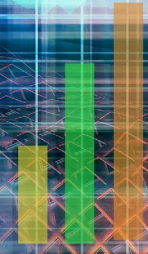


EXECUTIVE INSIGHTS

RESILIENCY + RECOVERY

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LEVERAGING REAL-TIME DATA AND ADVANCED ANALYTICS TO ANTICIPATE EARLY ONSET OF CRITICAL CONDITIONS

Identifying at-risk patients for sepsis, HAIs and readmissions

Leveraging Real-Time Data and Advanced Analytics to Anticipate Early Onset of Critical Conditions

Identifying at-risk patients for sepsis, HAIs and readmissions

Real-time clinical surveillance and analytics solutions go beyond electronic health record (EHR) alerts to identify the early onset of patient deterioration or life-threatening events requiring care team intervention. Busy hospitals and hospital systems wrestle with how to focus on sepsis improvement efforts, target health care-associated infections (HAIs) and reduce readmissions. The COVID-19 pandemic has only exacerbated these challenges. This virtual executive dialogue convened hospital executives across the country to discuss the use of clinical surveillance systems to leverage real-time patient data from EHRs to provide timely alerts about critical conditions to improve care quality.

KEY FINDINGS

- 1 As more reimbursement is tied to value-based contracts, hospitals and health systems are using **evidence-based, point-of-care tools in the EHR** and surveillance systems to reduce sepsis, HAIs and readmissions and are looking for more robust predictive capabilities.
- 2 **Visual dashboards and balanced scorecards** help health care leaders drill down into the data to see where the opportunities are and provide real-time coaching and correction on any gaps in processes.
- 3 Health care leaders are looking for implementable actions that **reduce clinician alert fatigue frustration** and identify the trajectory of deterioration — not just the deployment of a rapid-response team (RRT) or transfer to an intensive care unit (ICU).
- 4 **Surveillance systems** have to be highly accurate, integrated at the point of care, user-centric and process-driven.
- 5 Clinicians question a black box where decision support generated by machine algorithms does not entail the clinical reasoning behind the alert/suggestion, but they want **information that is explainable and actionable in real time** with minimal interruption to their workflows.
- 6 Health care leaders also are looking at **predicting with more accuracy** who's not going to deteriorate in the next 12 hours.
- 7 **Real-time analytics, machine learning and natural language processing** are changing surveillance systems of the septic patient to becoming useful tools for clinicians.

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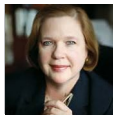
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MODERATOR (*Suzanna Hoppszallern, American Hospital Association*): **How is your leadership team setting clinical priorities to reduce sepsis, HAIs and readmissions? Which of these is the top priority?**

JASON ATKINS (*Emory Healthcare*): We place a priority on health care-associated infections. We have six improvement teams focused on HAIs, including catheter-associated urinary tract infections (CAUTIs), central line-associated bloodstream infections, pressure injuries, falls, surgical-site infections and *Clostridioides difficile* (*C. diff*) — and improvements in both technology and process. We have a dedicated sepsis team that is working on implementing our processes around how we screen for, identify and treat sepsis. We want to become more advanced in that area as we move into a new EHR that has more robust capabilities around sepsis identification and treatment. Readmissions are also an area of opportunity for us. We have readmissions on our balance scorecard and are focusing on how to tackle that challenge across the system. Those are our strengths and opportunities as of today.

MICHAEL OPPENHEIM (*Northwell Health*): Sepsis has been a big priority for us. We've had a long focus and a lot of success in moving our sepsis mortality numbers, recognition and mortality. We have been participating in a surveillance program that New York state has implemented. We're now making good progress in hospital-acquired *C. diff*, methicillin-resistant *Staphylococcus aureus* infections and surgical-site infections, which are coming down after a lot of focus.

WILLIAM KOSE (*Blanchard Valley Health System*): We use Cerner's St. John Sepsis Surveillance Agent and have implemented a good process. Right now, our priority is surgical-site infections. We had two of those last month, so we're reviewing our processes.

