Clinical Laboratory Educators Conference 2003 Abstracts

POSTER PRESENTATIONS

Authors listed in bold face type were the presenters.

Addressing Curriculum Problems through Creative Planning and Scheduling

Cheryl Burns MS CLS(NCA), ***Linda A Smith PhD CLS (NCA), Shirlyn B McKenzie PhD CLS(NCA),*** *Ronald Holton PhD, Betty Dunn MS CLSp(CG)*, University of Texas Health Science Center at San Antonio, San Antonio TX.

As the knowledge base of the CLS profession grows and the role of the laboratory professional expands, educators are challenged with curricular problems of too much content and too little time. Most CLS curricula already exceed the credit hours required for a BS degree, with many students taking five years or more to complete the program. In our department, CLS faculty were faced with two problems: the need to expand the molecular diagnostics course content for three student groups (CLS, cytogenetics, and molecular diagnostics students) and the integration of an immunology course (formerly taught at another institution) with serology. This had to be done without increasing credit hours, eliminating basics, or spreading faculty 'too thin'. The faculty held several brainstorming sessions to discuss integrating course content, determine student needs, and identify how the course could fit into the curriculum. The result was creation of a combined molecular and immunologic diagnostics course (lecture and laboratory) roughly divided into thirds. All three groups of students take five weeks of molecular diagnostics. The CLS students also take five weeks of immunology and five weeks of immunologic diagnostics. Multiple faculty teach the course depending on their area of expertise. Faculty agreed to give up turf and work together to fully integrate content. This course reorganization and development resulted in adding new content without adding credit hours. In addition, students gained communication and teamwork skills by working together on projects.

Biodefense Awareness Courses – Addressing Personnel Shortages and Preparedness for Biological and Chemical Attacks

Pat Greenup PhD MS MPH, University of Alabama at Birmingham, Birmingham AL.

The focus of bioterrorism preparedness has been the front line workforce in public health and medical emergency practitioners. Awareness and performance objectives have been identified for first responders with the ultimate goal to achieve a competent workforce able to respond to bioterrorism and other current and emerging health threats. A major limitation to national, state, and local biodefense preparedness is the current and emerging manpower shortages across the health professions. One proactive strategy is the offering of biodefense related courses to undergraduate and graduate students. The primary objective is to make awareness level information available and to recruit students into the health sciences for future response to incidents involving weapons of mass destruction. Two course offerings (a two credit course and a three credit Honors Program course) present awareness objectives including terrorism, event types and recognition, detection systems, and key competencies needed for biological and/or chemical response. Core content areas are linked to the WHO definition of health and the identification of interdependencies between social, psychological, political, economical, technological, legal, and ethical issues related to biodefense, counterterrorism, and emergency preparedness. The instructional design for these elective courses offered by the UAB Clinical Laboratory Sciences Programs will be described. An evaluation of the first course offerings and the potential for recruiting students to health professions, life sciences research and public health programs will be described.

The peer-reviewed Clinical Practice section seeks to publish case studies, reports, and articles that are immediately useful, of practical nature, or demonstrate improvement in the quality of laboratory care. Direct all inquiries to Bernadette Rodak MS CLS(NCA), CLS Clinical Practice Editor, Clinical Laboratory Science Program, Indiana University, Fesler 409, 1120 South Avenue, Indianapolis, IN 46202-5113. brodak@iupui.edu

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The Clinical Laboratory Practitioner: A New Level of Practice

David G Fowler, PhD CLS(NCA), Tina Martin MSN FNP, University of Mississippi Medical Center, Jackson MS.

Over the past thirty years many health professions have evolved into an expanded scope of practice while the CLS profession has seemed to languish. Recently there has been a task force initiated to study the feasibility of the post-baccalaureate entry level into the profession. Some health professions have limited success with requiring a post-baccalaureate entry-level while others have used an alternative education model to expand their scope of practice. This study is designed to look at potential areas of practice for the CLS and propose a graduate curriculum to prepare the practitioner for an advanced level of practice. The study identifies six issues that must be addressed before implementation of the advanced level of practice. These include patient safety, cost/benefit analysis, patient clinical outcomes, professional liability, healthcare reimbursement, and licensure/certification. Before entering into a new level of practice the CLS would be required to obtain an educational level commensurate for the anticipated level of practice. The proposed curriculum model is adapted from established healthcare educational models and culminates in a professional doctorate. This study is designed to address the issue of post-graduate education for the CLS profession and offers an alternative to the entry-level master's degree.

