Evidenced Based Practice: Classroom to Clinical Laboratory

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LEARNING OBJECTIVES

1. Discuss the application of Evidence Based Practice (EBP) in each phase of laboratory testing: preanalytic, analytic, post analytic.
2. Describe and distinguish between EBP in MLS student curriculum and clinical laboratories.
3. Describe the efficacy of clinical research for quality improvement in clinical laboratories.
4. Evaluate quality assurance problems and projects encountered in the clinical laboratory for classroom teaching and adaptation to clinical research projects

ABSTRACT: Evidence based practice (EBP) can be incorporated into the curriculum of Medical Laboratory Science (MLS) Programs. Current components of curriculum can include EBP in pre-analytic, analytic, and post-analytic topics. Discussion of EBP topics in the classroom using practices assessed through the Laboratory Medicine Best Practices Initiative (LMBP™) of the U.S. Centers for Disease Control and Prevention will give students a clear understanding of EBP and how it is used in the clinical laboratory for improved health care quality. Student involvement in Quality Improvement projects to improve laboratory performance and patient outcomes can be developed through capstone projects. Examples of clinical projects and application of EBP into the MLS curriculum are discussed.

ABBREVIATIONS: CLS - Clinical Laboratory Science; EBP - Evidence Based Practice; LMBP™ - Laboratory Medicine Best Practices; MLS - Medical Laboratory Science; NAACLS - National Accrediting Agency for Clinical Laboratory Science.

INDEX TERMS: Evidence-Based Practice, Evidence-based Laboratory Medicine, Medical Laboratory Science, Education

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INTRODUCTION

Evidenced based practice (EBP) can readily be incorporated into the curriculum of Medical Laboratory Science (MLS) programs. The National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) standards require instruction in pre-analytic, analytic, and post-analytic aspects of the testing cycle.[1] Students can be informed how EBP can improve laboratory practices and the importance in patient outcomes across these three phases of testing.

Evidenced Based Practice for MLS students can be accomplished in a variety of ways. Instruction at the baccalaureate level has traditionally focused on analytics. Components that are already taught include method validation (statistical analysis), quality control, management, and research. With increasing focus on value in health services delivery, CLS must connect analytic to non-analytic (pre- and post-analytic) outcomes, i.e., medical effectiveness and cost efficiency.[2,3] Higher order thinking is required to implement these additional quality measures and EBP is the methodology through which these skills can be taught and implemented.[2] Further expansion of these topics in the curriculum to include EBP can describe what it is, how best practices are developed, and the importance of EBP for the clinical laboratory.

EBP methodology has been modeled through the investigation of practices in the LMBP™ initiative that

represent the impact of non-analytic aspects of the testing cycle on testing cycle analytics.[2,3] CLS baccalaureate students can be taught EBP constructs using these practices as examples. EBP, which includes evaluation of quality measures throughout the entire testing process, can be taught and is the basis of CLS clinical practice. Focus on implementation of non-analytic quality improvement studies may best be accomplished in post-baccalaureate programs given the additional critical thinking and curricular time requirements for the design, implementation, and evaluation of clinical research studies.

The purpose of EBP for MLS students' participation is to encourage clinical research and quality improvement data generation. Adequate volumes of evidence are necessary to conduct assessments and develop recommendations for identification of best practices.[4] All the phases of laboratory testing, pre-analytic, analytic, and post-analytic, incur some errors. The majority of errors that occur in the clinical laboratory involve pre-analytic and post-analytic testing phases.[5] Issues identified as important to quality management and improvement in pre-analytical testing may include blood sample hemolysis, blood culture contamination, and specimen identification errors. These topics were evaluated and assessed by LMBP™ using published and unpublished sources of evidence from laboratory practices for scientific study. Quality Improvement studies are most often the sources of relevant unpublished data.

Pre-analytical studies taught to students can include the LMBP™ reports of reducing blood culture contamination and reduction in blood sample hemolysis through effective practices in venipuncture blood collection.[6,7] Patient identification errors and the effect on sample and testing errors can also be emphasized.[8] The different practices that can be implemented for reduction of these pre-analytical errors presented to MLS students enhances their awareness of these issues and how to implement solutions. The reports by LMBP™ can provide a framework and structure for inclusion of EBP in the MLS curriculum.[9]

Classroom to Clinical Laboratory

The correlation of problems that can be experienced in the clinical laboratory are initially presented in the classroom and then applied in various clinical projects. This application and evaluation of projects can aid in preparing students for their professional career in laboratory medicine. Quality Improvement projects from clinical laboratory sites will be brought into the classroom for review. Real data and clinical projects from all departments of the clinical laboratory where students are attending their practicums help them to visualize real and potential problems as well as how to approach the solving of such problems.

Practical problems, journal investigation, and discussion can clearly blend EBP with current MLS curriculum. Further application and practical knowledge can be accomplished through capstone projects and clinical research. Undergraduate and graduate MLS programs can participate in EBP projects.

