out insights that are truly useful and actionable. To do that, you need lots of computing power, meaning the cloud."**

**—Tom Lawry, Director of Worldwide Health, Microsoft**

“Microsoft has vast resources powering our cloud analytics engines, including sophisticated machine learning algorithms that no other company has,” Lawry said. “Imagine trying to set up this kind of infrastructure on your own, then managing it and keeping it compliant. Instead, you can use some of ours, and you only pay for what you use.”

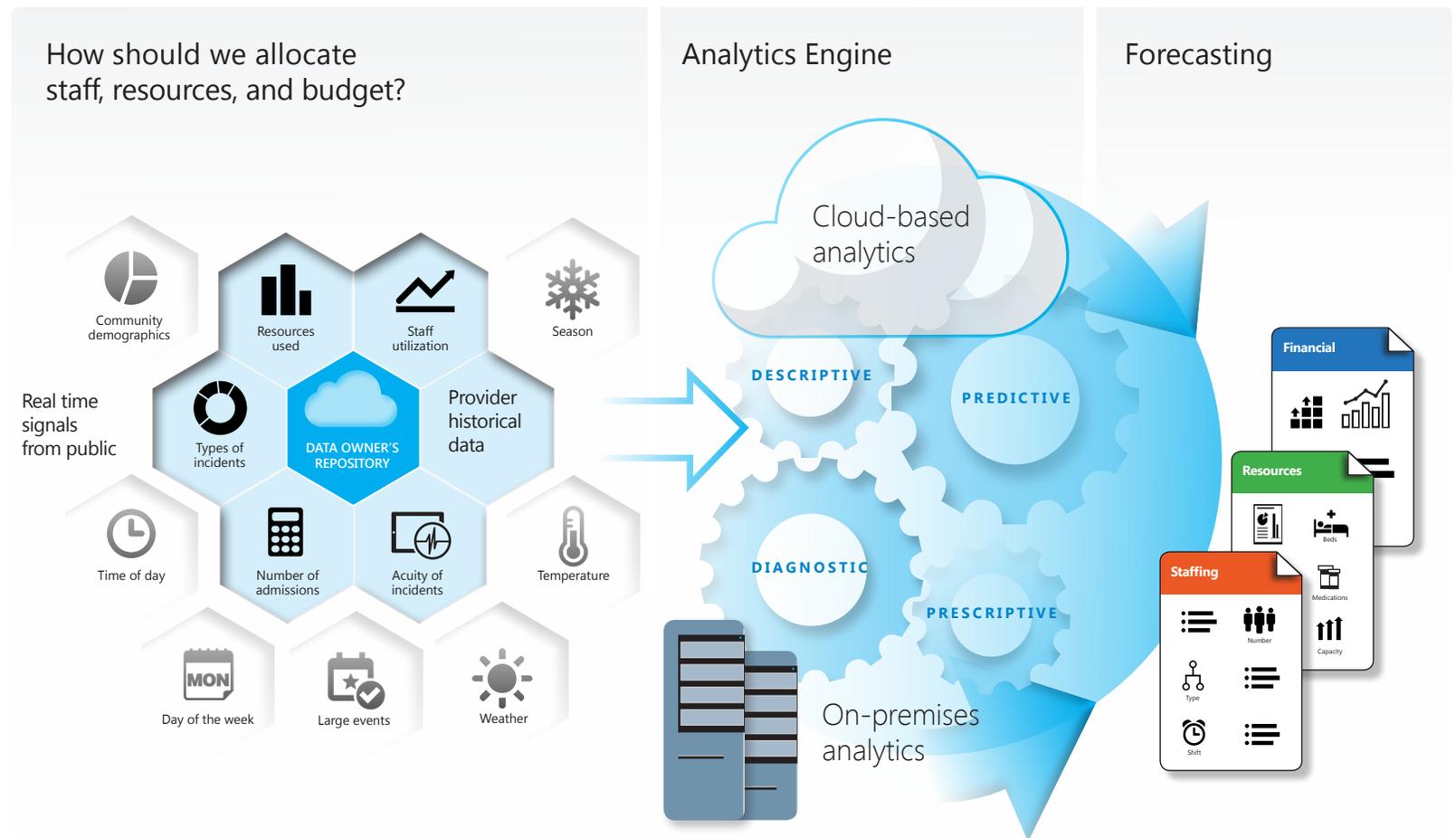
Microsoft Research, Cochrane, and the UK’s National Institute for Health and Care Excellence (NICE) are using Cortana Intelligence and Machine Learning to conduct systematic reviews on data to help improve the decision-making process in healthcare.

[Learn more.](#)

Organizations not yet ready to move into the cloud can still benefit from analytics. “Cortana Intelligence is our cloud framework for analytics, but it’s not our only way to create an analytics engine,” Lawry explained. “We also provide great options like on-premises SQL Servers. In other words, your data can be anywhere. Any or all components can be in the cloud, on-premises, or some combination of the two. And we offer strong security, no matter which configuration you are using now or in the future. This is actually one of our greatest strengths—flexible approaches for managing care and resources across all the care continuums.”

[Learn how to turn data into intelligent action with Cortana Intelligence Suite services from Microsoft.](#)

## Operational analytics help health organizations optimize care delivery





[www.microsoft.com/health](http://www.microsoft.com/health)

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