Clinical Testing Via University Website for Off-Campus Students

Libby M Spence PhD CLS(NCA), Thomas B Wiggers MS, University of Mississippi Medical Center, Jackson MS.

While current shortages in CLS have increased student class sizes, clinical facilities for training have remained scarce. To provide clinical internships for all students it becomes necessary to contract with outlying facilities for training. To offer off-campus students the same accessible, comparable clinical testing as for those on campus, an on line testing program, TestGenerator©, was utilized to provide Web testing.

The only requirement for any clinical facility to make testing available is an Internet connection as the program uses any browser and any operating system. Many security features, such as a password-protected page, random generated passwords, print and browser functions are not accessible from within the test, and the URL of the examination file is not visible, are employed. The student while being monitored, logs on, takes the test, and is immediately able to view his or her score. Simultaneously, the university clinical coordinator receives an e-mail of the student's score and a test analysis to review individually with the student at a later date.

This method has proven to be valuable to students, faculty, and clinical facilities in a number of ways. A high level of satisfaction exists for all parties involved because the program is easy to use and administer and provides immediacy of results for both student and faculty member. This practice relieves the clinical personnel from the responsibility of generating exams.

Comparing International Laboratory Education

Linda J McCown MS CLS(NCA), Jewish Hospital College of Nursing and Allied Health, St Louis MO.

Educators and employers of laboratory personnel face a difficult situation when trying to assess applicants from other countries. Internationally, medical laboratory science not only lacks a standardized educational track, it also lacks uniformity in the levels of practice within the profession. Professionals who may be licensed and credentialed in their own country may not be allowed to practice in another country. Through phone interviews, electronic mail, and literature searches, information was gathered about the education and credentialing of medical laboratory personnel in Australia, China, Ethiopia, and the Philippines. Like the United States, Australia has multiple routes to employment in a medical laboratory. Australia has programs ranging from two to three year technical education to a doctorate in science. Employment is dependent upon membership/registry with the Australian Institute of Medical Scientists. The Peoples Republic of China also has a hierarchy of positions in the medical laboratory and a variety of ways to become a medical laboratory technologist. Employment depends upon completion of a formal program. Ethiopia has one bachelor's degree program and three two-year technician programs. Laboratory professionals are registered and licensed by the Ministry of Health and an individual's place of employment is determined by the Ministry. In the Philippines, the only level of education is the four-year bachelor's degree which is followed by an examination of the Board of Medical Technology (governmental). Hopefully this study will increase awareness of the variety of laboratory education around the world and the difficulty in comparing education and credentials.

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Expanding Curriculum: A Forensic Science Concentration within a CLS Degree

Julie A Hammerling MS CLS(NCA), Jo Ann Wilson PhD CLDir(NCA), Florida Gulf Coast University, Fort Myers FL.

A surge of interest in forensic science has swept the nation as live courtroom dramas, fictional television episodes, and written media highlight laboratory science in criminal detection applications. Best poised for integration of this applied laboratory science into existing curriculum are the clinical laboratory science (CLS) programs across our nation. Currently, very few academic programs exist that provide a course of study in forensic laboratory science. CLS faculty possess the laboratory skills and theoretical basis behind forensic laboratory courses providing the perfect marriage of the two curricula. CLS students develop the skills and knowledge for clinical laboratory application that are easily transferred to forensic laboratory analysis. Florida Gulf Coast University developed a forensic science concentration within the CLS baccalaureate degree, with support of the existing university criminal justice program. Students choose forensic laboratory science or CLS or elect to combine the concentrations with additional coursework within their degree. The curriculum integrates a theoretical basis and applied technology of crime laboratory analysis balanced with laboratory science and criminal justice understanding. Courses include Forensic Microscopy, Human Genetics, Biochemistry, Molecular Genetics and Diagnostics, Forensic Analysis, Forensic Toxicology, Courtroom Forensics, and an Internship. The curriculum is augmented with courses from criminal justice including Criminal Justice Systems and Procedures, Forensic Psychology, Advanced Forensics, Constitutional Criminal Law, and Drugs, Alcohol, and Crime. As universities continue to place student numbers as the marker for successful programs, adding concentrations that attract students and meet the needs of today's marketplace is essential. Adding a forensic science concentration to your existing baccalaureate degree is a positive and cost-effective alternative.