We've set up multidisciplinary teams. If we get an HAI or a *C. diff* infection, we perform a root-cause analysis on each one. We have a small hospital so it's

easier to collaborate. Four or five physicians meet once a month with our infectious disease physician and we study this. Our pharmacist and infectious disease specialist make rounds and review all antibiotics three times a week. I am interested in what everyone is doing predictively. We are not making those kinds of decisions; our evaluations are retrospective about what we could have done better.

MODERATOR: What tools, technologies and metrics are you using to curb quality problems in these areas?

VI-ANNE ANTRUM (*Cone Health*): Our enterprise analytics team has created a visual dashboard that allows us to drill down into our HAI data and see where our opportunities are. For every unit in our system where we're monitoring and measuring MEWS (modified early-warning scoring), I can see how that unit is performing daily. We're also a lean organization, which helps because we perform layered, leader standard work. There is standard work for our staff and there is the first layer of leader standard work, where our charge nurses look at that information, and then our unit leaders, our executive leaders, right up to me at the system level. I do quarterly validations at each of our facilities. That allows us to respect the work, and receive the input and feedback from our front-line caregivers. It also gives us an opportunity to provide real-time coaching and correction on any gaps in our process.

But it's not just about data when it comes to looking at HAIs. We've looked across our supply chain at products that we use and at practice changes that make sense for us, like reducing our central lines and Foley catheter days, and helping people to embrace the concept of getting lines out of our patients. A patient can't acquire an infection if a line hasn't been inserted. We talk about this in our interprofessional rounds (or progression rounds), on a daily basis with all the clinicians. Our antibiotic stewardship is part of that work as well.

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OPPENHEIM: From a safety perspective, our organization puts a lot of focus on the Centers for Medicare & Medicaid Services' star measures and performance areas, and the Patient Safety Indicator 90, known as PSI 90, safety measures. We set enterprise standards, but our most current motto in the organization is 'Freedom within a Framework.' While we provide standards, the organizations and institutions under our health system umbrella can customize and add additional programs.

Performance across sites is shared with medical leadership and at medical director meetings. We share best practices, but it also gives a competitive feel among leaders at different hospitals. The PICG (Performance Improvement Coordinating Group), is a large group comprising medical nursing and quality leadership from all hospitals and meets intermittently to review these same measures for accolades and critiques and for further sharing of best practices and challenge areas.

CATHERINE CHUA (*Davis Health System*): We track sepsis measures. We have multiple different EHRs, so most of our tracking at this point is being done by hand by going through each case. At the end of the month, we list the cases and where the fallouts were, and who the fallouts were attributed to. Since we started doing that, we've gone from a 30% to 40% rate to 70% to 90% with our sepsis protocols, so that's actually helped a lot.

We haven't had a CAUTI in two years. We just hired a urologist who does a large volume, so we're getting some catheter-associated infections now, but we have been tracking that closely and we're putting new protocols in place.

MODERATOR: How is your organization leveraging data in the EHR and clinical decision-support tools

to improve patient outcomes? How integrated or disruptive is your current system within the clinician workflow?

KOSE: As you integrate feedback in the EHR, especially now with what we've seen during COVID-19, some practitioners are seeing 20% to 40% more infections than what they had been seeing before, and time is important in a sepsis protocol. We just tried to increase reminders on medications and that didn't work out.

NANCY FEISTRITZER (*Emory University Hospital*): We're focused on streamlining and removing inefficiencies in our practice arenas that cause frustration. One way to do that is to reduce the crisis mode in which some of our units must act if a patient deteriorates too quickly. We're interested in and working on a number of predictive models and have used some related to patient flow as we seek to optimize our capacity and match it to our staffing.

CHUA: We have order sets built in, but because there is a lack of fluency between the different EHRs, the timing is off. We can get the information manually by interviewing, but because we have a full-time employee dedicated to finding that information, it becomes frustrating for the doctors.

ANTRUM: We're using MEWS in concert with a sepsis score in our Epic system. If a patient triggers red or yellow for MEWS, we still have some additional questions that could help figure out whether the patient is at risk of deteriorating because of sepsis or another cause. We have a protocol in place.

