

PROFILES IN LABORATORY MEDICINE

UNIVERSITY OF WASHINGTON

SCHOOL OF MEDICINE

DEPARTMENT OF LABORATORY MEDICINE

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UW Medicine

PROFILES IN LABORATORY MEDICINE

is a publication distributed to the department's faculty, residents, staff, and friends.

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Automation is Coming

*By Wayne Chandler, M.D.
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Like laboratory medicine departments in other academic medical centers, ours is challenged by increasing workload with flat or reduced funding and a shortage of medical technologists. Our response is not unexpected or unusual – process improvements to 'lean' the laboratory, reduce medically unnecessary testing, and automation, automation, automation. Laboratory Medicine at the University of Washington Medical Center and Harborview Medical Center is taking the plunge on automation lines for both chemistry and hematology. A total of four separate lines will be installed. Beckman was selected as the vendor for the chemistry automation lines. Our chemistry lines will have 2 to 3 Beckman DxC chemistry analyzers, 1 to 2 Beckman Dxl immunoanalyzers and 1 Siemens Centaur immunoanalyzer attached. Sysmex was selected as the vendor for the hematology automation lines. Our hematology lines will have 3 cell counters, a slide maker-stainer and a sample sorter attached. We hope to have the lines operational at Harborview Medical Center by the summer of 2008, in time for the opening of a new Inpatient Expansion Building. The automation lines at University of Washington Medical Center will follow in the fall of 2008.

Getting to this point has been a long and complicated process. The single biggest challenge, as with most large projects these days, is software integration. We are in the process of



A picture from one of many site visits to laboratories with automated lines

updating our laboratory information system to track individual container IDs as needed for the automation lines. Development of middleware interfaces between the automation lines and the laboratory information system is also a continuing challenge. We have a distributed laboratory system with multiple lab locations around the Seattle area. The system we designed must be able to accommodate this. Behind the scenes we have been working on implementing autofiling on many of our high volume automated tests, reducing the number of tube types we have to process, moving as many tests as possible to the instruments on the automation line and reducing manually intensive testing wherever possible. All of these efforts will be needed to have sufficient staff in the future to support our teaching, research and method development goals. ♦

The University of Washington Department of Laboratory Medicine is the major contributor to Laboratory Errors and Patient Safety (LEPS; www.laboratoryerrors.org), a newsletter dedicated to improving the quality of laboratory testing. Employees who are interested in viewing past issues of LEPS can do so at www.labmed.washington.edu on the “Staff Only” website under the heading “Health and Safety”

In this excerpt from volume 3, issue 3 (Autumn 2006) we talk with Dr. Michael Bissell, Professor of Pathology and Director of Clinical Chemistry and Toxicology at the Ohio State University College

of Medicine (OSU). Dr. Bissell authored one of the first books on clinical laboratory automation¹, and has written and lectured extensively about his experiences. One of his more recent lectures on “Total Laboratory Automation” was given earlier this year at UW at our Laboratory Medicine Grand Rounds. This can be seen on UWTV and is available on demand at: www.uwtv.org/programs/displayevent.aspx?rID=16102&fID=1319

The laboratory at Ohio State was an early adapter of total laboratory automation, having first gone live in autumn 1999. The lessons learned from this experience will

benefit laboratories like ours that are now implementing laboratory automation.

BACKGROUND

LEPS: What has been the automation strategy at Ohio State?

Dr. Bissell: The overall concept has been to create two laboratories. The first laboratory is an automated critical care laboratory providing results with turnaround times of less than 24 hours. The second laboratory, which we call the supplemental or special functions laboratory, is for work that is not necessarily reported within 24 hours, and/or not yet automated. Over time, we try to move as many tests as possible from the supplemental to the automated laboratory.

LEPS: What have you automated and over what time period?

Dr. Bissell: In the first phase of the project, beginning in 1999, OSU developed two automated lines, one for serum and urine chemistry and one for hematology/coagulation. These lines automated the preanalytic processes and the highest volume laboratory tests. In the second phase, beginning in 2001, the lab added an immunoassay analyzer to the chemistry line, and the hospital implemented computerized physician order entry (CPOE).

LEPS: What vendors are you using?

Dr. Bissell: OSU has the Beckman-Coulter Total Lab Automation (TLA) system with instruments by Beckman-Coulter, Bayer and Diagnostica Stago on the line. We have a Misys laboratory information system, running SMART (Specimen Management Routing and Tracking). In addition, the automation system prepares samples for a number of instruments, for example various bench top analyzers, that are near the line but not connected.

LEPS: Can you describe the components of the chemistry line that was implemented in phase 1 of the project?

