

StO₂ Sensor

Forum for trends in tissue oxygenation monitoring for trauma, critical care, and emergency medicine

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In this issue

- Dr. Scheeren Interview — page 2
- Advanced StO₂ Education Program — page 3
- Economics 102 — page 4
- Philips MPM Connectivity — back page

Emergency Physicians In Europe: Have Cars, Will Travel.

Emergency medicine at Rostock Hospital, in Germany, and throughout much of Europe, is a mobile profession for physicians. Emergency medical personnel are typically joined by physicians at the scene of an accident or medical event. The physicians travel in emergency cars equipped with basic medical supplies and, in the case of Rostock, an **InSpectra** StO₂ Monitor. The **InSpectra** StO₂ Monitor has been a valuable asset because it supports the overall goal of this system which is to provide faster patient resuscitation. Rostock has four emergency cars, as well as 16 ambulances, providing pre-hospital attention to 36,000 cases a year.

Interest in Tissue Oxygenation “Black Box” Leads German Professor to StO₂ Monitoring

According to Professor Dr. Thomas Scheeren, health care has been missing the “black box” of perfusion monitoring until the **InSpectra**™ StO₂ Monitor came along.

Says Scheeren, “We have had ways to measure hemodynamics, i.e. the macrocirculation on the arterial and venous sides of the circulatory system, but not a way to look at the tissue between them. This is the first device that does this.”

Scheeren is full professor at the Department of Anaesthesiology and Intensive Care Medicine at University Hospital in Rostok, Germany, one of Europe’s oldest and most prestigious teaching institutions. Moreover, Scheeren is also participating in the Emergency Medical Transportation Program. (see *Emergency Physicians In Europe: Have Cars, Will Travel*; see sidebar)



Thomas Scheeren
MD, PhD

After taking an interest in tissue oxygenation, Scheeren learned about the **InSpectra** StO₂ Monitor, and purchased two to evaluate in his department about two years ago. One monitor resides in an emergency car where it is used to evaluate resuscitation efforts on patients who have suffered cardiac arrest or who are in severe shock. The other is located in an operating room where it is used intraoperatively during high-risk, and high blood-loss surgeries and/or in high-risk patients.

“I liked it right away,” says Scheeren. “It provides a clear reading, almost immediately. It is very easy to use, and our preliminary research results suggest it has broad clinical applications.”

Evaluating macrocirculation vs. microcirculation

“Prior to this device,” says Scheeren, “We have only had access to the macrocirculation, like blood pressure. The problem is, blood pressure does not tell you much about blood flow, or regional flow. In our evaluations, we have seen that about half the time microcirculation and macrocirculation measurements go hand in hand. The other half of the time, one goes a different direction than the other. Most often, microcirculation changes first and macrocirculation follows.”

Interest in Tissue Oxygenation “Black Box”, *continued*

“There have been several cases where typical measurements suggest we can stop resuscitation, but StO₂ measurements of microcirculation tell us it’s worth continuing. That is valuable advice.”

*“I feel safer with the **InSpectra™** StO₂ Monitor in place because StO₂ measurements can identify the perfusion alteration faster than other techniques.”*

Dr. Thomas Scheeren
Department of Anaesthesiology
and Intensive Care Medicine
University Hospital, Rostok,
Germany

Evaluating patients post-surgery

At Rostock, Scheeren has learned that roughly 95% of surgical patients monitored intraoperatively have no microcirculatory alterations. These patients are disconnected from the monitor when their procedure is completed. For the 5% who do have problems, he says, the **InSpectra** StO₂ Monitor is left connected when the patient is moved to the ICU. Normally, it is kept on until the next day, enabling the team to evaluate how therapeutic maneuvers, as well as a patient’s recovery, affects StO₂ values.

“After surgery, these patients can have internal bleeding or compromised circulation,” says Scheeren, “As a physician, I feel safer with the **InSpectra** StO₂ Monitor in place because StO₂ measurements can identify the perfusion alteration faster than other techniques.”

