PHOTOS BY MARY KORR

Robert Petrie checks assays being analyzed on the state-of-the-art High Speed Connected Automation (HSCA) system in Miriam's core biochemistry lab.

New System Vaults Lifespan's Core Laboratory into Future

Only second in nation, fourth in world, installed at Miriam Hospital

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PROVIDENCE – One physician viewing the High Speed Connected Automation (HSCA) system for the first time in The Miriam Hospital's core biochemistry laboratory likened it to a million-dollar Lionel train set. Hundreds of test tubes travel the four-lane track, which stretches 70 feet into the lab, in all directions. "This is futuristic and will take the lab through another decade," said **DAVID MORRIS, PhD**, Director of Clinical Biochemistry for Lifespan's Pathology Laboratories.

The approximately $3.8 million Beckman Coulter system went live in February – after ramping up for months not only at Miriam, but also at Rhode Island Hospital and Newport Hospital. Those systems had to be retrofitted and required the technologists to do yeoman's work – manually centrifuging, for example, for several months. One Miriam technologist said it was like going back to the Dark Ages of testing.

So far the transition has been seamless, with only a few minor glitches. Since it is only the second HSCA system in the nation, and the fourth in the world, the lab is expected be a showplace for those interested in viewing the cutting-edge system in operation. Laboratorium experts from across the country are expected to visit Providence and see the Lifespan HSCA line.

DOUGLAS ANTHONY, MD, PhD, Lifespan's Chief of Pathology and Laboratory Medicine, compared the system's capabilities to a superhighway. "There's even a passing lane," he noted. "Think of 1-95 North to Boston at 5 p.m. We used to have to handle samples from the emergency rooms or the ICUs manually. Now, we have the HOV (high-occupancy vehicle or carpool) lanes to bypass routine testing samples."

In addition to a dedicated STAT input area, there is a centrifuge bypass lane for tubes which have been pre-spun.

Dr. Anthony said because of the volume of testing the laboratory performs – perhaps as much as half of the tests done in the state – there were 'traffic' jams on the previous two-track system, which reached the end of its life after more than a dozen years of service.

The lab begins to hum with activity in the afternoon, as couriers arrive from 50 service centers, hospital laboratories and physicians' offices throughout the state and southeastern Massachusetts with specimens for testing. A pneumatic tube deposits the in-hospital samples. The average is 2,000-2500 samples tested daily.

Each sample has been barcoded when the sample was obtained. The sample vacutainer tubes have specific cap colors to validate required sample type against test ordered, are automatically loaded into instrument-specific racks, prioritized and queued for testing. Barcode readers double-check the sample identity and analysis requested multiple times, minimizing any chance for error.

The HSCA tube holders are equipped with radio frequency identification technology (RFID) chips to track the location of each sample in real time, verifying the sample's location with the patient's computerized record, and directing them along the tracks to one or more of the four analyzers and two

Robotic arms and pipette fingers inside the system.

centrifuges that are connected to the Automation Line. The read-through labels (RTLs) allow volume detection through three layers of labels.

The whole line is powered by compressed air; tiny air valves produce bursts of pneumatic air to propel the tubes north, east, south and west and into inlets for analysis. The unit features a consolidation of testing disciplines – chemistry, immunochemistry and immunology.

The new system has expanded capacity; for example, a chemistry analyzer can handle 1,200 tubes per hour. Dr. Morris estimates a 25 percent quicker turnaround time; all assays requested are usually completed within 30 minutes. Normal tests are reported instantly to the physician's office via direct computer interfaces.

He stops at the aliquotter unit to illustrate the preciseness and intelligence of the robotic components. Robotic "fingers" pick up the primary tube sample; the computer calculates how much serum or plasma is available to make "daughter" tubes, and once that is determined, it moves it on to an adjacent unit.

Here, pipette tips on the two robotic arms transfer serum from the primary to the secondary tubes, printers label the daughter aliquots with identification and barcodes, and then robotic arms direct them to an outlet and towards analyzers or for storage. "This is 100 percent accurate. There is no contamination. No hands touch it," Dr. Morris said.

The "command center" operator monitors the entire process on three computer screens. All testing is auto-verified, Dr. Morris said. For example, "If there's a potassium below 3 or critical values, the analysis is repeated instantly," he said.

At the end of the line is a pair of computer-controlled car parks or stockyards, which are refrigerated units that hold 5,400 tubes each on four levels for automated storage, instant retrieval if additional or repeat tests are required, and subsequent disposal.

The HSCA offers "standardization across the systems," said Dr. Anthony. "So it doesn't matter if your patient is seen in Newport, Rhode Island Hospital or here at The Miriam. All of the information is available in one format and is consistent."

In addition to streamlining workflow, increasing capacity while decreasing turnaround time, Dr. Anthony sees another advantage to the system. "It reduces the incremental costs to add on a research study since it doesn't take a lot of extra time to set it up." It has allowed the Laboratory to insource millions of tests per year creating job opportunities for Rhode Islanders.

"It's a brilliant system," reflected Dr. Morris. "If you can't make it work, it's you and not the system." ❖

The so-called refrigerated and automated stockyard stores 5,400 samples. There are two in operation at Miriam's lab.