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INSIDE THE CURRENT ISSUE

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Connectivity enables spot-on flexible monitoring

Temporal artery thermometry for today's nurses

by Jeannie Akridge

If ever there's a place for flexibility, it's in healthcare. Patients present to facilities with multiple conditions and complicated disease states and their acuity levels can change in an instant. Keeping track of these acuity changes and responding to patients quickly and appropriately has always been the challenge for time-strapped clinicians. New advancements in patient monitoring technology focused on flexibility, mobility and connectivity are helping clinicians from the surgical suite to the bedside make critical decisions.



Philips' remote viewing capability displays moving waveforms on a PDA in near real-time.



"We're seeing that the monitoring capability has really dramatically increased by the types of patients that they're taking, the number of parameters that they're needing to monitor at any given point in time because the population has a higher level of acuity," said Josie DeFrank, portfolio executive, cardiology at health care contracting services company [Novation](http://www.novation.com), Irving, TX.

"All of those sicker patients that used to be in the ICU are now moving into the other care areas," observed John Doherty, global marketing manager of monitoring solutions at [GE Healthcare](http://www.gehealthcare.com), Waukesha, WI. The patients coming through the ED and OR are sicker, and have more complicated diagnoses. The entire environment within the hospital is changing. How do you think about it care area by care area?"

Vendors are focused on providing monitors that can be "flexed" up or down in the parameters they measure to accommodate patients with varying acuity levels without having to transport them to another bed or bring in other devices.

"This flex monitoring allows them to place monitors on patients on floors that are not ICUs or telemetry floors – so it increases their monitoring capacity," said Michael Ainsworth, director contract services, cardiology at Novation. "If I can flex my monitors to other floors instead of building out additional monitored floors, that gives me the flexibility to have monitored and unmonitored patients on the same floor without a real heavy capital outflow."

[Philips Healthcare's](http://www.philips.com) scalable IntelliVue patient monitoring line accommodates the most critical care patients down to very low acuity patients. "With a range of IntelliVue products including network-connected monitors you can have the same bed be either a telemetry bed, or flex it up to a higher acuity bed by adding patient monitoring," explained Greg Eckstein, director of product marketing for Philips Healthcare's patient monitoring business, Andover, MA. "For example, you

Temperature is a vital sign often taken for granted, but is a critical component of patient care. Gentleness, accuracy, ease of use, and cost containment are all very important factors, but today, risk to patients and nursing staff from the opportunistic microbes hitching a ride from one bed to the next on the back of a thermometer are of critical importance. Given the current battle against nosocomial infections, particularly Methicillin-Resistant Staphylococcus aureus (MRSA) and Vancomycin-Resistant Enterococci (VRE) which are now even community acquired, as well as the recent surge in Clostridium difficile (C. diff), accurate temperature measurement has never been more important for nurses and their patients. It not only is a vital sign in the first indication of infection and its assessment in the first line of defense, but it should not contribute to patients' risk of infection.

There are a number of ways of taking temperature, most requiring inserting a probe into a body cavity in a compliant patient. Now, new technology has eliminated this invasiveness and discomfort, while improving the accuracy compared to older methods, as proven in 26 published studies to date. Temporal artery thermometers measure core temperature non-invasively with just a gentle scan across the forehead. New research has identified the temporal artery as a key factor as to why the forehead has been a useful indicator of fever since antiquity. By scanning across the forehead, the temperature of the arterial blood is detected and displayed as the core temperature.

Both cost containment and infection control are enhanced by the fact that the forehead has no mucous membranes. This allows the thermometer to be used without a disposable cover, and like a stethoscope, is wiped between patients. As additional assurance against cross-contamination, the temporal artery thermometer is manufactured with a silver-ion antimicrobial probe head that destroys harmful bacteria, mold, mildew and fungi on contact, even reduces levels of MRSA and VRE by over 20% in 10 minutes, and to undetectable levels in 6 hours, becoming the only thermometer capable of self-disinfecting between shifts.

can pick up additional measurements in that telemetry bed when you need them by combining the telemetry-monitored parameters alongside additional measurements on a single, integrated display without having to remove and reconnect the patient's ECG or SpO2 cables."

Doherty described a focus on "flexible acuity monitoring" with GE's CARESCAPE portfolio of patient monitoring solutions. "Some of the real power of the flexible monitoring system comes in where instead of saying 'I need to transport that patient back to critical care', you can actually flex the room up to be a critical care room. By adding parameters, I can make that a very elaborate monitoring environment and I haven't spent any time transporting the patient, changing lead sets and cables, and waiting for someone to bring that patient to the ICU."

