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## Indoor Positioning System Can Track Equipment and People

### *Massachusetts General Hospital Uses System To Locate Medical Devices, Patients and Personnel*

Santa Fe, N.M.--"You can run, but you can't hide" is the facetious description by Julian M. Goldman, MD, of the indoor positioning solution (IPS) in place in the operating room of the future (ORF) at Massachusetts General Hospital in Boston. Several hospitals have installed the IPS to track medical devices, but the ORF is the first facility to use a radio-based IPS to track people.

At Massachusetts General, the IPS has been in use since shortly after the ORF began operating in August 2002. "The main reason for using the Radianse [indoor positioning] technology was to be able to automatically measure everything to assess ORF performance," said Dr. Goldman. ORF team members have previously reported on time and motion studies that show reductions in wait times and anesthesia times compared to those in a conventional OR.

Data generated by the IPS are "part of a more comprehensive project of perioperative systems analysis. We can determine if a patient is checked in and where they are physically. We can figure out where the person who does transport is at the moment; is he getting the patient or is he busy somewhere else?"

### **Concept of Association**

A study presented at the 2004 annual meeting of the Society for Technology in Anesthesia (STA) described the first systematic integration of the concept of association, Dr. Goldman told *Anesthesiology News*. Simply, the concept of association is that if two people are in the same location for a given amount of time, inferences can be drawn about what might have happened. In other words, the time stamp may be a good surrogate for a specific event.

For example, if two hours ago the person who draws blood and the patient were in the location where blood is drawn for 14 minutes, it is likely that the patient had blood drawn. The anesthesiologist can reasonably search the computer to find the sample, said Dr. Goldman. If the same two people had been together for only five seconds, they may have merely passed each other in the hallway.

The Goldman team found that by using the IPS and the concept of association, when the patient and anesthesiologist were both in the induction area for more than one minute, the automatic recording of the start of anesthesia time correlated well with a manual recording of the event.

Start of anesthesia time is an important variable for billing and has broad medicolegal importance, the group noted. Frequently, however, the variable is not recorded in real time and is dependent on someone's memory.

## IPS

The Radianse, Inc., Indoor Positioning Solution consists of wall-mounted receivers that can spatially locate small, wearable, emitter identification tags. The IPS server software analyzes all received signals and generates a room location for each identification tag every 10 to 20 seconds. "Tags that are present in the same location at the same time can be identified and 'associated' by the server," the Goldman group reported.

"Locations are graphically displayed on a Web interface, which is updated every five seconds," said Michael K. Dempsey, Chief Technology Officer, Radianse, Inc. Patients and hospital personnel are color coded. "If you are properly authorized, you can get this information from pretty much anywhere."

The IPS has been available for years from several manufacturers. Mr. Dempsey suggested that acceptance has been slow largely because the systems are expensive--\$200,000 to \$400,000. However, the ability to locate patients, their charts and the equipment can have significant financial ramifications. "If you can't start a cardiac case because you can't find the external pacers, that impacts workflow efficiency," noted Mr. Dempsey. The return on investment has been independently estimated to be one to two years.

Medical staff have expressed "some reservations" about wearing the ID tags, noted Dr. Goldman. "But, patients are thrilled [that] we are finding new ways to monitor them and make sure they are safe and sound."

## Locating People and Tracking Events

The researchers compared start of anesthesia time as manually recorded by a trained observer with that determined by using the IPS. The start of anesthesia time was defined as the anesthesiologist and patient spending more than one minute together (dwell time) in the induction room prior to the induction of anesthesia. A one-minute dwell time was chosen to eliminate extraneous interactions, such as the anesthesiologist passing through the room or walking by the doorway. Fifteen cases were studied.

"The IPS performed well in automatically identifying the start of anesthesia," the researchers reported. "It works, and it didn't give us any false numbers," added Dr. Goldman.

The mean difference between the automatically and manually determined times was 35 seconds (range, 1 to 85 seconds). "The few seconds of variation are insignificant," said Dr. Goldman. "This is more than close enough for documentation." Employing dwell times of two and three minutes did not alter the results.

The concept of association is "very powerful," suggested Dr. Goldman. However, determining the locations of ID tags is a complex process, and the results of this study may not be directly applicable to other situations. Dwell times may need to be validated for other events or IPS installations, he said.

## Tracking Equipment

At Brigham and Women's Hospital in Boston (the sister hospital of Massachusetts General), a study is under way to evaluate the effectiveness and cost-benefit of using an IPS to track equipment. "Our goal

is to use the [IPS] to manage our assets," James H. Philip, MD, ME, told *Anesthesiology News*. "At the moment, assets are the cumbersome little things like pacemakers that are easily lost from their proper location." Dr. Philip is Director of Technology Assessment at Brigham and Women's.

Upward of 50% of small pieces of capital equipment cannot be found at any given time, he noted. "A large amount of resources are spent looking for these things in the course of patient care."

The study is being conducted in the cardiac surgery service. Pacemakers, small telemetry equipment and other devices carry an ID tag. A piece of equipment can be located by accessing the IPS server. If a piece of equipment is about to leave the service, an alarm sounds at the nursing station. The nurse can then query if the equipment is being transported for a specific use. Dr. Philip likened the exit tracking part of the system to security systems in retail stores.

Lee A. Fleisher, MD, said an IPS will be installed at the University of Pennsylvania Health System, Philadelphia, where he is Professor and Chair of Anesthesia. As at Brigham and Women's, the IPS will be used to track small, easily misplaced pieces of equipment.

The Goldman study was awarded the best technology abstract at the STA meeting. Co-workers with Dr. Goldman were James E. Stahl, MD, Warren S. Sandberg, PhD, MD, Pamela L. Fairbrother, Patricia L. Atkins, RN, Marie T. Egan, RN, Richard A. Wiklund, MD, and David W. Rattner, MD.

--Elizabeth Douglas

*Based on a presentation (Abstract 32) at the 2004 annual meeting of the Society for Technology in Anesthesia and interviews with Julian M. Goldman, MD, James H. Philip, MD, ME, and Lee A. Fleisher, MD.*

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