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The Exploration of Integrating EBLM into Clinical Laboratory Practice by TBL Based on Clinical and Laboratory Collaboration at OSBCM

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Abstract

With the rapid development of artificial intelligence (AI) technologies, AI is widely applied in teaching, learning and clinical practice. Although AI shows some potential in enhancing working efficiency, there are some challenges such as the data accuracy and ethical considerations. Therefore, we should focus on the dominant role of HI (Human Intelligence) in inspiration teaching and clinical practice. The teaching reform of OSBCM in clinical laboratory practice adapts to the needs of closely linking clinical laboratory medicine with clinical medicine, and promotes the awareness of early clinical, multi-clinical and repeated clinical training of clinical laboratory undergraduates, so as to improve their clinical thinking ability. Integrating evidence-based laboratory medicine (EBLM) into clinical laboratory practice contributes to cultivate the students' ability to comprehensively self-directed learn the clinical and laboratory knowledge, search for literature, and enhance their scientific research awareness, independent scientific innovation ability, realistic spirit, thus improving their analyzing and solving problems that closely relate to clinical decision-making objectively and accurately based on clinical and laboratory evidence and lifelong learning ability. Combined teaching model of TBL, CBL and PBL based on clinical and laboratory collaboration not only stimulates students' interest in actively learning and cultivates their collaborative spirit of mutual learning and communication, but also help develop students' clinical thinking, logical thinking and critical thinking. It is particularly worth mentioning that the teachers need to emphasize the importance of paying attention to the specimens, quality controls, instruments, relevant clinical laboratory inspections, clinical main symptoms, medical history, imaging examination and other inspections. The teachers especially encourage the clinical laboratory undergraduates to dynamically monitor changes of important indi-

cators in clinical laboratory practice. If consistent, further look for the crucial clinical evidence to support them; otherwise, if inconsistent, identify the interferences and manage them to get the correct results, so as to help make right diagnosis. The exploration paves the way for clinical laboratory undergraduates' future clinical practice and scientific research, so as to improve their post competency after graduation.

Keywords

Clinical Laboratory Practice, Evidence-Based Laboratory Medicine, Organ-System-Based Curriculum Model, Team-Based Learning, Clinical and Laboratory Collaboration

1. Introduction

To solve clinical problems needs the collaboration between clinical and laboratory departments. On one hand, the clinical diagnosis and treatment decision needs to be made based on the evidence that clinical laboratory provides. On the other hand, the development of clinical laboratory can push clinical medicine forward. Therefore, the clinical practice and the scientific research are mutually promoted. As we know, the hospitals are divided into several clinical departments based on organ and system. Organ-System-Based Curriculum (OSBC) is curriculum organized by physiological systems instead of traditional disciplines. OSBC can apply physiological concepts in clinical contexts to support learning in physiology-intensive units and adapt well to the needs of diverse student populations in integrated curricula [1]. Accordingly, Medical Science Center of Yangtze University has implemented the reform of the "Organ-System-Based Curriculum Model" (OSBCM) curriculum teaching mode in the excellent undergraduate class of clinical medicine for more than ten years. With the rapid development of the Medical Science Center, which is established by the integration of the School of Health Medicine and the School of Clinical Medicine, clinical laboratory practice, as a key linking the theoretical knowledge and future work for the undergraduates of clinical laboratory, plays a crucial role in enhancing the clinical practice ability and scientific research ability of clinical laboratory undergraduates to promote the post-graduation competency. The teaching reform of OSBCM in clinical laboratory practice adapts to the needs of closely linking clinical laboratory medicine with clinical medicine, and applies evidence-based laboratory medicine (EBLM) [2] to promote the awareness of early clinical, multi-clinical and repeated clinical training of clinical laboratory undergraduates, so as to improve their clinical thinking ability and scientific research awareness.