ITAY KLAZ (*Wolters Kluwer*): We've created an overarching sepsis early detection system with surveillance of septic patients as they go through the hospital, from the emergency department (ED) to discharge,

"I do quarterly validations at each of our facilities. That allows us to respect the work, and receive the input and feedback from our front-line caregivers."

— Vi-Anne Antrum —
Cone Health

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all based on real-time analytics, machine learning and natural language processing. The system provides answers to many of the challenges that folks bring up — not just the surveillance capability by integrating thousands of data points in real time, but also making sure that when we actually give a provider or a nurse an alert or another notification, they actually see it as a useful tool.

One of the biggest issues we see with SIRS (systemic inflammatory response syndrome), MEWS2 or qSOFA (quick Sequential Organ Failure Assessment [sepsis-related]) scoring systems, or even the generic alerts and risk scores that come with the EHRs, is that there's a honeymoon period at first, but often it becomes another tsunami of alerts or system disruptions. The average provider starts ignoring the system after only three false alerts. The average provider in an inpatient setting receives nearly 150 alerts a day. If only three false alerts cause disengagement, that is an issue. It's just another little sign that says high risk, but doesn't create action nor make a difference in the way that clinicians interact. Systems have to be accurate, integrated at the point of care, user-centric and process-driven.

MODERATOR: Are you using clinical surveillance technology to pinpoint the early onset of deteriorating conditions or life-threatening events? In what areas are clinical surveillance tools being used?

SHARON LUTZ (*Cottage Health*): We've just put in place what we call our Sepsis Navigator, which is a timer that pops up on the sidebar in Epic. If specific criteria are met, an ED order set is started or you can start it manually. It doesn't alert, but there are red bars for blood cultures or lactate not ordered and blood cultures not collected. There are probably 10 items on the red bar that alert the nurse as to where

we're at and what the timer is. I think we've seen some success, but it's still early. For the bundle, we were down in the upper 40%, and now we're hovering around 70%, which is the most improvement we've seen, with a vigorous team behind the effort.

We're hopeful, but it seems as though most of the responsibility is placed on the nurse, which is painful. I wish we had more implementable actions that didn't add more work to our nursing workforce.

OPPENHEIM: We had built MEWS into our EHR many years ago and have been relatively disappointed with it. We found that its positive predictive value is high. When someone has a high MEWS, it is associated with the two metrics we followed when we were calibrating our MEWS, specifically unexpected, unplanned transfer to the ICU, or death during the hospitalization. We've added RRTs to the metric list and data we track.

It correlated well on the positive predictive side, but on the negative predictive side, we found many cases where patients were deteriorating but the MEWS was not elevated. We started doing some predictive modeling to look at deterioration. What we really wanted to identify was the trajectory of deterioration, not just the end point of

ICU transfer or an RRT.

After finding that respiratory rate is not captured accurately, we started to experiment with wearable biosensors in med-surg, noncritical care areas. When you calculate MEWS off a wearable device, you miss certain parameters, such as a level of alertness and urine output. We can pull that from the EHR and integrate it, but those data won't be as concurrent as the sensor that takes measurements on a regular basis. We found that the MEWS scores coming off the sensors were actually higher

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despite missing some of the elements. And the one parameter that drove that was almost universally respiratory rate.

For our next set of pilots, we looked at our data to see what were the diagnosis-related groups (DRGs) most associated with an RRT or unplanned ICU transfer during the hospitalization. We found in that population, if you had an RRT, that the average length of stay on those DRGs was about five or six excess days above estimated days. We're evaluating if we can shave off some of those excess days.

On the flip side, we now have what's called the 'Let Sleeping Patients Lie,' initiative. Instead of saying, 'I can't necessarily predict who's going to deteriorate, can I predict with more accuracy who's not going to deteriorate in the next 12 hours?' The first practical application is an initiative to help patients get more sleep. We have a 'Quiet at Night' initiative, so that's where the name 'Let Sleeping Patients Lie' comes from.