Evaluation of Small Group Testing Strategies in a Clinical Microbiology Course

Mary F Lux PhD CLS(NCA), University of Southern Mississippi, Hattiesburg MS.

Lecture has been the traditional delivery method for content-driven courses such as clinical microbiology. The introduction of group activities into a structured, traditional lecture course represented a shift in style for both the instructor and students. Group activities help students to develop active learning habits and to cooperate to achieve a common goal. Classroom learning activities for small groups included preparation of illustrations, development of in-class questions and responses, solution of case study problems, and presentations of books or journal articles. If students invest in group learning activities, it follows that groups should participate in evaluation or assessment. The group evaluation techniques included occasional group quizzes and the case study portions of three major exams. The performance on group quizzes produced higher average grades when compared with the average grades from years in which each student completed the questions as individuals. Likewise, performance on the evaluation of the case history portion of the exams was higher than with the individual efforts of previous classes. However, overall course grades were not considerably higher for classes with group activities as compared to classes in which each student worked alone. Nevertheless, all students in the classes with group activities reported high satisfaction with the group's activities and testing strategies.

Human Granulocytic Ehrlichiosis: A Case Study

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Ehrlichioses are intraleukocytic bacteria of the family *Rickettsiaceae.* The bacteria are reported to be spread through contact with ticks. Ehrlichiosis symptoms can range from asymptomatic to severe life-threatening conditions. Although rarely seen in clinical practice, laboratorians working in high tick exposure areas should be aware of the laboratory results associated with ehrlichiosis. During a summer evening, at a Cape Cod hospital in Massachusetts, a 68 year-old male sought treatment for fatigue and shortness of breath. He had received chemotherapy recently and believed that his symptoms were probably due to the treatment and weather. Also, he stated that he noticed an insect bite on his left hand. A CBC count demonstrated a WBC count of 12.8 x 10^{-9}/L, reference range 4.8-11.2 x 10^{9}/L. A peripheral blood smear demonstrated 12 bands, 1 metamyelocyte, 4 lymphocytes, 1 monocyte, 2 eosinophils, 0 basophils, and 80 neutrophils with occasional hypersegmentation. The following morning the WBC count was 1.4 and the smear presented 2 bands, 44 lymphocytes, 1 monocyte, 2 eosinophils, and 51 neutrophils having prominent hypersegmentation and inclusions. These findings prompted a review of the smear by a hematopathologist. On the third day, the patient's WBC

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flagged a delta message of 0.5 (from 1.4; 12.8). The smear revealed 1 neutrophil, 1 band, 5 metamyelocytes, 2 myelocytes, 80 lymphocytes, 6 monocytes, and 5 eosinophils. Differential diagnosis from the pathologist confirmed intraleukocytic ehrlichiosis within the neutrophils. Using immunofluorescence the human granulocytic ehrlichiosis (HGE) antibody was detected, supporting the cellular morphological findings and confirming the diagnosis of HGE transmitted via the patient's insect bite.

In Search of a Meaningful Senior Honors Research Project

Margot Hall PhD FAIC CChem (MRSC), *Sabrina Bryant MS CLS(NCA) MT(ASCP), Jane Hudson PhD CLS(NCA) MT(ASCP) SM, Mary Lux PhD CLS(NCA) MT(ASCP), Carol Beck EdD, MT(ASCP) SBB, Shelley Myers MT(ASCP)*, The University of Southern Mississippi, Hattiesburg MS.

The problem addressed in this study was how to design and execute a senior honors research project which would be meaningful to medical technology students while also meeting university requirements. The overall goal was to introduce the students to applied chemistry research. Criteria for the research problem included: 1) it must be important scientifically; 2) it must introduce the student to a body of medical/scientific literature, research design, state of the art laboratory techniques, and statistical treatment of data; 3) it must culminate in publishable data; 4) it must require less than one year for completion (not open-ended); 5) it must involve the use of available and affordable resources; and 6) it must culminate in a written document which meets university standards for honors theses. In addition to the writing and defense of his/her senior honors thesis, each student was required to submit an abstract and give a presentation at a regional meeting. Sources of funding, instrumentation, reagents, and specimens are discussed. The work resulted in the evaluation of ten different serological tumor antigens (CA19-9, CA195, CA50, CA72-4, CA125, CA15-3, CA27.29, CEA, AFP, and Cyfra21-1) for their diagnostic efficacy in a population of 554 patients plus 200 healthy adults. Diagnostic predictive values were generated for breast, pancreatic, and gastric cancers and those results are discussed. The study resulted in three senior honors theses, four papers (two national, two regional), five presentations with abstracts (two national, three regional), and four student awards (two national, two regional), thus meeting all goals.