Flexible acuity beds allow facilities to effectively treat patients with multiple disease states, said Doherty. For example, a cancer patient coming in to be treated in the oncology unit may also have heart problems that need to be monitored. Centralized telemetry monitoring – where dedicated telemetry technicians monitor patients house-wide from a centralized room, much like air traffic controllers – can mean that patient can stay in the oncology unit to receive specialized treatment but still receive acute cardiac monitoring benefits.

Dorothy Marshall, communications manager, North America, for [Spacelabs Healthcare](#), Andover, MA, explained that "Spacelabs monitors are fully scalable and can be used throughout the hospital's care areas. Hospitals with Spacelabs patient monitors can use their existing hospital network to move monitoring data whenever/wherever needed – throughout the enterprise. For example, a physician can view a patient's live waveforms from the office or at home."

Spacelabs launched its Intesys Clinical Suite (ICS G2) at the recent American Association of Critical-Care Nurses' NTI Conference where it received rave reviews from nurses for its ability to provide easy access to information. "ICS G2 was designed by nurses for nurses," said Marshall. "It works the way nurses want to and it presents data as the nurses want to see data. With one click, nurses (and physicians) can access and view the info they need. There's no digging for information."



Spacelabs' Intesys Clinical Suite (ICS G2)

[Fukuda Denshi USA Inc.](#), Redmond, WA, offers solutions for flexible patient monitoring with its fully configured monitors for use in all care areas, explained Greg Accetturo, director of marketing. "Being pre-configured, they have everything you would want at a competitive price. By making our monitors' standard features and parameters more robust, nursing staff can avoid the need to look for a specific module and move it around the unit – as well as the possibility of having to choose which patient gets the more comprehensive monitoring. Overall cost of ownership is lower because our fully featured monitors can treat any patient on their floor without having to purchase extra modules or components," he added.

Fukuda Denshi's DS-7300 bedside monitor is "well-appointed by feature and parameter capability for the intensive care or critical care areas, and is also a good ED monitor in areas where you need to provide 12-lead ECG monitoring," Accetturo explained. The company will be releasing an OR monitor this summer that will come with all of the standard monitoring parameters, plus have the

Although a relatively new technology, temporal artery thermometers have been well proven in daily use on all patients, from newborn to geriatric, with some 30% of hospitals and clinics currently using them. Newest models are able to communicate with vital signs monitors to provide convenient and secure recording of temperature.

Marybeth Pompei is Senior Vice President and Chief Clinical Scientist for Exergen Corporation (www.exergen.com) developer of the TemporalScanner. Originally trained as a nurse, she has a Masters Degree in Bioethics and Health Policy, has been an active clinical scientist in the field of medical thermometry and thermoregulation for more than 20 years, and holds five U.S. patents in this field.

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capability of flexing to expand the parameter set. "You can pre-configure the monitor with additional invasive pressures, for example for neurosurgery or cardiac care. Also, by removing the gas module from the new OR monitor, it can be used in the PACU."

Patient SafetyNet from [Masimo Corporation](#) (Irvine, CA) is a wireless-based remote monitoring and clinician notification system that enables continuous monitoring of patients on general care floors using Masimo SET pulse oximetry. If clinician-established parameters are violated, Patient SafetyNet will send an alert to the central monitor which is immediately routed to the assigned clinician via pager.

The first facility to implement Patient SafetyNet, Dartmouth-Hitchcock Medical Center (DHMC) in Lebanon, NH, released findings showing an 80% decrease in distress codes and rescue activations and a 50% decrease in ICU transfers for Masimo Patient SafetyNet system-monitored patients in a 36-bed post-surgical unit.

The ability to accurately monitor patients on the general care floor can help prevent what Masimo's executive vice president of medical affairs, Michael O'Reilly, M.D., called "dead in bed" scenarios, or DIB. "This is now being recognized as something that's happening all over the country. And that's partly due to the fact that hospitals are now very aggressively treating pain post-operatively, often with patient-controlled analgesia pumps. There's a tradeoff between treating pain and affecting a patient's ability to breathe. The drugs that treat pain tend to decrease the natural ability to breathe. Many hospitals are now looking at how they can monitor patients on the general floor so they can tell when they're starting to decline physiologically before they get in trouble and become a DIB. So this kind of technology is generating a lot of interest. And because Masimo has measure-through-motion ability, our technology is essentially the only one that can work in this type of situation because it will measure accurately even when the patient is moving around," he added.