2. Adopting the Combined Teaching Model of TBL, CBL and PBL in Clinical Laboratory Practice

Implementing TBL is associated with increased knowledge acquisition, student

engagement, and student satisfaction [3]. The implementation of a case-based teaching concept with practical elements increases the ability of medical students to understand the relevance of core knowledge and improves self-perceived learning [4]. PBL has been identified as one of the primary teaching and learning methodologies in the implementation of the CBC. Its main objective was to improve the competency of medical students by facilitating their acquisition of the basic sciences of medicine and promote the development of the reasoning processes utilized by physicians and other healthcare professionals in their clinical practice, thereby facilitating the holistic growth of students. The PBL holds the potential to augment learning outcomes by facilitating the integration of basic science of medicine and clinical knowledge throughout the learning process. PBL involves an active learning process, which encourages learners to engage actively, inquire further, and retain knowledge. PBL enhances the educational outcomes of self-directed and reflective learning while also enabling the educators to continuously monitor and evaluate the students' learning progress. In PBL the clinical problem is usually used as a trigger to solve certain clinical scenarios through a gradual learning process, where the students actively engage in the learning process. Moreover, PBL typically involves small group collaboration thereby improving the students' soft skills such as interpersonal, communication and teamwork. These skills are integral components of health professionalism. However, the PBL alone cannot be a learning methodology by itself. PBL has the potential to improve students' problem-solving skills in a clinical setting because it exposes students to real-world clinical problems. During the PBL process, the students face real clinical cases, in their effort to solve the clinical problem, they have the opportunity to improve their knowledge, skills, and attitudes in diagnosing and treating real patient cases [5]. It means that TBL at OSBCM stimulates students' interest and enthusiasm in actively engage in learning, increases their paths to acquire and share knowledge each other, cultivates their collaborative spirit of interpersonal learning and communication, and enhances their experience satisfaction. CBL at OSBCM provides certain clinical scenarios to expose the students to real clinical cases, promotes the earlier contact and earlier participation of clinical laboratory undergraduates in clinical practice and scientific research, so as to cultivate their clinical thinking ability and scientific research ability [6]. PBL with EBLM encourages the students to actively engage in learning, reason and inquire further, and retain knowledge, facilitates the integration of theoretical knowledge of medicine and clinical practice, enhances their self-directed learning ability and logical thinking ability, thus improving their analyzing and solving the clinical problems. Therefore, the combined teaching model of TBL, CBL at OSBCM and PBL with EBLM are integrated and complement each other, so as to comprehensively enhance the self-directed understanding of the relevant core knowledge, the skills of actively identifying, analyzing and solving key clinical problems, and collaborative and realistic and innovative spirit.

3. Constructing a New Teaching and Learning System at OSBCM in Clinical Laboratory Practice

Clinical laboratory practice is the critical link between study at school and work after graduation. The reform of the OSBCM exactly integrates the teaching and learning of clinical laboratory medicine with clinical medicine, effectively preventing the separation of clinical laboratory theory and clinical practice, thus meaningfully meeting the characteristics of clinical practice and the needs of teaching and learning development as shown in Table 1. Evidence-based medicine de-emphasizes intuition, unsystematic clinical experience and pathophysiological rationale as sufficient grounds for clinical decision making and stresses the examination of evidence from clinical research [7]. Evidence-based laboratory medicine or EBLM is a separate branch of EBM which focuses on the evaluation and use of laboratory tests with an overall aim of improving patient outcomes [8]. The implication of EBLM includes: systematic evaluation of the diagnostic accuracy, predictive accuracy, effectiveness in maintaining health, and cost-effectiveness of testing items. Its purposes involve: diagnosing diseases, assisting in treatment, monitoring the condition, feedback prognosis, etc., in order to provide guidance for clinical practice and lay a basis for the rational use of testing items.

Table 1. The affected organs and systems and related diseases.

Affected Organs and Systems	Related Diseases
Respiratory System; Urinary System; Digestive System; Skin; Nervous System; Blood Circulatory System	Bacterial infectious diseases; Fungal infectious diseases; Parasites, viruses and other infectious diseases;
Blood Circulatory System; Urinary System; Immune System	Anemia; Leukemia; Coagulation disorders; Nephropathy; Tumor;
Hormonal System	Hyperthyroidism; Hypothyroidism; Cushing's syndrome; Primary aldosteronism;
Cardiovascular System	Coronary heart disease; Atherosclerosis; Acute myocardial infarction; Cardiomyopathy; Hypertension