Impact of a Change in CLS Program Structure on Student Retention

Karen R Murray PhD CLS(NCA), Tarleton State University, Fort Worth TX.

Retention is a critical factor in capacity enrollment programs. Students not retained represent both a financial loss to the program in tuition revenue and the loss of a new professional in a time of nationwide shortage of clinical laboratory professionals. Program assessment reports had revealed retention rates that were determined to be unacceptable when compared to program goals. A four-part plan entitled Strategies and Objectives for Success (SOS) was developed to improve student success. The first part involved a complete redesign of the CLS program structure and was implemented as a tool for increasing student retention rates, and thus success in the academic portion of the program. A new structure was adopted in which the CLS program courses were redesigned to divide the program into distinct phases. The phases were graduated in content difficulty and outcome objectives, resulting in a learning environment more conducive to student success. This study uses student retention rates to evaluate the first part of the SOS plan. Retention rates were compared using six different classes; three classes prior to the change in program structure and three after the change was implemented. Comparison of retention rates between the two groups revealed that retention increased by eight percent. These results were encouraging and as a result our program plans to implement the next three parts of the SOS plan. Other CLS programs with retention problems may benefit from adopting a similar structure.

Implementation of Manipulatives in the Clinical Microbiology and Immunology Classroom

Beverly Barham PhD, Illinois State University, Normal IL.

1) The 'hands on' experience for CLS students in the microbiology and immunology classroom is an essential part of the learning process. The cost of that experience can be a barrier for many programs. 2) Implementation of manipulatives can help students understand the basics of both traditional and molecular diagnostic testing methodologies without spending resource dollars. Manipulatives can be designed by students using common items such as construction paper or posterboard. Through creative but simple design, the basic components needed for a testing method-

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ology can be made. The students can then take these designs, apply the theoretical concepts of different methodologies such as enzyme linked immunosorbent assays and create a very simple but effective visual 'hands on' educational tool. 3) By using manipulatives, students were able to solve case studies and identify possible sources of errors in testing methodologies correctly in 80% of the challenges (n = 20) without any additional help. Students were also challenged to design testing strategies for solving a particular problem in groups or individually which allowed for enhanced student engagement. In a traditional clinical immunology course, the implementation of manipulatives throughout the semester was mentioned as a positive learning experience in 75% (n = 14) of the course evaluations. 4) Implementing manipulatives can contribute to a positive student learning experience and save resource dollars. It can also help assure that the next generation of CLS students will have a strong foundation in both theory and application of laboratory testing methodologies as they enter the profession.

Increasing Enrollment with Online and Off-Campus Delivery

Valerie Polansky MEd MT(ASCP), St Petersburg College, St Petersburg FL.

When single-digit enrollment threatened the future of the Medical Laboratory Technology Program at St Petersburg College, the curriculum was redesigned so that all of the courses in the major could be completed off campus. It was hypothesized that through distance education, program accessibility would be improved and enrollment would increase. The infrastructure to support a distance program was already in place at the college as a result of a five million dollar multi-year federal grant designed to increase access to workforce training. The program director and four adjunct instructors converted the theory courses for delivery in WebCT and redesigned the laboratory courses so that they could be carried out in affiliated clinical laboratories. The conversion was completed in two years. A national marketing campaign was undertaken and the new program was launched in August 2001. In the program's first year, 20 students matriculated and new affiliation agreements were developed with six clinical laboratories in distant locations. By September 2002, requests for information about the program had been received from 680 prospective students and 57 laboratory directors in 48 states. These preliminary data support the hypothesis that program enrollment can be increased through distance education. The significant level of interest in the program throughout the country suggests that this model of education could revitalize other programs and help to ameliorate the personnel shortage. The program's first distance education class will graduate in May 2003. At that time a comparison of outcomes for the distance and traditional programs will begin.