Dr. Bissell: The chemistry line consists of:

- Automated centrifugation and aliquotting for serum specimens

Award Winner

Albert R. La Spada, MD, PhD
Associate Professor Department of Laboratory Medicine
Director of the UW Center for Neurogenetics & Neurotherapeutics



The Hereditary Disease Foundation recently awarded Dr. Albert R. La Spada the 2007 Lieberman Award for a study on the “Role of PGC-1-alpha in Huntington’s Disease”. The two-year award is for \$150,000. This unsolicited award is given annually in recognition of outstanding accomplishment for translational research on Huntington’s Disease, an inherited neurological disorder for which there is no cure.

The award recognizes Dr. LaSpada’s groundbreaking research which is advancing the understanding of disease pathogenesis, and identifying and developing treatments for the disease.

In June 2007, The Muscular Dystrophy Association awarded Dr. La Spada, a three year grant of \$369,010, titled, “Modeling motor neuron degeneration in spinal bulbar muscular atrophy (SBMA),” which began July 1, 2007. Spinal and bulbar muscular atrophy (SBMA, Kennedy’s disease) is an adult onset neuromuscular disorder affecting only men. Toward this end, Dr. La Spada and his team of researchers created a highly representative mouse model of SBMA and produced neuron cell culture models of SBMA. These models were used by the investigator to understand why motor neurons degenerate in SBMA. This research has yielded important leads as to candidate pathways that are crucial for motor neuron degeneration. After validating the ability of certain genes or proteins to prevent neuron toxicity in cell models, these factors will be tested as potential therapies in SBMA mice. ♦

Quality Ideas: Lessons Learned (cont'd)

- Automated de-capping and re-capping
- Automated routing, loading, and unloading to Bayer Atlas and Beckman LX-20s, which are connected to the automation line
- Automated sorting for non-connected analyzers
- On-line refrigerated specimen storage with automated specimen re-call from the refrigerator.

LEPS: What are the components of the hematology/coagulation line implemented in phase 1?

Dr. Bissell: The components are:

- Automated centrifugation for coagulation
- Automated routing, loading, and unloading to hematology analyzers, which are connected to the line
- Automated sorting for off-line coagulation analyzers
- On-line ambient temperature specimen storage with automated specimen recall

LEPS: What is your approach to aliquotting?

Dr. Bissell: On the chemistry line, there is universal aliquotting. Every chemistry tube gets a barcode-labeled daughter tube. This is done by the automation system.

LEPS: What were some of the changes that were necessary to implement automation?

Dr. Bissell: The hospital had to go from seven different sizes and types of chemistry tubes to two, and had to upgrade our Sunquest (now Misys) laboratory information system. In addition, there was a long planning and purchasing period that preceded implementation.

LEPS: Were site visits made to peer institutions during the planning period?

Dr. Bissell: OSU was one of the earlier laboratories in the U.S. to implement total laboratory automation, so site visits were done in Japan.

LEPS: Once the parts for the automation system arrived in the laboratory in 1999, how long did it take to go live?

Dr. Bissell: After the parts arrived,

it took 6 months to put the system together and have it go live. It took another year to adjust the system to optimal performance.

LEPS: How important was the hospital leadership to the success of this project?

Dr. Bissell: It was critical. The hospital medical director at our institution, Dr. Hagop Mekhjian was particularly important.

LEPS: In what regard?

Dr. Bissell: The phase 1 implementation required standardization and reduction in the number of different blood tubes since the automation line cannot handle an unlimited number of tube types. The medical director's leadership was essential for pushing through this standardization in phase 1 of the project. In addition, true computerized physician order entry - as opposed to clerk or other third party order entry- is important for getting the most out of an automation system. Some physicians resisted this change, but the medical director was able to overcome this resistance, which was essential in phase 2 of the project.

STAFFING, PRODUCTIVITY AND TURNAROUND TIME

LEPS: How did phase 1 of automation (the two automation lines) impact staffing, productivity and turnaround time?

Dr. Bissell: Labor, productivity, and

turnaround time statistics before and after phase 1 are shown in Table 1. The total full time employees (FTE) decreased from 65.7 FTE to 53.3 with the biggest reduction coming in the processing staff. Overall, automation reduced employees, and changed the staffing mix to favor employees who are more educated and more highly compensated. During this FTE reduction, laboratory volume increased by about 2%.

LEPS: Were layoffs required to reduce the number of FTE?

Dr. Bissell: The FTE reduction was done by attrition without any layoffs.

LEPS: In previous issues of LEPS, we discussed how strong interventions are often difficult and sometimes adversely effect morale². Were there any morale issues associated with this project?

Dr. Bissell: Among the laboratory staff, lab management was able to maintain high worker morale during the project for two reasons. First, the FTE reductions were accomplished without layoffs, and certainly it is easier for people to get behind an automation project when they know they will still be employed. In addition, there was a big morale boost associated with being one of the first U.S. labs to accomplish this level of automation.

