In This Issue:

Changes in Clinical Laboratory Technology (Part 2) ..................1,5
Baxter Scholarship ..................................2
Campaign for Students .........................2
Quality Ideas ......................................3,5
Labbé Scholarship ..................................4
Teaching Profile ....................................4
In Memoriam ........................................6

Changes in Clinical Laboratory Technology During the Last Half of the Twentieth Century, Part 2

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This is the second of a two-part series reflecting on changes in medical technology and the crucial role of medical technologists in the clinical laboratory.

A BO and Rh(D) Compatibility Testing

More than a decade ago serological agglutination methods used to determine the ABO group of recipients and donors included a major crossmatch of recipient’s serum and donor’s red blood cells; a minor crossmatch used donor’s serum and recipient’s red blood cells. These procedures were done on glass slides and/or test tubes. ABO was also confirmed by test tube or slide methods using commercially prepared reagents. Rh(D) was performed in a test tube, a capillary tube and/or a preheated view box using commercially or non-commercially prepared reagents. The results relied on the visual acuity of the technologist performing the test. Since about 1993 an electronic, computerized crossmatch has been available using licensed reagents. This procedure requires that the donor and the recipient ABO and Rh be tested serologically. These test results are entered into a computer and compared for compatibility. If donor and recipient test results agree, the electronic crossmatch is deemed compatible.

In 1999, FDA approval was given to the Puget Sound Blood Center for implementation of the computer crossmatch in lieu of the serological crossmatch for recipients without a clinically significant antibody. A computer system, which is validated according to FDA regulations, ensures that only ABO/Rh compatible red cell components are selected for transfusion. The system contains logic to alert the user to discrepancies between the donor ABO/Rh on the product component label, those determined by blood group confirmatory tests and ABO/Rh incompatibility between the recipient and the donor. Discrepancies are subsequently resolved by additional methods. The sole purpose of the computer crossmatch is to confirm ABO and Rh compatibility between patient and donor; it cannot prevent hemolytic transfusion reactions caused by patient antibodies not detectable by the best antibody screening procedure or due to patient misidentification errors.

Laboratory Diagnosis of Chronic Myelocytic Leukemia

In 1950 physicians relied on the total white cell count and the WBC differential to help confirm a diagnosis of chronic myelocytic leukemia (CML). Using a Thoma pipette
Sandra R. Baxter, B.S. ’62 has seen her profession change since she graduated from the Medical Technology Program at the University of Washington. For one thing, computers now play an important role, performing operations that technologists used to handle.

One thing that hasn’t changed over the years is the need for scholarship support.

To help meet that need, Baxter and her husband, UW engineering alumnus John Baxter, are creating the Sandra Richardson Baxter and John D. Baxter Endowed Scholarship in Laboratory Medicine. The fund will support students pursuing bachelor’s degrees in medical technology.

The seed for the scholarship was planted many years ago, when Baxter’s high-school health education teacher suggested she look into a career in medical technology. Choosing a school wasn’t difficult for the Seattle native, who knew how you can support students and leverage matching dollars, please contact Caroline Anderson, assistant vice president for development, at (206) 221-2899 or by email at cmanders@u.washington.edu. Thank you for your interest.

Blood work is interesting, says Baxter, because “you have to look for minute details” when differentiating between diseases. The work was fulfilling, too. “You saw how the laboratory helped the doctors diagnose children’s problems,” says Baxter.

Despite all the changes in health care since Baxter’s graduation, medical technologists are still crucial to the profession of medicine. And the current crop of “med tech” students at the UW is quite impressive, says Baxter.

When the UW Medical Technology Program celebrated its 50th anniversary, Baxter and her husband, John, had the chance to hear some of these students talk about their research projects. A few months later, the couple spoke with Mary Lampe, B.S. ’68, Ph.D., director of the Medical Technology Program. In passing, Lampe mentioned that she was going to create a student scholarship fund. Lampe’s generosity was the final bit of inspiration the Baxters needed, and they promptly created their own scholarship in the Department of Laboratory Medicine.

The Baxters recently have made a second commitment, arranging for a portion of their charitable remainder trust to augment the Baxter Scholarship, with another portion to support medical technology faculty. One thing is certain: their generosity will be long remembered by both faculty and students in the Department of Laboratory Medicine.

References
1. Originally published in UW Medicine, a magazine for alumni of the University of Washington School of Medicine, Volume 30, No. 1, Winter 2007.
The University of Washington’s 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. Our contributions consist of feature articles, cases, and interviews with experts in patient safety. Employees who are interested in viewing LEPS can do so at www.labmed.washington.edu on the “Staff Only” website under the heading “Health and Safety.”

In this edited excerpt from the 4th issue of 2005 LEPS, Drs. David Chou and Michael Astion talk about notifying caregivers about laboratory results. The ideas presented here give us a conceptual framework regarding physician notification, and help us better understand the problems faced by the caregivers we service.