“In addition, because the **InSpectra** StO₂ Monitor can be battery-powered, we can see what happens to StO₂ enroute from the operating room to the ICU. Previously, there was no practical way to monitor a patient’s tissue perfusion in transport.”

Defining protocols

The challenge ahead — and something Scheeren is looking at in his capacity as a researcher — is to find “normal” values for StO₂ in patients who are in EMS and ICU settings. “We are working to define a protocol that would include StO₂ for these patients.”

“The more information clinicians have, the easier it is to make good decisions,” says Scheeren. “I look at StO₂ measurement as a valuable addition to the methods we already have.”



InSpectra™ StO₂ Monitoring System Advanced StO₂ Education Program (ASTEP)

In an effort to help more clinicians gain an understanding of the value of InSpectra™ StO₂ System Measurement (StO₂), Hutchinson Technology is delivering a range of live, online and printed educational programs to nurses and physicians.

Among them is the Advanced StO₂ Education Program for Nurses designed for trauma, critical care, and emergency department nurses who may be responsible for educating staff nurses or providing clinical resources on the use of the InSpectra StO₂ System.

"The ASTEP session gave me an opportunity to learn about StO₂ monitoring capability and physiology of the body. The education was incredibly informative."

Susan O'Neill, RN, CCRN
Patient Care Specialist
Lehigh Valley (PA) Health Network

This comprehensive, 1.5-day program, taught in a highly interactive environment includes lecture, small group work, readings, case studies and online simulation learning. By using a train-the-trainer format, this class provides nurses with the opportunity to deepen their understanding of shock and the physiology of tissue oxygenation in the microcirculation, become familiar with the impact various therapies used for treating sepsis have on the oxygenation of organs, and appreciate how tissue oxygen saturation (StO₂) can help guide therapy decisions.

To date, three ASTEP sessions have been held, attended by a capacity audience of 30 nurses each.

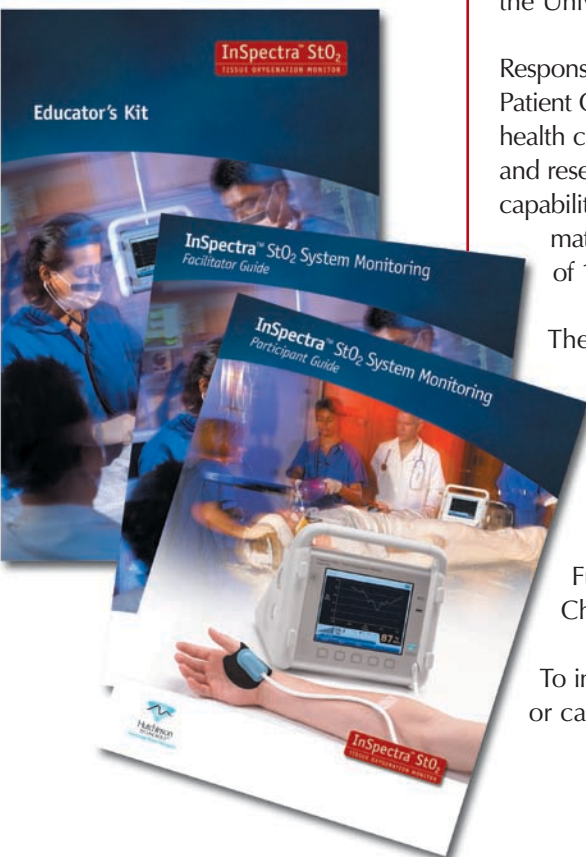
Instructors for the sessions have included: Frederick A. Moore, MD, Head, Division of Surgical Critical Care & Acute Care Surgery at The Methodist Hospital and Weill Cornell Medical College in Houston, TX; Tom Ahrens, DNS, RN, CCNS, FAAN, Research Scientist at Barnes-Jewish Hospital in St. Louis, MO; Reginald Burton, MD, FACS, Director, Trauma and Surgical Critical Care at BryanLGH Medical Center in Lincoln, NE; and Professor Dr. Can Ince, Head, Department of Clinical Physiology, Academic Medical Center (AMC) of the University of Amsterdam and Erasmus Medical Center Rotterdam.