To date, the "Organ-System-Based Curriculum Model" (OSBCM) curriculum mode reform has been carried out in the excellent undergraduate class of clinical medicine in the Medical Science Center for more than ten years, yet there are no relevant reports on integrating EBLM into teaching and research of clinical laboratory practice by TBL based on clinical and laboratory collaboration at OSBCM. In this study, the design of integrating EBLM into teaching and research of clinical laboratory practice by TBL based on clinical and laboratory collaboration at OSBCM is as follows. The teachers guide the students to review the relevant content that learned before clinical practice, select typical cases at OSBCM and pose possible problems that may arise during the diagnosis and treatment process. The students are grouped according to their interests based on OSBCM, and solve the problems raised by the teachers through self-searching for relevant Chinese and English ma-

terials, discussion and communication in group, etc. The teacher comments on the solutions proposed by each group of students to the problems, summarizes the key and difficult points and precautions of teaching knowledge. Relying on TBL, CBL and PBL, this model cultivates students' ability to accurately retrieve relevant Chinese and English materials based on EBLM according to their interests, medical knowledge, cases and related issues to meet the requirements of precision medicine. It is more conducive to the cultivation of students' independent innovation ability and collaborative spirit, thereby improving their job competence and lifelong learning ability after graduation.

4. Integrating EBLM into Clinical Laboratory Practice by TBL Based on Clinical and Laboratory Collaboration at OSBCM (See Table 2)

EBLM is applied to clinical laboratory practice by TBL based on clinical and laboratory collaboration at OSBCM. Students are divided into groups at OSBCM according to their interests, review the relevant content that learned before clinical laboratory practice, discuss and prepare the cases and problems in combination with OSBCM and EBLM teaching resources provided by teachers. In clinical laboratory practice, teachers introduce cases, raise questions, and guide students to consider them. Students search for the related information, discuss and communicate the cases and questions, and propose the solutions as teams. Teachers make induction, summary, comment on the performance of the students, inspire students, and evaluate the effectiveness. Students conduct assessments in team and between teams.

Table 2. Implementing new clinical teaching and learning practices.

Procedures of new clinical practices	Details of measures
1) Review the relevant content that learned before clinical practice	Clinical biochemistry laboratory; Clinical microbiology laboratory; Clinical immunology laboratory; Clinical hematological laboratory; Clinical molecular biology laboratory; Clinical basic laboratory; Clinical blood transfusion laboratory; Clinical laboratory equipment; Clinical laboratory management; Clinical medicine summary
2) OSBCM introduction	Affected organs and systems; Related diseases; Pathogenesis
3) The students are grouped according to their interests based on OSBCM	Encourage the students to implement team-based learning based on EBLM
4) Select typical cases	Encourage the students to implement case-based learning based on EBLM
5) Pose crucial problems	Encourage the students to implement problem-based learning based on EBLM
6) Follow up and solve the problems that relate to clinical decision-making	Encourage the students to focus on the specimens, quality controls, instruments, relevant inspections, clinical main symptoms, medical history, imaging examination and other inspections, dynamically monitor changes. If consistent, look for the important evidence; if inconsistent, identify the interferences and manage them.

The proposal for integrating EBLM into clinical laboratory practice by TBL based on clinical and laboratory collaboration at OSBCM:

4.1. Constructing OSBM and EBLM Teaching and Learning Resources

Teachers identify the key and difficult points based on the teaching syllabus and objectives of clinical laboratory practice, and search for extracurricular reference materials, clinical guidelines, Chinese and English journal literature, Chinese and English professional websites, Chinese and English professional databases, and other teaching and learning resources. Thus, teachers compile some clinical case databases that focus on diseases and health and are based on clinical and laboratory collaboration according to the organs and systems, so as to construct OSBM and EBLM teaching and learning resources for clinical laboratory practice.

4.2. Preparing in Groups at OSBCM before Clinical Laboratory Practice

Teachers guide the students review the relevant content that learned before clinical laboratory practice.

Beforehand, the teacher selects corresponding typical cases based on the teaching plan and OSBCM, then designs some crucial related questions for the students to think over and solve. Clinical cases and problems materials are given to students at OSBCM in groups based on their interests 2 weeks in advance. The students are guided to prepare and discuss as teams by consulting OSBCM and EBLM teaching and learning resources.