**Pulling and pushing:** A result is useless unless a caregiver becomes aware of it. There are two basic strategies regarding achieving awareness: “caregiver pull” and “laboratory push.” In “pull,” results are made available to caregivers, for example in an electronic medical record (EMR), laboratory information system (LIS), or paper chart, and the caregiver must go and retrieve the result. “Push” is a more intrusive and direct form of delivery best exemplified by directly phoning results to the care provider, and then receiving read back of the result. Most delivery systems for lab information can be viewed as lying on a continuum between pull and push (Figure 1). The laboratory traditionally “pushes” critical values. In the absence of a practice management system most laboratory information is retrieved by pulling. Hospitals and practice groups are installing electronic medical record systems supporting physicians through softer push methods.

**The problems with pull.** "Pull" can be accomplished with an acceptably low error rate by caregivers who have low-volume practices and relatively uncomplicated patients. In addition, pull is facilitated by laboratory reports that flag abnormal results using visual or text clues, for example displaying abnormal results in a different color, or placing an "H" next to an abnormally high result. Unfortunately, most caregivers are busy, and busy caregivers sometimes forget to retrieve results. In addition, pulling is slow since it requires that caregivers retrieve the electronic or paper records on each patient, and then search each record for the results of ordered tests.

Pulling results can be quite burdensome, and therefore, laboratory staff need to be appropriately sympathetic to caregivers who fail to follow up on ordered tests. A hospital-based caregiver might pull results on 20 - 30 patients per day, and many of these patients have long lists of ordered tests. A clinic practitioner might be responsible for seeing 30 patients in one day, retrieving test results from 10 - 15 patients from the previous day, and acting on results from both days. Pulling is clearly a tedious and laborious task.

**Movement toward push.** The burdensome and error-prone nature of pulling results from medical records has led to the desire to use push methods. The oldest and simplest form of push reporting is a paper report for the physician is printed when results are completed. Early push reporting using pagers and email were obtrusive and overloaded providers with too much data. More sophisticated forms of push reporting today are still in their infancy and attempt to address the data overload problem by sending or displaying results in order of potential importance. Email and the custom inboxes in EMRs still require retrieval by the caregiver. However, the retrieval is easier than conventional pulling since results from multiple patients are either displayed on the desktop when the caregiver enters the EMR, or the results are just one click away. In contrast, pulling requires retrieving and parsing each patient’s record. In addition, the email and custom inbox can potentially be individualized so that physicians can indicate which tests and patients require a higher level of push regarding notification.

Other sophisticated “push” methods include automated paging of critical values by the information system rather than the technologist, and electronic messaging in which specific results are sent to the physician’s widescreen alphanumeric pager. There is already reasonable evidence that these methods will improve patient outcomes. The electronic messaging systems that have been described have a number of noteworthy features. In one system, physicians choose which patients, and results, they want sent by this method, so they are not overwhelmed by results that are not likely to be urgent. In another system, the decision to page is based on a complex algorithm that combines laboratory results and other clinical data. Automated paging of clinically significant laboratory results and other urgent clinical conditions may become standard practice in the long term, and it is likely that it will significantly improve patient safety. Unfortunately, the movement toward this method will be slow because implementation is complex and requires strong leadership, a significant amount of capital and human resources, and cultural changes.

In summary, the most common methods of notification currently in use are “pull” methods that require a caregiver to repeatedly retrieve results from records. In most institutions, only critical values are pushed onto caregivers. Laboratory staff should be sensitive to the immense amount of work that pull methods place on caregivers to identify laboratory results.

Continued on page 5
In describing the inspiration to make this gift, Dr. Labbé says, “First, I had support in days when I needed it.” He knows how helpful even a small grant can be and hopes that his gift will provide “the little extra to make things happen.”

Dr. Labbé’s wife, Norma Lee, was a registered nurse and shared his interest in medicine and the role research played in the field. According to Dr. Labbé, “almost every position she held as a pediatric nurse was related to clinical research in some way.” The fellowship will honor her memory and their medical and research careers.

With a background in biochemistry and physiology, Dr. Labbé began his UW Medicine career in the Department of Pediatrics. Pursuing his interest in clinical chemistry, he asked Dr. Paul Strandjord about openings in the new Department of Laboratory Medicine. Dr. Labbé joined the department in 1974 and became head of clinical chemistry in 1980; he retired in 1993.

Dr. Labbé’s research interests include the study of porphyrins, metalloporphyrins, and other pyrrole compounds, including the chemistry, biochemistry, and molecular pathology of many of the metabolites. His interest in nutrition led him to establish a nutrition section in the division of clinical chemistry.

While he has been planning to make this gift for years, Dr. Labbé took advantage of new tax rules that, for a short time, allow people 70 ½ and older to make tax-free charitable gifts from their IRAs.

Dr. Labbé is delighted that his gift will support researchers for generations to come. As a regular participant in rounds and faculty meetings, Dr. Labbé keeps well apprised of departmental activities. He looks forward to meeting the first Labbé fellow and seeing the results of their work.

