PREDICTIVE ANALYTICS: Using Data to Enhance Clinical Quality
Hospitals and health systems continue to strive toward harnessing big data to drive systemwide cost management and quality improvement efforts. Through predictive analytics, hospitals can use technology and statistical methods to cull through historic and real-time data to forecast trends and change behaviors, ultimately improving outcomes and patient experience, as well as the bottom line. In the era of value-based care, it’s imperative for organizations to have a solid management strategy and organizational framework for making digital assets work for administration and front-line clinicians. Health Forum convened a panel of hospital executives and industry experts July 18 in San Diego to discuss the use of predictive analytics to enhance clinical quality. Health Forum thanks the participants, as well as VigiLanz Corp. for sponsoring this event.
MODERATOR (Suzanna Hoppszallern, Health Forum): How are your organizations currently using predictive analytics, and what challenges have you encountered along the way?

TRISH GALLAGHER, R.N. (Carilion Clinic): We’re in the early stages, using it mostly for readmissions. We just completed a project around catheter-associated urinary tract infections that started out as a performance improvement initiative and grew into analytics, looking at providers’ ordering practices and evidence-based care. We’re still getting the organization ready for analytics, though. We have a fairly large data governance initiative underway to help drive the shift toward predictive analytics.

The biggest challenge we face is the data. We have so many different sources of data, many reporting on the same thing. The result is that there are many sources of truth; we need to whittle it down so we are working from one source. We’re trying to get people on the same page, and our data governance is starting to do that. We need to educate everyone on the difference between reporting and analytics. Another challenge is that we can’t get it done quickly enough. Our clinicians want the data now. We’re trying to turn things around as quickly as possible. And, unfortunately, people are trying to figure out ways to access data on their own. If they can’t get them from the central data office, then they’ll get them another way.

GEORGE CONKLIN (CHRISTUS Health): We are a 44-hospital system with several hundred clinics, doctors’ offices and other organizations in the U.S., Mexico, Chile and Colombia. We have access to a tremendous number of exciting resources for analytics, and we have the same issues that Trish mentioned in relation to the collection and management of data. We do have a data management governance committee to help us with this issue. It’s been in place for about two years and has become effective at creating the uniform definitions that we need for our data. We’re growing so quickly that we’re always having new sources of information coming into the organization, so are constantly having to figure out how to map another organization’s data into our data and to bring it into our systems. For example, we’re partnering with Ochsner and other organizations across our markets. We don’t expect Ochsner to change the way that it’s doing business, so we have to figure out a way to align what they’re doing. That’s a big challenge.
LYNN WITHERSPOON (Ochsner Health System): We’ve had automation in place for many years and our initial efforts around analytics happened in the mid-’50s when we thought it would be a great idea to understand how well we’re taking care of our patients and to help doctors understand how to provide the best care. Our efforts quickly became focused more on the finance side, around adherence to insurance contracts, etc. Over the last 15 years or so, that’s been the case. We’ve not had a real focus on clinical analytics. More recently, we consolidated our infrastructure on a single electronic health record platform. Now we’re awash in clinical data, at least data that were gathered in clinical domain settings. If you think about an EHR, it’s a large, messy aggregate of data that comes from many different sources. The real challenge is going to be the quality of the data that we have, and whether it truly represents what’s happening at the point in care. Data governance has had some success, but then we become awash with new sets of data that challenge our ability to maintain coherence. The growing pains are pretty substantial.

JIM VELINE (Avera Health): We’re very integrated, partly due to our strategy, our governance and our growth over the last 25 years. It also has to do with the communities that we serve. We are often the sole provider in many communities. We’re fortunate in the sense that we have a homogeneous database across the continuum of care, which many organizations in urban settings are still fighting to resolve. Right now, we’re focusing on two areas. One is analyzing the data we have specifically as they relate to readmissions to hospitals from long-term care facilities. We’ve had a great deal of success in the last 12 months in being able to identify the characteristics that are most likely to predict readmission and have successfully reduced readmissions as a result of that analysis. The one area of the continuum that we don’t manage or own or control is retail pharmacy. And retail pharmacies spend in the payer world in excess of 15 percent of the total claim. That being said, that’s a piece of this that we have to get our arms around. So we’re working with two retail pharmacies and a consulting agency right now to capture dispensed data. We’re doing pretty well in capturing data that have been prescribed, but we do not have dispensed data. So trying to capture that data which, in essence, represents the gap between what’s prescribed and what’s dispensed is a critical factor for us. And we’re making a lot of headway on that right now.