One East Coast hospital had tried previously to implement general floor monitoring before Masimo SET and experienced 10,000 false alarms a month. "You might have found nurses running through the hallways responding to patient alarms only to get there and find that the patient was just moving, and it was a false alarm. However DHMC, using Patient SafetyNet, experienced overall alarm rates of only four per patient/ per day," said Dr. O'Reilly.

Grabbing data on the go

Lower acuity monitors are now being brought in to address issues such as patient overflow in the ER, noted DeFrank. "Patients who typically weren't monitored in the past are now being monitored. As they've had overcrowding in the hospitals, you're seeing more and more of those areas becoming monitored spaces. Wherever they're able to put a body, they're able to put one of these portable monitors."

Philips' new IntelliVue MP2 is a compact, lightweight and easy-to-carry portable bedside monitor that can be used during transport or for monitoring in low acuity settings. "You can do advanced patient monitoring but in a very flexible, portable bedside monitor," said Eckstein. Also new to the IntelliVue portfolio is the X2, which takes Philips' Multi-Measurement module (MMS) and adds to it a small screen for a totally independent patient monitor that provides continuity of data during transport. "You have continuous visible monitoring the entire way during transport. And it will automatically associate with Philips' Smart Hopping Network and continue to send data to the central station for continuous centralized monitoring during transport," said Eckstein.

GE Healthcare's CARESCAPE Patient Data Module docks onto GE's Solar monitor and Transport Pro Monitors to provide clinicians with the ability to maintain critical baseline measurements during transport.

Ainsworth noted, "With an enterprise solution where all the monitors are linked, that physician can either via a handheld or a computer pull that patient up, pull up his EKG history and look at that arrhythmic event and then decide what needs to be done without ever really having to come up into the ICU."

GE's CARESCAPE Enterprise Access provides a single wireless infrastructure to support multiple applications. For example, "mobile viewers" allow clinicians to view patient monitoring information anytime, anywhere on PCs, PDAs or cell phones.

Philips also now offers remote viewing capability on a PDA, which allows clinicians to see a patient's moving waveforms remotely from the physical nurse's station.

EMR connectivity

Systems that provide connectivity to a patient's electronic medical record (EMR) can play a big role in improving workflows.

"Today many of the institutions that are implementing monitoring systems are at the point in time where they're also implementing

EMRs," commented DeFrank. "So this is usually the time when they start thinking about the connectivity between their patient monitors, the patient bed, ventilators and other devices. This is the also time that they start thinking maybe it's time to upgrade their monitors so that they can have this interaction between the patient and the EMR. It really produces a seamless flow of information back and forth. It's just where healthcare is going. And I think with some of the funding that's starting to become available for institutions for their EMRs, you're starting to see that a lot of their patient monitoring needs are being addressed as well."



Masimo's Radical-7 Pulse CO-Oximeter featuring Masimo Rainbow SET can now be upgraded to include a continuous noninvasive total hemoglobin (SpHb) measurement.

GE Healthcare's Aware Gateway is a bi-directional interface between the GE patient monitoring system and the rest of the hospital environment. "It pulls patient demographic data from the hospital information system, puts it into the monitor, and exports vital signs data," said Doherty.

Before Skyline Medical Center in Nashville, TN, implemented GE Healthcare's Aware Gateway system in two of its ICUs, retrieving information from patient monitors was done in the traditional way, explained Rynda Christensen, RN, senior systems analyst. Like in most other facilities, "in order to get data from the monitor, the nurses would have to print a piece of paper, then sit down and manually enter it into our documentation system. It was very time-consuming," she said. "And if you have a doctor sitting in his office and he wants to see what's going on it's only as accurate as [the last person's data entry]."

Despite the fact that the system was easy to learn, recalled Christensen, like with most process changes, there was some resistance. "The nurses were a little bit skeptical at first. They had always done it this way, writing it all down. We had a couple of older nurses that said, 'I'm just going to keep doing it the way that I've always done it.' They didn't want to learn the new way. But as soon as they saw the other nurses that were in there doing it as they went and they could do it so quickly, boy, they just bought right into it. Now if we were to take that away from them, there would be mutiny," she laughed.

"And the physicians love it," added Christensen, "because if they're sitting in their office or they have their PDA and they want to bring up the patient's record to see what's going on with that patient they can look at it any time and it's pretty accurate."