ANTRUM: I agree with your comments about the limitations of MEWS. In fact, we're getting ready to do our next iteration called NEWS, which will incorporate pulse oximetry and some other elements, so we hope it will be more accurate. We looked at piloting some wearable devices, particularly in our EDs, as many of us have experienced overcrowding in our waiting rooms. Ultimately, we didn't choose the wearables, because the staff felt that it would be more work, and it didn't integrate into Epic.

MODERATOR: What criteria is the clinical leadership team using to evaluate and justify investments in clinical surveillance technology? Has there been a significant impact on patient outcomes, readmissions or length of stay?

CHUA: We don't have any predictive analytics right now, so I am interested in learning what other people are doing with predictive analytics — what works and what doesn't. We're talking to Cerner and Epic and trying to decide what direction to go in the next couple of years, so I'd like to know what types of predictive analytics are working in those arenas.

ATKINS: We're converting to Epic from Cerner, and we don't have any predictive models within our Cerner application. Epic has its cognitive computing platform where you can either adopt its models or build your own. The challenge we're having is what was outlined in the recent Michigan Medicine study around the sepsis model being only as good as the population against which you validate it. We are struggling a bit to figure out how we validate the model that is inherently part of the software, or do we adopt models that have been developed in collaboration with our university biomedical informatics group?

There are pros and cons to both. There are costs to developing our own model. More importantly, how do we embed that at the point of care so that the workflow is seamless for the nurses and physicians and they can understand what parameters go into the model as well as the expected actions?

If you have a risk score that's displayed, but you have either nonstandard actions or a misunderstanding from the clinicians as to the actions they're supposed to take, it reduces the effectiveness of the score, regardless of how much positive predictive value there is.

MODERATOR: How is artificial intelligence (AI), machine learning and natural language processing being used to detect patient deterioration and accelerate diagnosis and appropriate interventions?

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— Jason Atkins—
Emory Healthcare

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KLAZ: Risk scores may seem like a black box to many clinicians, especially when you talk about machine models or AI that generates those scores. Many of these are not familiar to clinicians, or have supporting clinical interpretation in human terms, because they have not been validated yet in a traditional way and are viewed with some skepticism. The system looks great when you run it on test data, or even on the patients retrospectively, but it doesn't really make a change in the way the institution delivers care.

To address clinicians' concerns regarding the black box, we decided to provide information to the clinical team — they receive the full context in an abbreviated form, specifically about what we're predicting and the type of deterioration. That has shifted the relationship with the support system to a completely different level. When providers are able to look at one screen and in five seconds know why the system is predicting this or that, they can decide whether they want to continue with that recommendation. This really moved the needle.

Also, a system has to apply some suggestions or actionable elements to it. When the system shows a risk score or a warning sign, it still may not be actionable, even with the explanation. But when the system is fully integrated into the clinician workflow and looks like part of the EHR, it drives an alert or notification that says, 'I would recommend that you start this, for instance: Step 1 bundle for severe sepsis with hypertension. I've set the clock for three hours, because this is the timeline you have.' In one hospital study, we were able to reduce mortality by 50% and readmissions by 30%.

While not a black box, it is something explainable and actionable in real time. Another element is minimal interruption to the clinician workflow:

95% is the lowest threshold for us to generate an alert. A crucial element is that the system does not remind clinicians to do things they're already doing. For example, there would be no instruction to take lactate a minute after the lactate order already went to the EHR. That delayed message creates an immense pushback, increases physician burnout, and they may ignore the difficult cases when they should have listened.

ATKINS: We're in this phase of predictive and prescriptive analytics, and we don't always know whether the model is providing a return on investment, whether we can trust the model or what actions are indicated by the model. We need to start thinking as health systems around new care models to support predictive and prescriptive analytics — something akin to eICU systems, where you have experienced clinicians who are your air traffic control. They're the ones who are dealing with the predictive and prescriptive alerting and taking care of the actions around assessing whether there is actual risk based on the score; carrying out actions such as the timers around the treatment that should be done for sepsis; and communicating with front-line clinicians so that those things don't fall on the backs of the front-line providers and nurses.

We're going to have to think about how we manage all the alerts and scores in a different care model from what we have today, especially given our health care worker shortage.

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