ADAM KLASS (VigiLanz): VigiLanz provides a platform that sits on top of the EHR. We have about 400 hospitals around the country that have been using our services for many years. We assess the hospitals’ data streams to do their real-time workflows. As this information comes in, we standardize and normalize the data, the real key to making true quality data. As we run our rules engines against those data, the data are fed into machine learning models for scenarios around sepsis or other conditions, alerting clinical staff in their workflow before a patient becomes septic. That’s really what VigiLanz is focused on right now.

JONATHAN PERLIN, M.D. (HCA): There’s been great progress in hospitals and health systems across the country to make care more effective and data-driven. At HCA, we have the benefit of scale on a diverse and broad platform around the country, and through that we accumulate a great deal of data. We have the privilege of having 28 million patient encounters annually, with about 168 hospitals and more than 1,000 sites of care ranging from ambulatory surgical centers to urgent care centers and physician practices.

Over the last few years, in conjunction with meaningful use, we’ve augmented our enterprise data warehouse to include all of the clinical data created within our various systems. We knew that meaningful use would compel the digitization of our work. That data stream, if captured, becomes the fuel for continuous improvement and the basis for precision medicine that tailors therapy directly to clinical needs, and the personalized tailoring to all the circumstances based on the range of data from the most molecular to personal preferences and needs. That’s how we envisioned our data system.

As I said, we’re blessed with a great deal of data. If the printed matter within the Library of Congress were the moon and Google were the sun, we’d be somewhere between Saturn and Jupiter in terms of the amount of data with which we work.

In the area of sepsis, we’ve been piloting a
good bit of work. We’ve trained our systems, using machine learning to actually predict sepsis, not only with the same sensitivity as the most highly trained clinicians, but with better specificity so that the focus can be on those patients who are apt to deteriorate. Those models allow us to detect sepsis using established clinical indicators 24 hours earlier than the most highly trained professionals. With sepsis, survival directly correlates with the timeliness of the intervention. It’s like having a fire-prevention program based on seeing flames coming out of a building. We don’t want to see flames and then react. We want to smell smoke. And the ability to smell smoke is really the fundamental advantage of the predictive analytics machine learning and the ability to support care.

**WITHERSPOON:** We’ve also had significant experience with early detection of sepsis and with predicting readmissions. The readmission side is interesting because we can make interventions and see early declines in readmissions, but the sustainability over time has been challenging. So, we wonder if, as the data become richer, how we can use it to help with sustainability.

**GALLAGHER:** In addition to our work around sepsis, we’re starting an initiative around surgical-site infections. We have a large population of persons with undiagnosed diabetes, so we are looking at how we can use the patient’s pre-op information, including lifestyle habits, their A1C, and other key indicators, to help predict surgical-site infections.
CONKLIN: One of our interesting interventional studies is a telemedicine project that captures patient data from their homes. It’s allowed us to stop readmissions, particularly among at-risk patients.

VELINE: The term ‘frequent flyer’ has been around in health care for years and, in the past, we’ve done very little interventionally to limit those readmissions. Now we’re using analytics to gather what we already should have known: who are they, to whom they should be referred, and how we intervene properly so they’re not frequent flyers anymore. The data are there. It is just a matter of our taking action on them. We’ve had some tremendously important stories come out of interventions that we’ve done with folks who repeatedly come into the ED without coverage and are not getting any social services. Part of it is making sure they get lined up with the kind of care they need.

PERLIN: We now have a predictive, cognitive computing program that helps us identify cancer earlier. We conducted a study over 13 months at three major EDs. During that time, there were approximately 33,000 chest CTs. We used cognitive computing machine learning, trying to get the algorithm to put together and understand certain key indicators. For example, if there were a density or a nodule on a chest CT that was done for an individual who came in after an accident, it would look at that and say that’s significant. And it would understand it to be particularly significant if the patient were 40 years old with a history of smoking or tobacco use. Cognitive computing, machine learning and natural language processing are really powerful today in terms of differentiating between a tobacco farmer and a 40-year-old with a history of heavy tobacco use. That knowledge, in conjunction with a density or nodule in the lung, is worrisome for an incidental finding of a cancer, and potentially the kind of cancer you want to find early, when it is treatable, curable.

During the course of our study, within the 33,000 CTs, we found about 1,055 with the algorithm identified as having potentially worrisome incidental findings. Clinicians then reviewed the cases. We filmed about 55 patients who needed a biopsy and, among those, about a third were lung cancers or potential lung cancers. Eight were early-stage. I’m really proud of the fact that we assured those early-stage patients that they had the best possible trajectory. We would like to think that across the U.S. and worldwide, we would always catch those incidental findings, but we know that’s not the case. The system not only offers the advantage of early detection of treatable, curable disease, but it also offers the assurance of never missing a potentially life-threatening diagnosis and the opportunity for potentially life-saving therapy.