4.3. Implementing Clinical Laboratory Practice by TBL Based on Clinical and Laboratory Collaboration with EBLM at OSBCM

The teachers introduce some clinical case databases that focus on diseases and health and are based on clinical and laboratory collaboration according to the organs and systems, put forward some key questions, and guide students in interest groups to discuss and cooperate based on searching for important clinical and laboratory evidence. Students communicate and debate with each other to focus on, analyze and solve clinical problems that closely relate to clinical decision-making. It is particularly worth mentioning that the teachers need to emphasize the importance of paying attention to the specimens, quality controls, instruments, relevant inspection results, clinical main symptoms, medical history, imaging examination and other inspections. The teachers especially encourage the students to dynamically monitor changes of important indicators in clinical laboratory practice. If consistent, further look for the important clinical evidence to support them; otherwise, if inconsistent, identify the interferences and manage them to get the correct results, so as to help make right diagnosis.

4.4. Summary and Evaluation of Clinical Laboratory Practice

The major phases of the evaluation are as follows: Technical quality of the test; Diagnostic accuracy; Change in diagnostic thinking; Change in patient management; Change in patient outcomes and Societal costs and benefits [2]. The teachers summarize the content of clinical laboratory practice, comment on the discus-

sion, communication and cooperation of the students as teams, and inspire and encourage the students. Next, the students are guided to conduct the clinical laboratory practice records which involve the content, prominent problems and typical cases that encountered in clinical laboratory practice, and main gains, experiences and reflections on them. Tests including various types of multi-choice questions and case analysis questions are performed. The teachers collect the clinical laboratory practice records and test paper to track and analyze the outcomes. Therefore, it is conducive to assess the ability of the students' understanding knowledge, identifying the key clinical and laboratory evidence, and flexibly applying learned knowledge to analyze and solve problems, thus reflecting teaching effectiveness. Finally, the mutual evaluation surveys among the student teams, between the teachers and the students are conducted and collected to provide timely teaching and learning feedback for better adjustments in clinical laboratory practice. Since implementation began, the preliminary feedback collected shows promising prospects.

5. Achieving the Significant Goals through Integrating EBLM into Clinical Laboratory Practice by TBL Based on Clinical and Laboratory Collaboration at OSBCM

In this teaching and learning mode of clinical laboratory practice, the teachers guide the students to find out important information by looking for clinical and laboratory evidence, literature and so on with TBL based on clinical and laboratory collaboration at OSBCM, identify key problems, and analyze the relation between crucial information to solve the problems from the view of clinical decision-makers. OSBCM reform with TBL promotes the integration between clinical laboratory theory and clinical practice, facilitate early clinical practice, multi-clinical practice and repeated clinical practice for students, at the same time, enhance teamwork awareness, so that laboratory knowledge and clinical practice are interconnected and permeate each other, accelerating the pace of laboratory advancement and clinical further development. Integration EBLM into clinical laboratory practice contributes to cultivate the students' ability to comprehensively self-directed learn the clinical and laboratory knowledge, search for literature, and analyze and solve problems objectively and accurately based on clinical and laboratory evidence. Therefore, by promoting clinical and laboratory cooperation, and learning independently, the clinical thinking ability, independent scientific innovation ability, realistic spirit, communication ability and lifelong learning ability of the students will be enhanced, thus paving the way for their future clinical practice and scientific research, so as to improve their post competency after graduation.

6. Conclusion

In this study, we implement the exploration of integrating EBLM into clinical laboratory practice at OSBCM, adopt the combined teaching model of TBL, CBL