Investigating Medical Laboratory Practitioners Scope of Practice

Donna Surges Tatum PhD CAE, ***Kory Ward-Cook PhD MT(ASCP) CAE,*** ASCP Board of Registry, Chicago IL.

Job task, or practice, analyses are a vital component of the certification process. They are used to validate examinations by providing a link between job performance and examination content. Before an examination is developed, and every three to five years thereafter, a job task analysis must be performed to define or confirm the scope of practice in order to assure appropriateness and relevance of the certification. In 2001, ASCP Board of Registry staff visited 22 diverse practice settings and recorded more than 150 observations to create an ethnographic report. These data were used to develop an in-depth Job Task Survey for Medical Technologists (MT), Medical Laboratory Technicians (MLT), and Phlebotomists (PBT), mailed in early 2002. The table below shows the response rate is more than sufficient to determine the various scopes of practice and the validity of the certification examinations.

Category	# Mailed	# Returned	Response Rate
All	17,310	2,665	15.4%
MT	7,010	1,058	15.1%
MLT	5,626	876	15.3%
PBT	4,674	731	15.6%

Results indicate overlapping scope of practice with MTs and MLTs for many tasks. However, MTs perform complex tasks more often than do MLTs. PBTs have defined jobs and do not practice outside clearly defined parameters. Other variables examined, such as geographic differences, length of time in the profession, practice setting, type of facility, and schedule, are useful for blue printing the examination and validating the examination content. Further, educators can review their curricula in light of practice, and government agencies will have the facts when determining laboratory regulations.

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Investigation of the Utilization of Learned Generic Skills by CLS/MT Practitioners

***H Jesse Guiles EdD**, Michelle Brown,* University of Medicine and Dentistry of New Jersey, Newark NJ. *Donna Surges Tatum PhD, Psychometrician ASCP-BOR*, Chicago IL.

Application of generic skills such as: Analytical Reasoning, Correlation of Data, Communication, Computer Use, Decision-Making, Precision Studies, Problem Solving, Quality Assessment, Research, Supervision, Teaching, Technical Writing, Troubleshooting, and Utilization Studies is considered a hallmark of competent baccalaureate level CLS/MT practitioners. In 2002, Guiles (CLS15:23-9), looked at the acquisition and utilization of these skills by a cohort of CLSs/MTs who stated they left the field (LTF). It was proposed that the same skills should be examined for CLS/MTs who remained in the field (ITF). Data were collected from 517 (44% response rate) practitioners who have been ITF since 1993. Utilization was grouped into two categories: used, didn't use. Learning was grouped into three categories: learned as a student and developed as a practitioner, learned as a practitioner only, never learned. Chi square analysis showed a significant difference in learning vs. using the skills in ITF jobs for computer use, research, supervision, problem solving, and utilization studies. Except for learning computer skills, no significant difference in learning or using the skills in ITF jobs was observed between those practitioners who qualified for the ASCP-BOR certification exam as NAACLS program graduates vs. other routes. These findings are in contrast to the LTF study that showed no significant differences in using vs. learning these skills and several significant differences in learning the skills via different eligibility routes. These findings may indicate that LTF jobs provide graduates with better opportunities for applying certain learned generic skills than do ITF jobs.

Demonstration of Proper Micropipetting Technique, Calculation of Precision and Accuracy, and Beer's Law

Wayne Gade PhD CLS, University of Illinois at Springfield, Springfield IL.

The Science Division at UIS has upper division programs in biology, chemistry, and CLS and attracts traditional and non-traditional transfer students from central Illinois who vary greatly in laboratory training and expertise. A laboratory techniques course is required of all students to insure that students gain essential proficiencies. This abstract describes a laboratory exercise that provides substantial pipetting practice, and generates data that illustrates principles of precision, accuracy, and Beer's Law using a 96-well microtiter plate and EIA plate reader. Students develop pipetting technique while filling three columns of the plate with specified volumes of dye, and they also generate sets of eight repetitions used to calculate precision (typically 2-5 % CV). Students perform a series of two-fold dilutions, construct a standard curve to illustrate Beer's Law (linear relationship of absorbance to concentration), and determine concentrations of unknowns. Students also construct an atypical standard curve, by adding increasing volumes of dye (from 50 mL to 300 mL), which demonstrates linearity between absorbance and path length or volume. Finally, the microtiter plate is re-read at another wavelength (and different pH of dye), illustrating that molar absorptivity is constant only for specified conditions, and that changes in conditions affect absorbance (even with constant concentration and path length). Results on final practical exams demonstrated improvement in pipetting competency and a better understanding of Beer's Law.