At the heart of Philips' patient monitoring solution is the IntelliVue Information Center which provides continuous patient data to a centralized monitoring location and collects and stores this data. "One of the things we do in the IntelliVue patient monitoring system is to collect a wide range of physiological data which is easily interfaceable to the EHR or other charting systems," said Eckstein.

The Fukuda Denshi patient monitoring system – through its new DS-7600 series 16-bed central station which Accetturo describes as an all-in-one unit with a smaller footprint at the busy nurses' station – will interface with any hospital information system, in addition to allowing for positive patient authentication. Caregivers can scan a patient's bar coded wristband then scan the bar code on the monitor to eliminate the risk of the caregiver accidentally entering the wrong patient ID number and having the wrong patient's data associated with the data coming off of the monitor, said Accetturo.

The Fukuda Denshi central station uses an embedded flash memory card versus a hard drive to store full disclosure information. "Often times those hard drives are the weakest link, and they fail," said Accetturo.

Spacelabs focuses on making the most of the hospital's monitoring and IT investments. "There is no reliance on proprietary hardware. It's based on open standards," said Marshall. "Even if the hospital network goes down, Spacelabs patient monitors continue collecting and saving critical patient information. Also, Spacelabs Healthcare's Flexport Device Interfaces integrate data and alarms from

third party (standalone) devices, such as ventilators, etc., into the Spacelabs patient monitor."

With patient beds as medical devices that are at the center of care, capable of collecting and presenting data in a meaningful way for caregivers, and openly transmitting data to hospital information systems and EMRs, Hill-Rom (Batesville, IN) has been focused on "integrating that technology around the room and unifying the clinical and IT objectives," said Adam McMullin, vice president, marketing and strategy for Hill-Rom's IT Solutions group.

Hill-Rom builds its systems around the processes and protocols used by caregivers to work with and help improve their workflow. "We want to ensure that the IT itself doesn't create extra steps or the need for nurses to develop workarounds in their processes," said Michelle McCleerey, RN, PhD, business unit director for Hill-Rom's Patient Safety business. "It's been a challenge to date with the entrance of IT into the patient care environment in that respect. For example, the gateways from some of the monitoring companies aren't necessarily interoperable with the other devices in the room. They've taken a very forward step in being able to deposit the data into the medical record, however there are still many other devices that are operating that are not able to deposit data directly into the medical record."

"You end up having data in disparate devices and that places an increased burden on the caregiver to have to collect these isolated pieces of data and then attempt to aggregate and analyze that data themselves," McCleerey added.

Hill-Rom's answer comes in the form of a "medical device data system" to be introduced this Fall. Part of the company's NaviCare platform, the system will provide "a way of aggregating all of the data that's coming off of these devices in a neutral way versus a proprietary gateway – in a way that is very caregiver friendly," said McMullin.

The medical device data system features an adapter attached to a device so that as soon as the device gets close to a bed it will be identified by the system and is capable of transmitting data to the medical record, explained McMullin. "You don't have to write things down, you don't have to go get things, you don't have to plug wires in. You just have to verify the data that is automatically sent to the medical record."

Hill-Rom recently announced a strategic relationship with Cerner Corp. in which Hill-Rom smart beds communicate directly with the Cerner computing platform, and will continue to pursue partnerships with other companies offering EMR platforms, he said.

"Given the manual and often redundant entry process required to get information into the EMR, the available data may not be accurate or timely," said McMullin. "So physicians stop trusting the EMR and they go to the caregivers and they go to a paper chart, because you don't have the appropriate level of data. So this solution starts to relieve some of those barriers of adoption of the EMR."

"When folks call me about monitors," offered DeFrank, "I ask number one, do you have, or are you going to implement any type of EMR in the future? You need to bring in IT personnel from the start to see what your capacity is number one, and what additional costs are going to be involved. There are a lot of things that you need to consider. I think rule number one is: What am I going to do in the next year, the next two years, or five years even?"

Specialty OR monitors

Specialized monitors that measure parameters such as brain function and oxygen saturation are also providing clinicians with enhanced decision support tools.

Masimo recently added a continuous noninvasive total hemoglobin measurement (designated by SpHb) to its Masimo Rainbow SET blood constituent monitoring platform. This newly FDA-cleared noninvasive measurement will soon be available as a software upgrade to existing Masimo Rainbow SET pulse oximeters.