Response from those attending has been overwhelmingly positive. Susan O'Neill, RN, CCRN, a Patient Care Specialist at Lehigh Valley (PA) Health Network, says, "With the many changes in health care technology these days, it's challenging for clinicians to keep up with new knowledge and research. The ASTEP session gave me an opportunity to learn about StO₂ monitoring capability and physiology of the body. The education was incredibly informative, and the materials I was given there I later used at my hospital to help teach others. On a scale of 1 to 10, I would give it a 20."

The ASTEP for Physicians is a one-day session, conducted by experts in the field of trauma and critical care. The most recent session featured physicians from seven different hospitals. In order to accommodate clinicians' busy schedules, Hutchinson Technology offers the ASTEP program for nurses and physicians onsite and offsite. The onsite program requires a minimum of 22 participants; the offsite program requires approval by a Hutchinson Technology representative.

Future offsite ASTEP sessions are being scheduled now for San Diego, CA (August); Chicago, IL (September); and New York, NY (November).

To inquire about any of these programs, contact your Hutchinson Technology representative or call the Customer Service Center at 1-800-419-1007 (U.S.) or +31 26 365 3370 (EU).



Economics 102: Measuring StO₂ In Dollars And Cents

Healthcare providers are under considerable pressure to improve the effectiveness of services while reducing the costs of providing care to an increasingly diverse patient population.^{1,2}

In the last edition of *StO₂ Sensor*, we discussed the economic impact of hypoperfusion and how early detection of it with an **InSpectra™** StO₂ Monitor can lead to treatment that improves outcomes, reduces mortality and decreases overall treatment costs. In this edition, we look at additional evidence that the **InSpectra** StO₂ Monitor makes economic sense in specific patient situations.

Transfusion Cost Savings

Early detection of inadequate perfusion can have measurable economic impact.

Clinicians report that understanding perfusion status in patients at risk for low hemoglobin may influence transfusion decisions.³ This is noteworthy because unnecessary transfusions represent a base cost of \$500⁴ — which includes costs for the unit of blood, transfusion disposables, labor and overhead to manage blood. In addition, unnecessary transfusions can lead to a risk of patient infections, acute lung injury, immunosuppression and other complications.^{5,6} Infection, in particular, can be a potential cost burden, because infection rates for critically ill transfusion patients are 8.5% greater than non-transfusion patients.⁶ The cost to resolve a nosocomial infection is approximately \$16,000.⁷ Other costs of complications include longer ICU length of stay and eight days longer hospital stays.⁶ Add to this the fact that Medicare and insurers no longer cover costs of transfusion-related complications, and the difference can be substantial.

Transfusion Cost Savings

% OF PATIENTS IDENTIFIED IN WHICH TRANSFUSIONS COULD BE AVOIDED	NUMBER OF PATIENTS AT RISK FOR LOW HEMOGLOBIN			
	400	600	800	1000
14%	\$ 716,160	\$1,074,240	\$1,432,320	\$1,790,400
16%	\$ 831,040	\$1,246,560	\$1,662,080	\$2,077,600
18%	\$ 945,920	\$1,418,880	\$1,891,840	\$2,364,800
20%	\$1,060,800	\$1,591,200	\$2,121,600	\$2,652,000

Assumptions:

- Blood unit cost is \$500, on average each patient receives two units.⁴
- **InSpectra™** StO₂ Sensor cost is \$220, all 1500 patients get one sensor, whether they receive blood or not.
- Transfusion patients experience infection rates 8.5% (absolute) greater than non-transfusion patients.⁶
- ICU stays five days longer, and hospital stays are eight days longer.⁶
- The cost to resolve a nosocomial infection is approximately \$16,000.⁷
- Average hospital stay is \$1,200 per day and ICU costs range from \$2,400⁸ to more than \$4,000 per day.⁹

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Sepsis Cost Savings

Quickly identifying hypoperfusion in patients at risk of developing severe sepsis has helped increase sepsis resuscitation bundle compliance.¹⁰ This, in turn, translates into significantly improved outcomes, reduced mortality, and a decrease in treatment costs by 27%, or approximately \$6,000 per treated patient.^{10,11}

Unfortunately, according to Surviving Sepsis Campaign data, only 30% of sepsis patients nationally are identified and receive the early aggressive surviving sepsis resuscitation bundle.¹² Two reasons sepsis bundles are difficult to implement: lack of nursing availability, and the time required to place the central catheter.¹³

Here, too, **InSpectra™** StO₂ System monitoring gives clinicians a critical edge because it provides StO₂ readings in seconds.¹⁴

What’s more, because the **InSpectra** StO₂ Monitor is non-invasive, hospitals avoid the risk of potential catheter-related infections, which cost as much as \$35,000 to \$56,000 to resolve.¹⁵

Sepsis Cost Savings				
% OF SEPSIS PATIENTS IDENTIFIED AND TREATED	NUMBER OF PATIENTS AT RISK OF DEVELOPING SEVERE SEPSIS			
	100	140	180	220
8%	\$ 26,000	\$ 36,400	\$ 46,800	\$ 57,200
10%	\$ 38,000	\$ 53,200	\$ 68,400	\$ 83,600
12%	\$ 50,000	\$ 70,000	\$ 90,000	\$110,000
16%	\$ 74,000	\$103,600	\$133,200	\$162,800

Assumptions:

- Early aggressive resuscitation will achieve 27% cost reduction or \$6,000.^{10,11}
- **InSpectra™** StO₂ Sensor cost is \$220, all sepsis patients get one sensor.

Hemorrhage Cost Savings

Unchecked, hemorrhage can lead to hemorrhagic shock, causing perfusion-related complications.

In addition, total patient charges escalated as hemorrhagic shock severity increased. Severe hemorrhagic shock increased costs three-fold over trauma without hemorrhagic shock. Severe hemorrhagic shock with MODS increased costs six-fold over hemorrhagic shock without MODS.¹⁶

Identifying hypoperfusion quickly in patients at risk for hemorrhage helps reduce decision time for initiating resuscitation efforts.¹⁷ The **InSpectra™** StO₂ Monitor helped clinicians identify hypoperfusion immediately.¹⁸⁻²² It is easy to use, requires no calibration and no special consent, and begins providing measurements seconds after the noninvasive sensor is attached. Most important, it reduces decision time for initiating resuscitation efforts.

Hemorrhage Cost Savings				
% OF PATIENTS IDENTIFIED AND TREATED TO PREVENT HEMORRHAGIC SHOCK	NUMBER OF PATIENTS AT RISK FOR OCCULT BLEEDING			
	400	500	600	700
4%	\$104,000	\$130,000	\$156,000	\$182,000
5%	\$152,000	\$190,000	\$228,000	\$266,000
6%	\$200,000	\$250,000	\$300,000	\$350,000
8%	\$296,000	\$370,000	\$444,000	\$518,000

Assumptions:

- InSpectra™ StO₂ Sensor cost is \$220, all hemorrhage patients get one sensor.
- The cost to resolve complications associated with shock following hemorrhage is approximately \$12,000.²³