Survey of Clinical Instruction of Pathology Residents in Immunohematology

***Linda M Hawthorne MHS MT(ASCP)SBB**, Lynda Britton PhD, Debra Judd PhD, Aixa Garcia MD, Diana Veillon MD, Deborah McCaskill MT(ASCP)SBB*, Louisiana State University Health Sciences Center, Shreveport LA.

This study investigated methods of instruction used in clinical pathology (CP) programs to train residents in immunohematology. The exam scores of residents suggested our current protocol might inadequately train residents in basic immunohematology concepts and techniques. Time, budget, and staffing constraints make using a supplemental computer tutorial an alternative to expanded traditional training. Applications of computer assisted instruction (CAI) show promise of fostering student enthusiasm and learning, while reducing instructor time and participation. United States CP programs were surveyed to determine training methods and gauge interest in incorporating a hypermedia tutorial. Teaching personnel at 110 randomly selected CP programs were surveyed and statistics were used to analyze data. A total of 60/110 surveys were returned (54.5% response rate). Respondents from 47/58 programs (81%) considered their trainers experienced teachers. Medical technologists performed the majority of bench instruction at 50/59 sites (84.7%). Independent reading and lecture were used primarily in 53/60 programs (88.3%). Although only 2/60 (3.3%)

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currently used CAI, 53/59 (89.8%) expressed interest in incorporating CAI. Respondents assessed training effectiveness as excellent in 19/59 programs (32.2%), good in 30/59 (50.8%), and satisfactory in 9/59 (15.3%). A primary research goal was comparison of our CP resident immunohematology training protocol to that of other programs. Results indicate our training program is comparable to other respondents. Independent reading, lecture, and bench training are the primary methods of instruction. Appreciable interest exists in incorporating CAI into training. Data provides useful information to staff for assessing their training protocols and should facilitate streamlining or redesign.

Updating Pre-CLS Requirements in Molecular Biology and Biochemistry to More Effectively Prepare Students for New Molecular Technologies

Mary Louise Greeley PhD, Salve Regina University, Newport RI.

The techniques of molecular biology are increasingly being used in the clinical laboratory both to diagnose patients and to monitor their response to treatment and/or the progression of their disease. Because of the increased use of molecular diagnostic techniques, many clinical laboratory internship programs are fast revising their curricula. However, many students come to the clinical year with a poor background in biochemistry/molecular biology making it harder for them to understand the applications of these techniques as presented during the clinical practice. Since most CLS programs require either biochemistry or organic chemistry, the content presented in organic courses was compared to that in biochemistry courses to see which would better prepare students for the 21st century clinical laboratory with its increased emphasis on molecular techniques. The biochemistry courses contained the theories and techniques of nucleic analysis and structure while the organic chemistry courses did not, making biochemistry a more appropriate prerequisite. A survey of the undergraduate requirements for biology majors revealed that many colleges/universities have either dropped their requirements for organic chemistry or reduced this requirement to one semester. This change in biology requirements coupled with the fact that biochemistry courses provide a better foundation for meeting the new demands of clinical molecular biology suggests that a two semester preclinical biochemistry sequence should be required for all CLS students.

The WEBCLS Project: Its Effects on Participating CLS Faculty

Vicki S Freeman PhD, David Holcomb EdD, University of Texas Medical Branch, Galveston TX.