LEPS: What were some of the barriers you had to overcome in phase 1 of the

Employees	Before	After	Change
Technologist FTE	41.7	38.3	-8%
Processing FTE	21.5	13.0	-40%
Supervisory FTE	2.5	10.0	300%
Total FTE	65.7	53.3	-19%
Hours worked	136656	110864	-19%
Productivity	Before	After	Change
Specimens processed per processing FTE	39900	68700	72%
Tests performed per technologist FTE	80000	89100	11%
Turnaround time	42.7 min	34.6 min	-19%

Table 1. Employment, productivity, and turnaround time before and 1 year after the first phase of laboratory automation. Turnaround time refers to average turnaround time for tests performed on the two automation lines.

Quality Ideas: Lessons Learned (cont'd)

project?

Dr. Bissell: OSU had to upgrade the Misys laboratory information system to SMART. This created a new order entry process for registering (logging in and accessioning) the specimens. The new “upgraded” order entry process was more complex and time-consuming than the DOS-based registration system it replaced. During the early implementation of phase 1, this caused a period of decreased productivity and increased turnaround time as the lab learned the new system. During this difficult period, OSU actually hired more processing employees to work around the problem. This is not reflected in Table 1. Table 1 shows the net change in FTE after overcoming these problems, which took a few months.

LEPS: What is your recommendation

to laboratories regarding avoiding the problem you faced?

Dr. Bissell: It is best to implement total laboratory automation into an environment where there is both CPOE (Computerized Physician Order Entry) and specimen barcoding before specimens arrive in the laboratory. This means specimens are manually labeled only once, at the point of care. For specimens destined for the automation line, there is no longer a complex specimen registration process in the laboratory. The processing staff need only check the integrity of the specimens and load them on the automation line, where the specimen barcodes are scanned. The scanning of the barcode triggers the automation system to correctly process, route, sort, analyze, and store the specimen.

LEPS: You have CPOE.

Dr. Bissell: Yes, but this was implemented in the second phase of the project, a few years after the two automation lines were implemented. I recommend implementing CPOE before automation if possible. This will allow laboratories to get the most from their automation system regarding productivity, turnaround time, and error reduction.

LEPS: Besides the specimen registration problem, were there any other significant problems in your implementation?

Dr. Bissell: Besides this problem, I think our implementation was a case of how to do this right, and much of the credit for this goes to Laboratory Manager Kevin Shively.

Laboratory Medicine Courier Service

by Tucker Sparkman

The immediate service area for Laboratory Medicine’s outreach program stretches the entire length of Puget Sound, a distance of 150 miles, from Bellingham in the north to Olympia in the south. Within this area, our clients receive a daily courier visit in order to deliver hard copy reports and supplies, and to pick up specimens for delivery to the Medical Center in Seattle.

The couriers providing this service are Laboratory Medicine employees. They receive training in biohazard safety, specimen transport and viability, and in the relevant HIPAA regulations (patient confidentiality and data security). There are seven daily courier routes, each with its own driver, plus two back-up couriers.

For our clients, the couriers become the human face of the Department, the only Laboratory Medicine employees that make a physical appearance on a daily basis in the labs, clinics and doctors’ offices that we serve. In the course of one year, these couriers

collectively will log over 240,000 miles of driving. Although they travel thousands of miles and spend hundreds of hours behind the wheel, our couriers have an excellent safety record. Their safety is encouraged and maintained with annual driving review programs. These programs can take the form of interactive computer training, or on-the-road driving instruction from a national professional driver training agency. Without the daily efforts of our couriers, our outreach and reference

lab services would not be possible.

In addition to our own Laboratory Medicine couriers, we have begun using the services of a local commercial courier service, called Couriers Inc. This company specializes exclusively in the transport of medical specimens, for which their drivers are specifically trained. Their drivers also receive training in HIPAA, Confidentiality and Compliance regulations. The availability of Couriers Inc enables us



A recent photo of our couriers

Research Roundup: Dr. Ajit Limaye, BK Virus in Transplant Recipients

LEPS: What have been the productivity gains over the entire seven years of the automation project?

Dr. Bissell: When the project started in 1999, the annual volume was 3.4 million billable tests. Now OSU is performing 6 million billables annually with only a slight increase in FTE. Automation was the main factor in this increase in productivity.

REFERENCES

1. Bissell MG, Petersen JR. Automated Integration of Clinical Labs: A Reference. AACC Press, 1998.

2. Getting lean not mean: morale, leadership, and integration issues surrounding Lean in the laboratory. An interview with Dr. Joe Rutledge and Joanne Simpson. Lab Err Pat Safety. 2006; 2(5):1-8." ♦

to continue providing service during emergency weather and staffing events, and at points in the day when our own couriers are geographically unavailable.