WITHERSPOON: That brings up an important issue. The typical radiology report is text, so we need to ensure that we capture that information in some form that the computer can understand. I wonder what the input side of that study looks like in terms of how you get the data into something so that you are then able to do the analytics?

PERLIN: That’s a great commentary on the state of health records today. We know that 20 to 30 percent of clinical data are structured data or computable, things like numbers that can be operated upon mathematically. But the rest of it is very messy. It’s a language, and sometimes an imprecise language. For example, sometimes there are words with multiple synonyms. Density and nodule are synonyms in the lung cancer example. We’re invested in being able to make the text tractable to the point where we’ve invested in a company that is new to health care, but has done a great deal of work in complex interpretations, defense intelligence and other industries. We’re finding that we can actually capture these types of words and make meaning of them.

KLASS: We’ve designed an event-based rules engine, so as information comes in, whether it is discrete or non-discrete data, we’re able to track everything. If the data signal that action is required, we want to see some sort of guidance within a period of time. We’ve also done that with test results. We have exclusions built into these events. Organizations can embed into events what types of keywords they want to look for. It differs between organizations. As the system ingests information in real time, it alerts only the staff who are needed to take action in real time.

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George Conklin

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WITHERSPOON: Those radiology reports are probably still dictated, but today’s EHR platforms tend to use note-writer tools and smart forms, which provide data that describe the clinical circumstance. And so, we’ve forced clinicians to pick one of 12 things on the drop-down menu when the real world isn’t quite that way. There is much more nuance there than we’re able to capture. I wonder if we’ve lost our way a little bit and gone in a wrong direction trying to get structured, discrete information at the outset, as opposed to using some other tools to extract the data part of it that we then subject to the analytics downstream. I worry that we focus too much on the analytics back-end tools. We have a large mature data warehouse environment, lots of extract, transform and load function-types of activity, with all sorts of data coming in. It kind of gets back to: What did we start with in the first place? Do we have a rich enough array of data sources that will enable us to do what we want to do?

PERLIN: We don’t want to dictate to clinicians how they should do their work. As a physician, when I think of the number of different ways of expressing a concept, it’s daunting. Rather than trying to force people into a particular box, our goal is to take the data that are structured and easiest to work with and put them together with data that are unstructured.

CONKLIN: We’re using a lot of natural language processing and dictation text, voice-to-text conversion right now. We are asking questions during the course of that dictation to see if we can refine the information and still capture the natural language that the doctor is using, but still analyze and refine that information and get to a real definition of what’s occurring. When I was still practicing as a psychologist at a large psychiatric center in New York state, we did a chart study to see if the information collected is actually predictive in final patient outcomes. What we found was that less than 20 percent of what was in the charts was predictive of the ultimate patient outcomes. We’re dictated by payers and by regulation to collect information a certain way, and little of that is predictive of final outcomes.

PERLIN: The management of paper is virtually impossible. Think about all of the information
that is created around health care. We need to be able to ingest that information or actually ingest the raw data and be able to provide it as usable information. That’s the exciting part in this iterative process. That’s the point at which it is really important not only to have the data scientists who can help us with the technological aspect, but to marry it with the subject matter experts, whether they’re administrative or clinical, and be able to train those algorithms to increasingly provide better signal to noise. But at the end of the day, it comes back to this important point: What are the outcomes for patients? Obviously the goal is really to support patient care, support the highest levels of safety, the greatest levels of effectiveness and the highest concordance with the best evidence on the most compassionate personalized care that can be delivered. I’m interested in hearing everyone’s experience in taking the data back to the bedside the way we provide it back into the workflow, whether it is in real time for clinical decision support or whether it is for all of our operational processes.

**MODERATOR:** That’s a great transition to where we want to go next. How are you getting information to the caregiver and how is it embedded into the workflow process? What has your experience been with predictive analytics with the care teams?

**CONKLIN:** Our first run at that was through the work we did to establish best practices in our meaningful use required analytics for real-time analytics decision support. We looked at clinical analytics, specifically the relationship between the use of CPOM, or computerized patient order management, and computerized physician order entry. We looked at three dependent variables: readmissions, mortality and length of stay for every patient. For the physicians who made the greatest use of the CPOM tools that we offered, we showed decreases in every one of those variables. The results were exciting and will be published in the *Journal of Clinical Pathways*.

The other work that we’re doing is designed to provide real-time data to clinicians through an iPad-based application that enables a deep dive into the patient’s information.