Additional clinical projects developed at the clinical practicum sites for students to perform will become part of their senior capstone project. Capstone projects synthesize the concepts learned and enhance problem-solving performed by students. These projects require the clinical research, abstract, methods, results, discussion, and conclusion for a scientific poster presentation at the annual state Clinical Laboratory Science (CLS) meeting. The projects are further developed for oral presentation to faculty and peers. The students work with preceptors at the clinical site as well as an advisor in the CLS department at the university to develop the clinical project, poster presentation, and oral presentation. Student presentations of the capstone projects are graded according to a rubric that encompasses certain concepts for content knowledge, presentation, poster development, and fielding of questions for those present at the oral presentation and the poster presentation.

Clinical Research Projects

MLS Students at a university in the upper Midwest have conducted clinical research in conjunction with quality improvement projects at their clinical practicum sites. Pre-analytical clinical projects have included a correlation of the use of different blood tubes to prevent hemolysis. Another study conducted by a student analyzed long term stability of hematology specimens at room and refrigerated temperatures. The results of these studies will aid the clinical laboratory in making decisions based on evaluation of the data and implementation of new protocols for quality

improvement and possibly leading to scientific publication.

Analytical studies can include method validation statistical analysis. Implementation of a new instrument with performance of comparison studies with statistical analysis is an important and specific practice continually conducted in clinical laboratories. This analysis can be incorporated into the MLS curriculum to evaluate analytical error and validate the correct method for testing a particular analyte.

Students at this university have also conducted clinical research studies of the analytical laboratory component. A comparative study of a new immunoassay analyzer with the analyzer to be "retired" was conducted with all of the inclusive data analysis and evaluation of potential error. Another validation study of the use of the Beckman-Coulter Airfuge was conducted. Test results before and after centrifugation were compared and evaluated. An MLS student performed the testing, used the new Airfuge, and analyzed the data from the testing.

Post-analytical results of critical value reporting have been analyzed and reported by LMBP™. Quality Improvement projects in the post-analytical phase of testing can also be designed by the clinical laboratory for students to conduct for their clinical research project. Projects involving turnaround time and process improvement could be analyzed in this post-analytical component. MLS students at this university have not yet developed research projects in these areas, but as relevant topics and Quality Improvement projects at clinical practicum sites are proposed, this area will eventually be addressed.

This development of best practices utilizing published work and the clinical research performed by students can constitute EBP for the laboratory and the classroom. The laboratory can establish definitive measures to contribute to decision making for the enhanced quality of care for patients. Emphasis is not just about the methods used in the laboratory, but now looking more at the outcomes for improved quality of health care. The connection between laboratory results, information provided to the clinician, and interventions provided must now be correlated with patient outcomes.[10] All of this information and correlation is valuable clinical research and teaching applicable to students as part of their MLS program.

Collaboration with clinical practicum sites can reveal many investigative, practical projects the clinical laboratory has had to delay or eliminate due to staffing shortages or time constraints. For example, students can also work with staff in the laboratory to perform studies for validation of a new instrument or method being implemented. The performance of the necessary studies and evaluating the statistical data will reinforce the information learned in method evaluation and the analytical phase of testing.[11] Examples of clinical projects that have been performed by undergraduate MLS students at this university are included in Table 1.

Table 1. Examples of Capstone and Clinical Research Projects for MLS Students

A Correlation Study of Blood Tubes to Prevent Hemolysis
A Validation Study of a Beckman-Coulter Airfuge
Long Term Sample Stability Determination and Comparison for Hematology Specimens at Room and Refrigerated Temperatures
A Comparative Analysis of ChromAgar and MRSA PCR
Evaluation of Nanosphere Verigene® Gram-Positive Blood Culture Nucleic Acid Test
Errors with Microbiology Set Up
Should ESwab be used in the Lab?
A Comparative Study of Immunoassay Analyzers in a Clinical Setting

These projects reinforce pre-analytical, analytical, and post-analytical issues with the generation of data and specific solutions evidenced by this clinical research. Students, working with mentors at the university and clinical practicum sites, can relate results achieved to application in clinical laboratory practice. Such correlation can directly and indirectly impact quality of laboratory testing, quality of health care, and improved patient outcomes. Evidence from results of clinical research projects developed by clinical and university mentors with their students can provide new processes and protocols to improve health care delivery by the laboratory.[12,13,14]

Students can actively participate in clinical research where they will develop research skills to use in their future capacity as Medical Laboratory Scientists. These clinical studies will aid students' understanding in using the results of their studies to develop analysis and assessment of current and new methodologies, instrument comparisons, and clinical practice

processes.[14]

CONCLUSION

Laboratory involvement in EBP focuses on quality improvement practices, enabling improved health care and patient outcomes. Medical Laboratory Science students must grasp the importance of EBP in clinical practice and laboratory medicine. The benefits of students knowing the importance of EBP will help them to be more involved in the implementation of clinical research projects and to be actively seeking solutions to improvement of laboratory quality and patient health care. Utilizing problems and projects for clinical practicum sites, students will help in developing Quality Improvement projects that will be of functional benefit for the clinical laboratory. Problems encountered in the clinical lab that need development of clinical research projects can be investigated and performed by CLS students in conjunction with preceptors at the clinical sites as well as university instructors to result in real time solutions for improved quality of results. These clinical research projects develop confidence and appreciation for their contributions to quality laboratory medicine. Once MLS students graduate and enter the laboratory profession, they will have a clear understanding of EBP, its importance and application to improved health care quality, and readily increase participation in these important endeavors.

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