Also worth mentioning is the University of Washington's award winning Motor Pool, from whom Lab Medicine leases our courier vehicles. The UW Motor Pool was awarded the 5 Star rating (the highest) from King County's Hazardous Waste Management Program for their environmentally conscientious policies and procedures. They recycle and re-use common automotive products whenever possible, and have begun to employ electric vehicles. Two of Lab Medicine's Motor Pool vehicles are Priuses, the gas-electric hybrid cars made by Toyota. The Motor Pool provides us with clean, low-mileage vehicles, and the Motor Pool staff insures that those vehicles are well-maintained and mechanically sound.

Please contact us if you have questions or comments concerning any aspect of our courier service. Our goal is always to serve you and your patients with laboratory performance of the highest quality. ♦

In this feature, PROFILES presents a short question and answer with a faculty member regarding the importance of their research. The interview for this issue is with Dr. Ajit Limaye, Associate Professor of Laboratory Medicine and Medicine. Dr. Limaye is the Director of the Transplant Infectious Disease Program and Associate Director of the UWMC Clinical Microbiology Laboratory.



Dr. Ajit Limaye

Profiles: What clinical problem does your research address?

Dr. Limaye: Currently, BK virus infection is one of the most common reasons for the loss of a transplanted kidney. This disease entity is called BK virus nephropathy ("BKVN"). Currently 5% of kidney transplant recipients develop BK virus nephropathy, and of these, up to 50% lose their kidney. This is a very significant problem in kidney transplantation.

Profiles: Why do patients get these infections?

Dr. Limaye: Nearly all people are infected with BK virus as children and the virus is controlled by the immune system and then goes into an inactivated (latent) state. In kidney transplant recipients, the combination of immunosuppression and other factors specific to the kidney, leads to reactivation of BK virus. Sometimes the reactivation leads to full-blown disease, termed "BK virus nephropathy".

Profiles: How is your research addressing these problems?

Dr. Limaye: The molecular virology

laboratory is developing and refining highly sensitive PCR (polymerase chain reaction) assays for BK virus detection in blood and urine that can be used to predict which kidney transplant recipients are at greatest risk for developing BK virus nephropathy. These laboratory assays are important because BK virus does not typically cause symptoms such as fever or flu-like aches and pains. Using these assays, we will be able to routinely monitor kidney transplant patients and identify those who are in the earliest stages of infection. When detection of BK virus infection is identified by this sensitive assay, we decrease the patient's immunosuppressive therapy. Reducing immunosuppressive therapy at the earliest stages of BK virus infection has been shown to effectively prevent progression to full-blown BK virus disease.

We are also studying treatments for BK virus nephropathy. Toward this end, I am currently the principal investigator on a multicenter, placebo-controlled trial of a promising therapy for BK virus nephropathy. Overall, we are hopeful that we can prevent BK virus nephropathy in most cases by close viral monitoring, and also potentially treat it successfully when it is not able to be prevented.

Profiles: Who are your collaborators?

Dr. Limaye: My main collaborators are Dr. Linda Cook and Dr. Keith Jerome in the Virology Division. The assays are developed and performed by their fine laboratory at 1616 Eastlake. Many thanks to the technologists and other staff members working in that laboratory.

♦

Close-up: The Administrative Staff

by *Miriam Ahmu*

The department has grown in leaps and bounds over the last thirty-five years. There is now a dedicated team of administrative professionals to handle a great many faculty and staff needs in the main office. This is who they are and what they do:

Elinor Barrus has been with the department for twenty-two years. She was an office manager for a federal defense contract-auditing agency before coming here. Her main functions include entering ICD-9 codes and often looking them up in MINDscape, maintaining all the record storage data, and getting students entered into the graduate program.

Karen Walter has worked in the University of Washington for 16 years in several different positions. She is currently the assistant to Dr. James S. Fine, Chairman of the Department of Laboratory Medicine, and CIO of UW Medicine IT Services and Paul Henderson Administrator in the Department of Laboratory Medicine. Before coming here, she served 20 years



From left: Karen Walter, Elinor Barrus, Leslee O'Neil, Miriam Ahmu, Elaine Brooks

in the US Navy and US Coast Guard.

Leslee O'Neil has been with the department for fourteen years. She was a high school special education teacher before coming here. Her responsibilities are to greet visitors, answer telephones, process cost center reports, monitor the fax machine, and distribute a large amount of mail and faxes that comes in and out daily.

Elaine Brooks has been with department for seven years. Her main functions are prox cards and key issuance, clerkship duties, and administration of Grand Rounds. She also supports doctors'

Limaye and Cookson. She coordinates a number of office functions and events as well. Lastly, she is generally known as the go-to person for anything anyone has a question about.

Miriam Ahmu has been with department for two years. She graduated from Evergreen State College before coming here. Her main duties include overseeing conference room reservations, taking minutes at a number of essential department meetings, backing up Elinor, Elaine and Leslee, keeping TB compliance records, and managing office and grant record storage. ♦

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