**GALLAGHER:** We’re trying to make nursing a data-driven culture, moving away from monthly reports to daily dashboards. We’re monitoring things like which patients have had catheters in place longer, which patients have central lines and why, and which patients have had flu immunizations. Basically, we’re pushing data in real time and getting away from the monthly retroactive review. We’re providing our nurses with process measures, rather than outcome measures. It is a culture change. We’re seeing a great deal of adoption, and they are asking for more data. It is definitely a journey.

**VELINE:** We’ve developed something we call a health tracker, which focuses on ambulatory care. For every inpatient admission, we run about 35 ambulatory or outpatient procedures for the same patient. That’s where the greatest contact is occurring. The health tracker pulls data from the data warehouse into a patient-centric display, so that wherever the patient shows up along the continuum of care, there is essentially a checklist for the provider to identify what’s been going on with the patient, both retroactively and proactively. Regardless of the type of provider they see, there may be information that’s relevant to the primary care provider. It’s been extremely helpful in identifying patients who need intervention before their conditions worsen.

**MODERATOR:** Does it take a while to get the care team on board with some of these changes? Have you run into any obstacles in deploying these processes?

**GALLAGHER:** It’s mostly a matter of getting clinicians to change their behavior because it impacts patient rounding and how they use the data. We also need to teach clinicians how to use the data and how to hardwire it into their work. You can’t just hand it over and expect them to know what to do.

**KLASS:** When we engage with hospitals or health systems, we sit down with the different clinical groups and ask them specifically: What are the types of things you want to track? What are your real dose protocols? What do you want to track for health care-associated infections? We then design a rule-set specifically for that hospital, so the clinicians are contributing to the end result. That helps to achieve buy-in. The workflow that
WITHERSPOON: The way this has evolved, analytics and analytics platforms are separate and disparate from where the work was actually being done, the transaction systems. Where we ran afoul in the early stages was attempting to get information back into the workflows, which was a separate dashboard or a URL that forced clinicians to have to go someplace else to look for information. Today, the major EHR vendors are beginning to integrate some of the analytics components to create an integrated environment as opposed to taking information out of the system, analyzing it and then trying to put it back. That’s problematic. We’ve become fairly good at taking it out and conducting the analysis, but getting it back has been a challenge that we can’t overcome. This has great importance for our population health initiatives. If we have some data in one location and some in another location, how do we patch the longitudinal story of each patient together to make it whole in both environments? This is an interesting piece of what we’re facing today.

KLASS: With interoperability and smart applications, it really shouldn’t matter what systems these applications are running. You should be able to come to a single place and be able to see or pull this information.

CONKLIN: The keyword is interoperability.

WITHERSPOON: Interoperability really doesn’t exist to any meaningful extent today. There is a great deal of work being done in that area, but then we still have to get it implemented and operational.

PERLIN: We are on the cusp of something big in terms of interoperability. There are organizations, such as the Center for Medical Interoperability, that are doing some great work, looking to provide that degree of consolidation. The more progressive EHR vendors see themselves not as a monolithic closed-loop entity, but rather as an operating system, the middleware that connects everything together. Those who subscribe to that vision are going to thrive in the future, and those who don’t are really writing their end because it’s hard to believe that health care won’t go in the direction that every other industry has gone, and that’s having a service-oriented architecture.
The ability of having a service-oriented architecture makes the things that we need to do possible. We’re able to work with VigiLanz, for example, to be able to provide real-time decision support for antimicrobial absorption, which is one of the best uses of this technology. We can’t operate in silos. We think about our future purchases in terms of interoperability, and being able to foster communication.

**MODERATOR:** What are the must-haves, whether you’re a hospital or a health system, to really put together analytics that will move the dial on care?

**CONKLIN:** The AHA’s interoperability task force focused, in part, on the extraordinary difficulty and expense associated with culling patient data and helping to ensure that it’s for the right person. There may be a dozen or more Bob Smiths or Juan Garcias in the hospital’s network, so we need to make sure we are gathering all of the data on the right person. We’re investing a great deal of money at CHRISTUS to get that done. There is a policy discussion that needs to occur, and we approached the Office of the National Coordinator for Health Information Technology to talk about the need to push Congress to approve the national patient identifier. Having a national patient identifier would simplify the process and eliminate unnecessary costs. But it’s such a politically charged issue.