References
1. Originally published in UW Medicine, a magazine for alumni of the University of Washington School of Medicine, Volume 30, No. 1, Winter 2007.
chromosome (Ph1) and had a reciprocal translocation between chromosome 9 and 22 t(9;22)(q34;q11). This diagnostic tool could identify 90-95% of CMLs. In the 1990s identification of these chromosomal translocations led to the discovery of the CML molecular genetic defect, a fusion gene designated BCR-ABL (breakpoint cluster region-Abelson oncogene), found on chromosome 22. A patient’s DNA can now be analyzed by molecular techniques, such as the RT-PCR (reverse transcriptase polymerase chain reaction), to identify the BCR-ABL gene. The BCR-ABL assay is positive in 99% of CML patients. In addition this assay is utilized to detect minimal residual disease and monitor the effectiveness of treatment for CML.

Identification of Mycobacterium species
For decades, the identification of Mycobacterium species was based on conventional phenotypic testing - a labor-intensive process that took many weeks and often generated inadequate results for the definitive classification of the organism. The initial phenotypic identification was based on the rate of growth, colony pigmentation, and standard biochemical tests, often taking four to twelve weeks for isolation and identification of the organism. The incorporation of high performance liquid chromatography (HPLC) analysis of cell-wall mycolic acids into identification schemes allowed a more rapid classification of mycobacteria into groups, but it could not accurately identify all of the species. Also, the organisms that failed to grow robustly in culture rarely provided sufficient growth for phenotype-based identification. Currently commercial rRNA hybridization probes are available for the identification of the five most commonly isolated slow-growing mycobacteria. This system has had the greatest impact with respect to both accuracy and turn around time for the definitive classification of Mycobacterium species; however, it requires >10<sup>5</sup> viable organisms per milliliter and targets only a small number of species. The latest techniques, developed at the UW Medical Center Clinical Microbiology Laboratory, are sequence-based, rapid-real-time PCR identification methods that target species-specific regions of the 16S rRNA, heat shock protein 65 and the beta subunit of the RNA polymerase genes. These powerful tools provide a rapid and accurate identification in one to two days of all Mycobacterium species directly from clinical specimens, culture, and paraffin embedded tissue.

The examples of changes in clinical laboratory instrumentation and techniques given in this two-part article reflect the dynamic world of the clinical laboratory and laboratory medicine. Try to imagine the changes that will take place in the next fifty years! Try to imagine writing an article like this fifty years from now!

References

Available at:

Quality Ideas (cont’d)

Continued from page 3

that require action but are not flagged as critical values. Unfortunately, today’s methods cause some laboratory results to go unseen and unused. There is a slow, difficult, and inevitable trend toward using push technology to notify caregivers about laboratory results, and this trend will probably be associated with improved patient outcomes.

References


Dr. Bruce C. Gilliland, a beloved member of our department passed away on February 17, 2007 after a long illness. He was a colleague and mentor to many of us, and contributed to the Department in numerous ways including his fundamental contributions to the development of the Immunology Division. His funeral, which took place on February 22, was a standing room only tribute and celebration that took place at St. Joseph's Catholic Church. The following is an edited version of his obituary, which appeared in the Seattle Times on February 21, 2007:

Bruce Collins GILLILAND (September 4, 1931 - February 17, 2007) Dr. Bruce Collins Gilliland was born in Lima, Peru, the first of five boys born to his medical missionary parents. Raised in Los Angeles, Bruce excelled in athletics and academics. He enrolled at the University of Arizona in 1949 on a basketball scholarship and subsequently transferred to Occidental College where he graduated in 1956. His college years were interrupted by a two-year term of service in the U.S. Army. During his time at Occidental he met his wife, Maren, and they married in 1959. He graduated from Northwestern School of Medicine in 1960 and moved to Seattle to begin his medical career and his 45 years with the University of Washington School of Medicine as an intern, resident, fellow, physician, administrator and professor. Dr. Gilliland's numerous awards, honors, and publications bespeak of his excellence and expertise as a physician.

Dr. Gilliland is a renowned expert in Rheumatology, a Grand Master in the American College of Physicians, served as Acting Dean at the UW School of Medicine, and has lectured all over the world. However, his greatest legacy is the impact he had as a professor and clinician. He is respected and beloved as an exceptional teacher and role model to hundreds of medical students, residents and junior faculty. His patients all benefited from his superior diagnostic skills and expertise, but more importantly the time and care he devoted to them. His lifetime of service to others is surpassed by none.

Away from the hospital, Bruce was devoted to his family and he loved living near the water. Bruce spent many hours with family and friends on the golf course and had a passion for the game. He also loved to fish with his son, boat with his family in the San Juan Islands, spend time with his grandchildren and travel with Maren, especially to warm destinations.

Bruce is survived by: his wife, Maren, his daughters, Jean Gilliland Stivers (David), Anne Marie Gilliland Pickles (Mike) and son, John; seven grandchildren, Elizabeth, Kate, Tom, John, Andrew, Sarah and David; and his brothers, Keith (Lynnai), Vincent (Gina) and Victor. †