The Web-based Education in Clinical Laboratory Sciences (WEBCLS) project, in addition to the overall goal of developing courses for CLS distance education, had additional objectives including improving participating CLS educators' skills in designing, developing, delivering, and evaluating interactive, Web-based instructional programs. To assess the project's outcomes in accomplishing this objective, a survey was sent to the 27 primary faculty participants in WEBCLS activities. Twenty-four participants completed the survey for an 89% response rate. Overall, the WEBCLS project accomplished its objective of improving CLS educators' Web-based, distance education course development skills through systematic instructional design training. One of the most positive outcomes was the belief that their participation in the project expanded their contacts with colleagues in CLS education as well as with instructional design experts, computer programmers, and other technical support personnel. This outcome prompted the faculty to report that this enhanced collegial relationship will sustain their interest in curriculum development over time. In addition, the CLS faculty members reported that they now integrate more technology in their teaching, better organize their courses, develop and use alternative methods of evaluating students, and were moving away from lectures towards more student-centered activities. Problems associated with faculty participation in the project primarily focused on lack of quality time devoted to developing the CLS instructional units. Heavy teaching loads and lack of release time caused delays and gaps in the time available for project activities of most faculty participants. The WEBCLS project clearly had positive effects on the participating CLS faculty, and, subsequently, should enhance CLS education.

When the Road Becomes Bumpy, Throw It Some Curves: Making the Transition from Live Lectures to Interactive Web-based Courses

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With the shortage of laboratory personnel, Web-based instruction is becoming necessary to expand options in educating clinical laboratory scientists (CLSs). Web-based courses can meet the needs of place-bound students who are

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not able to attend regularly scheduled lectures in a course. Such instruction is ideally interactive; just such instruction was designed for courses in chemistry and pathogenic microbiology to be delivered to clinical laboratory technicians (CLTs) in a CLT to CLS articulation program. Unfortunately, these courses were not available in the on-line format in time for use during the first designated semester. To meet a variety of learning styles and still meet the needs of distance students, an array of formats for delivering the learning materials were used in these courses. Didactic material was delivered both videostreamed and in PowerPoint with expanded verbiage or narration. Extensive study questions and case studies were also provided to these students. Students answered and discussed these materials on the discussion board. Prompt instructor feedback via e-mail and the discussion board was provided. Students in the Web sections of these two courses performed as well as the students in the on-campus sections on examinations and assignments. For educators lacking the availability of interactive Web materials, this approach provides the opportunity to educate students via the Web with minimal investment in a Web-authoring program. Blackboard, along with other similar programs, is very intuitive and easy to use. Place-bound students that may have been previously unreachable can now be served in this Web-based structure.

TECHNOLOGY DEMONSTRATIONS

Antimicrobial Susceptibility Testing: An Interactive Educational CD-ROM

Judy R Delany MPH MS MT(ASCP), Janet F Hindler PhD, Fred C Tenover PhD, Eunice R Rosner EdD MT(ASCP), Centers for Disease Control and Prevention, Atlanta GA; *Diana Mass MA CLS(NCA),* Arizona State University, Tempe AZ.

Antimicrobial susceptibility testing is becoming increasingly complex as new antimicrobial agents are introduced and bacteria develop new resistance mechanisms. These changes present challenges for the clinical laboratory in testing and reporting. This continually changing field also presents a challenge to educators preparing tomorrow's CLSs. An interactive CD-ROM, available free of charge, has been developed which is designed to meet these challenges. This program, developed by leading experts in the field of antimicrobial susceptibility, is composed of four different modules: modes and mechanisms of action, testing methods, Gram-positive organisms, and Gram-negative organisms. Continuing education credits and continuing medical education credits (CEUs and CMEs) may be earned for each module independently. The course answers such questions as: 1) How do antimicrobial agents work? 2)What organisms should I test? 3)What antimicrobial agents should I test? 4)What methods should I use? and 5) How should I report results?. The course is structured with basic components, which could be used in the education of the beginning CLS student and also includes very detailed explanations of complex modes and mechanisms of action of antimicrobial resistance by different organism, which would be of interest to experienced microbiologists.

Computer Simulated Laboratory: Student Perception and Outcomes

Janelle M Chiasera MS*, Sally V Rudmann PhD*, The Ohio State University, Columbus OH; *Bob Harr*, Bowling Green State University, Bowling Green OH.

Technology has significantly impacted our lives on several levels and has resulted in change almost on a daily basis. The students we are educating have grown up with technology and are used to an environment that is fast-paced, convenient, and available to them at their fingertips. As educators, we need to take our education environment to a level that will foster that technological environment and suit the needs of our students without sacrificing the quality of education. In an effort to accomplish this we developed a computer simulated blood gas module to study the effect of a computer simulated laboratory on student outcomes and perceptions. Clinical laboratory science (CLS) students from three university CLS programs were selected and randomly assigned to two treatment groups: computer simulation or traditional wet laboratory. The students completed a multiple-choice post-test and a questionnaire. A two-way analysis of co-variance was used to compare the scores on the cognitive post-test and descriptive statistics were run on the qualitative questionnaire.