and PBL based on clinical and laboratory collaboration, thus improving clinical thinking ability and scientific research awareness of clinical laboratory undergraduates. It is worth mentioning that the clinical laboratory undergraduates should especially pay attention to identify and manage the interferences issues [9] in pre-analytical specimens such as hemolysis, icterus and lipemia, quality controls, instrument state, maintain concern about the related clinical laboratory inspections and clinical symptoms, dynamically monitor changes. In addition, we follow AI in application of clinical laboratory with interest. On one hand, the integration of AI in EBLM holds immense potential to optimize workflows, enhance diagnostic accuracy, and facilitate personalized medicine. However, addressing challenges related to data quality, ethics, and clinician acceptance is crucial for the successful integration of AI into laboratory medicine [10]. In addition, the application of AI requires very solid professional knowledge from Human to cooperate. The illusion of a large model implies false or misleading information that appears to be factual. AI often makes mistakes, whereas the cost of making mistakes needs to be undertaken by users. Excessive reliance on large language models may lead to a decline in ability of the students. It means that the better use of AI in modern clinical laboratory medicine needs the cooperation, judgment and innovation from Human Intelligence (HI). Therefore, we should focus on the significant role of HI in inspiration teaching and clinical laboratory practice. The proposed EBLM-TBL model exactly integrates the advantages of AI and HI. Thus, this human-centric, collaborative model meets the teaching and learning environment demand of "student-centered, supplemented by AI" in modern clinical laboratory medicine. In the human-centered concept, this is the reason why we integrate EBLM into clinical laboratory practice by TBL based on clinical and laboratory collaboration at OSBCM. However, the implementation has some potential challenges, such as insufficient clinical context and practical experience for the students, limited scientific research consciousness for some students. We are grateful to the faculty from department of laboratory medicine in Jingzhou Hospital Affiliated to Yangtze University and department of laboratory medicine in the First People's Hospital of Jingzhou for their training for clinical and laboratory faculty, resource allocation, and logistical coordination.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Barrabi, C. and Derricott, H. (2025) Teaching Renal Physiology through a Flipped Classroom: Integrating Active Learning and Clinical Context in an Organ System-Based Curriculum. *Advances in Physiology Education*, **49**, 812-816. https://doi.org/10.1152/advan.00086.2025

[2] Badrick, T. (2013) Evidence-Based Laboratory Medicine. *The Clinical Biochemist Reviews*, **34**, 43-46.

[3] Sterpu, I., Herling, L., Nordquist, J., Rotgans, J. and Acharya, G. (2024) Team-Based

Learning (TBL) in Clinical Disciplines for Undergraduate Medical Students—A Scoping Review. *BMC Medical Education*, **24**, Article No. 18. https://doi.org/10.1186/s12909-023-04975-x

[4] Himmels, J.P.W., Sterz, J., Rüsseler, M., Kempf, V.A.J. and Brandt, C. (2022) Case-Based Learning with Practical Exercises in the Course Hygiene and Microbiology as a Model for the Implementation of the New Medical Licensing Regulations. *Deutsche Medizinische Wochenschrift*, **148**, e21-e28. https://doi.org/10.1055/a-1973-6533

[5] Mohammed, A.B., Zegeye, R.T., Dawed, H.A. and Tessema, Y.M. (2024) Implementation of Problem-Based Learning in Undergraduate Medical Education in Ethiopia: An Exploratory Qualitative Study. *Advances in Medical Education and Practice*, **15**, 105-119. https://doi.org/10.2147/amep.s443384

[6] Liu, R. and Zuo, H. (2024) The Practice and Exploration of Applying EBM to Bilingual Teaching of Medical Genetics at OSBCM. *Open Journal of Applied Sciences*, **14**, 983-990. https://doi.org/10.4236/ojapps.2024.144065

[7] Guyatt, G., Cairns, J., Churchill, D., Cook, D., Haynes, B. and Hirsh, J. (1992) Evidence-Based Medicine. A New Approach to Teaching the Practice of Medicine. *JAMA*, **268**, 2420-2425.

[8] Sackett, D.L., Rosenberg, W.M.C., Gray, J.A.M., Haynes, R.B. and Richardson, W.S. (1996) Evidence Based Medicine: What It Is and What It Isn't. *BMJ*, **312**, 71-72. https://doi.org/10.1136/bmj.312.7023.71

[9] Zaninotto, M. and Plebani, M. (2019) Understanding and Managing Interferences in Clinical Laboratory Assays: The Role of Laboratory Professionals. *Clinical Chemistry and Laboratory Medicine* (*CCLM*), **58**, 350-356. https://doi.org/10.1515/cclm-2019-0898

[10] Pillay, T.S., Topcu, D.İ. and Yenice, S. (2025) Harnessing AI for Enhanced Evidence-Based Laboratory Medicine (EBLM). *Clinica Chimica Acta*, **569**, Article ID: 120181. https://doi.org/10.1016/j.cca.2025.120181