One application for the SpHb technology, explained Dr. O'Reilly, "may be in the OR for patients who are having surgeries that are associated with significant blood loss." Traditionally, "in major surgeries where the patient is losing blood, you have to draw blood out of them and send it to the laboratory for analysis to find out whether the patient needs a transfusion or not," Dr. O'Reilly explained. "Now Masimo noninvasive total hemoglobin (SpHb) provides a continuous measurement that we believe will enable clinicians to more easily and closely monitor the patient in real-time to see whether they need a transfusion. There are also situations where patients have received transfusions when they really

didn't need one because the OR clinicians got anxious. In surgery, knowing when and when not to transfuse is sometimes a guessing game. While waiting for labs to come back, you could have passed the critical point."

Using the new Masimo SpHb measurement, "It's sort of like flying a plane where you have an altimeter and you can tell how high or low you are," described Dr. O'Reilly. "You'll be able to tell where the hemoglobin level is in real-time without actually drawing blood out of the patient. And with it, clinicians should be able to more appropriately make decisions about blood transfusions." Dr. O'Reilly pointed out that in addition to the cost associated with an unnecessary blood transfusion, it can also put the patient at risk of negative immunological consequences that can be significant.

Another application for Masimo's total hemoglobin monitoring technology may be in diagnosing internal bleeding in trauma patients. "The rate of the change in a patient's hemoglobin level can be significant for diagnosing internal hemorrhage, so in the past you'd have to draw multiple blood samples," explained Dr. O'Reilly. "By having a continuous real-time measurement of hemoglobin levels at your fingertips, we anticipate clinicians will be able to identify patients who have internal bleeding that otherwise would have gone unrecognized. Masimo SpHb could also be very useful for the military and in mass casualty situations where there might be 30 or more people injured at the same time who need to be triaged according to severity of internal injuries."

Masimo SpHb can also be used to spot-check patients for anemia.

Another monitoring technology that's helping anesthesiologists to more accurately determine the appropriate amount of anesthetics to give patients during surgery is Hospira's SEDLine brain-function monitor. "Typically, anesthesiologists rely on recommended dosages and then evaluate patient consciousness by monitoring blood pressure, heart rate and involuntary muscle movements," explained David Yureck, general manager, critical care, Hospira Inc., Lake Forest, IL. "Patients anesthetized under these circumstances are sometimes under-medicated or over-medicated. By monitoring brain activity, clinicians can appropriately adjust sedation levels to minimize risk. Patients who receive too much anesthesia can experience slower wake-up times, longer recovery periods and extended hospital stays."

The SEDLine monitor features a unique four-channel sensor that is placed on the patient's forehead and temple area to enable real-time monitoring on both sides of the brain. When used with other traditional anesthetic and sedation monitoring methods, Hospira's SEDLine help clinicians evaluate a patient's response to anesthesia and sedation throughout the procedure.

In addition to SEDline, Hospira systems are used throughout the hospital to assist clinicians with monitoring patient status and assessing which components of the hemodynamic (blood circulation) profile need to be managed. These include a large selection of standard and made-to-order angiography kits used in the cardiac catheterization lab for diagnosing coronary artery disease.

The INVOS Cerebral Oximeter from Troy, MI-based Somanetics, is a noninvasive patient monitoring system that continuously monitors changes in the blood oxygen levels in the brain, in order to immediately alert clinicians to periods of declining or inadequate cerebral oxygenation and allow corrective action to prevent injury.

Jim Groneck, BS, CCP, staff perfusionist, Children's Hospital of Wisconsin (Milwaukee) operates the heart-lung machine to support patients' circulation and respiration during open heart procedures. A perfusionist for 20 years, Groneck has used the INVOS system since starting with Children's five years ago. Groneck noted that one of the challenges in monitoring levels of cerebral oxygenation has been that a key historically-used measure, mixed venous oxygen saturation, or SVO₂, provides a *global* indicator of the balance of oxygen supply and demand, versus the INVOS rSO₂ which provides *regional* measures. "The patient could have normal global SVO₂ numbers, but if the brain saturation was low we would not have known that before."

"The INVOS system allows perfusionists to measure the different vascular beds, versus just one measure of the sum total of all vascular events in the body," he added. "Now we can look at that specific vascular bed and see what the saturation of the brain is. It gives us a better understanding of what is going on in the brain."

The real-time nature of INVOS also provides an early indicator of possible shock situations that may have previously been missed between hourly arterial blood gas draws in the ICU, said Groneck. "With all of the other monitors and parameters we look at in the OR and in the ICU setting – now we have one more

tool that can in real-time give us an indication of how well the brain tissues are receiving oxygen." [HPN](#)