**VELINE:** A great deal of emphasis on sharing patient information has been focused on sharing among providers and yet, with such a large part of our health care system being driven by private payers plus Medicare and Medicaid, the payer community is not sharing its data with the provider community. And now, we have many people changing plans on almost a yearly basis, which is problematic. There is no doubt a need to emphasize this cross-industry sharing of information. When a patient switches plans, if that plan automatically shares the historical care data in its database with the new plan, there’s a more complete picture of what’s going on with the patient. It’s important, and that information has been lost in the shuffle. I think some interdisciplinary dialogue has to occur with the payers.

**PERLIN:** As we move forward with population health, we need to think about the breadth of data that will be coming together. We then need to think about where these data will live. Will they live within or outside your organization? Is there a need for a third-party organization to house the data? There has to be some education. That, as a corollary, gets to the challenge of interoperability, and the challenges as have been accurately characterized by the lack of a common patient identifier.

My colleagues and I live in world of data governance. There are many sources of data: patient-reported data, patient-generated data, whether it is text input from a patient or whether it comes from devices, smartphones or exercise trackers. What are the rules around how those data are responsibly sorted? That’s important, not only in determining the best use of the data, but also to address cybersecurity concerns, etc. Finally, we need both the operating and the clinical leadership to close the loop regarding how we make system improvements in our business operations. It’s going to create a real paradigm shift in terms of how we, as clinicians, view our role. It’s important to understand that we can be supported, and our roles are changing to interpret patient data and to be astute in their application. This is an exciting shift, moving from descriptive and diagnostic care to prescriptive care. This is the doorway to personalized and precision medicine.

**WITHERSPOON:** The organizations represented around the table today have some capability to do some of these things, but the independent physician or small private practice physicians don’t have that capability. It makes me wonder whether this doesn’t need to become some sort of a public utility, something that is ubiquitously available to anybody and everybody who sees patients. That’s a real pie-in-the-sky idea. We’re going to end up with a capability gap, with some physicians able to do this sort of work. So, rural physicians, or physicians not in large group practices, may be at a disadvantage as this evolves.

**GALLAGHER:** There’s one thing I struggle with and that’s expectations. We all thought clinical decision support was going to be the be-all and end-all to drive standardization and evidence-based practice. But that hasn’t been the case, at least from our perspective. Too many people...
have ignored alerts due to information overload. How are we going to push data at the point of care so that people are going to use it? I’m still struggling with what is the best way for people to get the data and use them for that very reason.

KLASS: That is a challenge. Alerts need intelligent rules that have been vetted by clinicians.

PERLIN: The ability to insert decision support into the workflow is really critical, but perhaps the more critical piece is getting the end user to feel a sense of ownership and respond to the alert. What’s really exciting about the notion of a learning health system is not only the commitment to evidence-based practice, but having the ability to engage clinicians in developing practice-based evidence. If you have the ability to look at outcomes, you frankly have the responsibility to look at the outcomes and understand what works best and what doesn’t work.

We just participated in a large study that was published in the *New England Journal of Medicine* on reducing methicillin-resistant *Staphylococcus aureus*.

We were looking at an approach that served our organization well in terms of reducing infections to a third lower than expected. When we presented to the Institute of Medicine, we were asked, “How do you know that’s best?” We were screening patients on admission to the intensive care unit, and placing those positive for MRSA in isolation. By doing that alone, our results were a third lower than the national average in terms of expected rates. But, the IOM noted that two other strategies were getting the same results. One approach was, in addition to isolation, give a sponge bath with the antiseptic chlorhexidine and give nasal antibiotics to those positive for MRSA. The third approach was more novel: Provide an antiseptic sponge bath and antibiotic nose drops for everybody. We were asked if we could test this at our hospitals to compare the three techniques. We did that over the course of 18 months. We conducted a three-arm comparative effectiveness study with roughly 15 hospitals in each group, and about 75,000 patients. It turns out that Option 3, the universal decolonization, was the best. It not only cut MRSA by 37 percent, it also cut all bloodstream infections by 44 percent. That’s a big result. But, it’s not the most important finding of the study. The most important finding is that it didn’t take one hospital 64 years. It took 43 hospitals only 18 months to make significant improvements. That’s great news, but it also both tantalizes me and terrifies me. What if those data already existed in the experience of care, and what if it shouldn’t have taken 18 months, but, in fact, 18 minutes to answer the question? That’s really where we want to get.

The National Institutes of Health came back to us and asked us to conduct a similar study with general medicine and surgical patients. They asked us to get 50 hospitals and 300,000 patients. Well, we got 50 hospitals, but we closed the study after one year with 666,000 patients. We published a follow-up piece to the reduced MRSA study that showed that 91 hospitals that weren’t part of that study were able to adopt the practice in less than six months. It took two quarters to get to the same level of performance, cutting infections by half.
THANKS

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