With the population of students studied, we found no significant difference between institutions in post-test scores implying that the computer module worked as well as a traditional wet laboratory at all the institutions we studied. In addition, students seemed to have overall good perceptions of the computer laboratory as well as the traditional wet laboratory with the only difference being that the computer users felt they had more opportunities to assess their learning throughout the laboratory as compared to the wet laboratory users.

We believe that the use of technology in our laboratories will give us the opportunity to meet the needs of our stu-

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dents and lower the cost and time associated with our traditional laboratories without sacrificing the quality of education. In addition, it will allow us the ability to provide open access to our laboratories not only to our students, but to students at a distance as well as students in other health related disciplines that rely heavily on laboratory data, e.g., circulation technology and respiratory therapy students.

Computerized Atlas of Peripheral Blood Smears as a Job Aid

***Michelle Montgomery CLS(NCA)**, Kathy Doig PhD CLS(NCA), Brian Winn MS*, Michigan State University, East Lansing MI.

This demonstration will showcase a computerized atlas of peripheral blood smears to be used as a job aid by practicing clinical laboratory scientists (CLSs). Current computerized hematology atlases are designed for varying target audiences, most often novices, resulting in a number of shortcomings for optimal CLS use in the workplace. A needs assessment indicated general support for a job aid such as this one. The atlas, uniquely designed to support performance of white blood cell differentials, is intended to assist generalist staff in smaller laboratories and on minimally staffed shifts. A large number of digital images of peripheral blood smears are included. A database of text accompanies the images on an interactive CD-ROM. The atlas has been pilot tested for accuracy of content and usefulness in the workplace. Pilot test results have provided valuable information and suggestions that are currently being incorporated into the final product, which will be available for examination.

UND/Mayo Cohort; Putting it all Together

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The University of North Dakota School of Medicine and Health Science, Grand Forks ND has entered into a cohort project with the Mayo Clinic, Rochester MN. The cohort program allows non-CLS Bachelor degreed students to complete a CLS certificate (4+1) and MLT employees to complete a BS degree in CLS (2+2). UND also provides a CLS graduate program for employees. The cohort program allows students to complete didactic course material online, asynchronously. Intense laboratory sessions will be held at the Mayo Clinic in three, two-week blocks to minimize employee absence from work. The challenge becomes how to utilize technologies available to deliver courses, advise students, and maintain adequate communication. Blackboard.com, streaming audio/video, interactive online testing system, interactive delivery of the material on CD/DVD, and H.323 multiple site video conferencing are currently utilized to deliver the course material. A secure online database, handheld devices, and a document handling system are utilized to advise students and provide an effective interface for counseling at either location. This technology presentation will include examples of the above. The UND/Mayo cohort began the fall semester of 2002. Evaluation will consist of ongoing student interviews, student satisfaction surveys, faculty and student course assessment, and Mayo administrative review. The attrition rate and course completion rate will be monitored for students participating in the project. Results from the 2002 fall semester will also be presented.

Using Basic Technology to Prepare Supplemental Urinalysis Study Guide CDs

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Rapidly advancing computer technology provides opportunities to supplement course material requiring visualization of structures. Increasing numbers of adult learners with work and family responsibilities create a need for study sets that each student can copy and use as his/her schedule permits. Purchasing these materials commercially can strain the budget and preparing such materials can appear overwhelming.

In the CLS Urinalysis and Clinical Laboratory Methods courses for Physicians Assistants and Nurse Practitioners, study sets providing additional educational materials were needed. To resolve this problem, previously taken departmental slides plus photos captured using a digital camera mounted on a microscope mounted and linked to a computer were imported in Adobe Photoshop. Photoshop allowed sharpening of images using the contrast and intensity settings. The color contrast modified images to more closely reflect the sediment as it would be seen under the scope. These pictures were transferred onto PowerPoint slides, where structures of interest were identified and a brief narrative explaining the significance of the objects as well as hints for use in identification were included. Rather simplistic CDs were cost effectively produced to provide students additional learning opportunities to enhance their identification skills.

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