Economics 102: Supporting Formulas

Transfusions

$$\left(\frac{\text{Reduced transfusion \%}}{\text{Number of transfusion patients}} \times \frac{\text{Units of blood}}{\text{Reduced transfusion \%}} \times 2 \right) + \left(\frac{\text{Reduced transfusion \%}}{\text{Number of transfusion patients}} \times 8.5\% \times \frac{\text{Infection cost}}{\text{Infection cost}} \right) +$$

$$\left(\frac{\text{Reduced transfusion \%}}{\text{Number of transfusion patients}} \times 5 \times \text{ICU days} \times \$2,400 \right) - \left(\frac{\text{Number of transfusion patients}}{\text{Number of transfusion patients}} \times \$220 \right) = \text{Savings for facility}$$

Sepsis

$$\frac{\text{Number of patients at risk of developing severe sepsis}}{\% \text{ of sepsis patients identified and treated}} \times \$6,000 - \left(\frac{\text{Number of patients monitored with InSpectra StO}_2 \text{ Monitor times cost of sensor per patient}}{\text{Number of patients monitored with InSpectra StO}_2 \text{ Monitor times cost of sensor per patient}} \times \$220 \right) = \text{Savings for facility}$$

Oculta Bleeding

$$\frac{\text{Number of patients at risk for occult bleeding}}{\% \text{ of patients identified and treated to prevent hemorrhagic shock}} \times \$12,000 - \left(\frac{\text{Number of patients monitored with InSpectra StO}_2 \text{ Monitor times cost of sensor per patient}}{\text{Number of patients monitored with InSpectra StO}_2 \text{ Monitor times cost of sensor per patient}} \times \$220 \right) = \text{Savings for facility}$$

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StO₂

InSpectra™ StO₂ Monitor Now Links To Philips MPM

Increasingly, clinicians are looking to collect patient information and understand it in conjunction with other parameters, to help guide interventions.

With this in mind, many hospitals have configured data collection systems, using multi-parameter monitors (MPMs) and electronic medical records.¹ This integration of information allows institutions to collect real-time, accurate patient data¹ and manage the data to their requirements and needs.

Hutchinson Technology responded to this trend by launching **InSpectra™** StO₂ Case Graphing Software, an application developed to help clinicians learn about and demonstrate the utility of **InSpectra™** StO₂ System Measurement (StO₂).

But the software was only the beginning. While growing numbers of clinicians have embraced the concept of monitoring StO₂ and the importance of understanding how StO₂ numbers relate to other, familiar parameters, clinicians asked that information from the **InSpectra** StO₂ Monitor be incorporated into their bedside MPM.



In response, Hutchinson Technology introduced **InSpectra** StO₂ Connectivity to a Philips Patient Monitoring System in April 2009.

This connectivity feature, via a Philips VueLink module, allows display of StO₂ as well as THI and other vital signs on one screen.

In addition, alarm messages and inoperable conditions (INOPs) are transferred from the **InSpectra** StO₂ Monitor to the Philips Monitoring System.

Adds Kristi Rice, Associate Product Manager, "Connectivity is a critical requirement for integrating patient data today.

The **InSpectra** StO₂ Monitor connects an important measure of a patient's condition (StO₂) with other data that is essential to quality care."

A majority of hospitals view electronic connectivity as a way to better manage increasingly overburdened EDs, nursing shortages, growth in new facilities, data collection process improvement, and improved patient safety through the accuracy and availability of patient information.

While not all customers have Philips systems installed in their hospitals, Philips was selected because it is the market leader in MPMs. Hutchinson Technology has been looking at the possibility of creating similar software for other MPM brands such as GE and Datascope.

If you are interested in connecting to bedside monitors other than Philips, talk to your Hutchinson Technology representative. To stay abreast of future developments, visit: www.htbiomeasurement.com.

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Customer Service Center: 1-800-419-1007 (U.S.) or +31 26 365 3370 (EU).



The **InSpectra™** StO₂ Tissue Oxygenation Monitor is a non-invasive monitoring system that measures an approximated value of percent hemoglobin oxygen saturation in tissue (StO₂). Visit us online at www.htbiomeasurement.com for our full contact information and Instructions for Use.

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