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Original Research Article

Training interns with a structured pathology and microbiology module during elective posting of compulsory rotating medical internship

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Abstract

Background: Pathology and microbiology are essential for clinical decision-making, yet medical interns often receive minimal structured training in these areas. In India, the National Medical Commission (NMC) mandates laboratory medicine exposure during internship, but implementation varies. This study aimed to develop and evaluate a structured Intern LabMaster Training Program (ILTP) in pathology and microbiology.

Materials and Methods: An interventional study was conducted with sixty MBBS interns assigned to a 2-week laboratory medicine elective. They were randomly divided into an ILTP intervention group (n = 30) and a control group (n = 30) following the standard internship curriculum. The ILTP included lectures, hands-on lab sessions, and role-play-based clinical case discussions. All interns underwent pre- and post-training assessments using a 50-item MCQ test (knowledge), a 10-station OSPE (lab skills), and two OSPE stations for communication skills. Statistical analysis was performed using paired and unpaired t-tests.

Results: Interns in the ILTP group showed significant improvements after the training in knowledge (54.3% to 82.4%), lab skills (51.6% to 79.8%), and communication scores (3.2 to 4.5 out of 5; $p<0.001$ for all), while the control group showed no significant changes. Post-intervention, the ILTP group outperformed controls in all domains ($p<0.001$).

Conclusion: A structured pathology and microbiology training module during internship significantly enhances interns' competencies. Broader implementation may strengthen clinical preparedness and patient care. Further multi-center research is warranted.

Keywords: Pathology, Microbiology, Medical internship, Laboratory medicine, Communication skills.

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1. Introduction

The integration of clinical pathology and microbiology into medical training is essential for accurate diagnosis and effective patient care. These disciplines form the investigative foundation for clinical decision-making.[1,2] However, they are often underrepresented in undergraduate curricula and internship programs.[3]

Traditional medical internships in India and elsewhere usually lack structured teaching in laboratory medicine. This creates a gap between theoretical knowledge and its application in real-world clinical settings. As a result, new doctors may struggle with appropriate test selection and interpretation, which can lead to diagnostic errors.[4,5]

To address this, the National Medical Commission (NMC) of India introduced the Compulsory Rotating Medical Internship (CRMI) Regulations in 2021.[6,7] These regulations require interns to receive exposure in laboratory medicine, including areas such as clinical biochemistry, histopathology, hematology, transfusion medicine,

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microbiology, and infection control. However, the guidelines are broad and leave the design of structured teaching modules to individual institutions.[8]

Internationally, the need to strengthen laboratory medicine education is also gaining attention. A 2023 white paper by the Association of Pathology Chairs in the United States called for better integration of laboratory training in undergraduate education.[9] In many U.S. medical schools, formal teaching in laboratory medicine remains limited.[10] The United Kingdom offers more structured postgraduate training, but early exposure is increasingly recommended.[11]

Despite these efforts, few studies have evaluated structured laboratory medicine training for interns. Orientation programs and targeted skills modules have shown benefits.[12] However, to our knowledge, no study has specifically addressed structured training in pathology and microbiology for interns. This study aimed to fill that gap.

2. Materials and Methods

2.1. Study objective

The Intern LabMaster Training Program (ILTP) was developed by the authors to offer structured training in pathology and microbiology during the internship. The aim was to enhance interns' knowledge, laboratory skills, and communication competencies compared to the standard internship schedule.

2.2. Study design and participants

This was a single-centre interventional study with a parallel control group, conducted over six months at a tertiary-care teaching hospital in Bihar, India. Sixty MBBS interns who opted for a two-week elective posting in laboratory medicine were enrolled consecutively. Participants were randomized into two groups using concealed chits: thirty interns were assigned to the ILTP group and thirty to the control group. Written informed consent was obtained from all participants. The study was approved by the Institutional Ethics Committee.

2.3. Intervention: ILTP module

Interns in the ILTP group underwent structured training over ten working days. The module included case-based lectures on core topics in pathology and microbiology, hands-on practical sessions, and clinical case discussions integrated with role-play exercises. Practical training involved supervised performance of diagnostic procedures such as smear preparation, FNAC, blood grouping, and culture interpretation. Daily clinical case discussions demonstrated the application of laboratory findings to patient care. Role-plays simulated real-life communication scenarios such as conveying lab results, counseling for tests, and handling critical values.

2.4. Control group

Interns in the control group followed the standard curriculum. They observed routine laboratory processes and performed tasks as instructed but did not receive structured teaching, case discussions, or communication training. The allocation of students in each stage is shown in **Figure 1**.

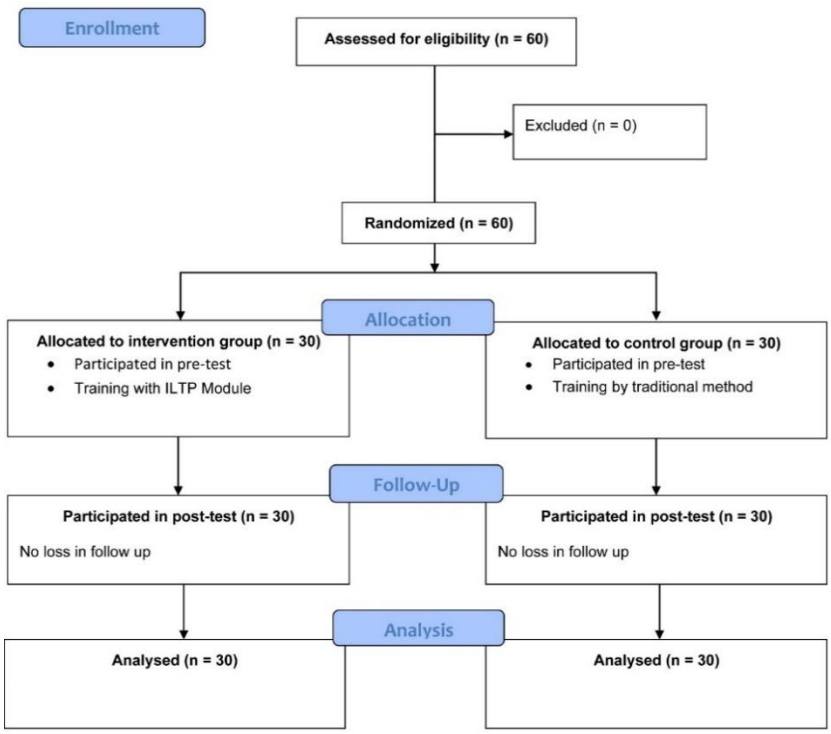

Figure 1: Flowchart of participant allocation and study flow from enrolment to analysis

2.5. Assessment of outcomes

All interns were evaluated before and after the posting using a consistent assessment protocol. Knowledge was tested using a 50-item multiple-choice questionnaire (maximum score 50). Laboratory skills were assessed using a 10-station Objective Structured Practical Examination (OSPE) with a maximum score of 40. Communication and attitude were assessed through two OSPE stations involving simulated scenarios, with a total score of 10. Identical pre- and post-tests were used for all participants, with consistent assessors and validated instruments.

2.6. Data analysis

Data were entered into Microsoft Excel and analyzed using GraphPad Prism 9.5.0. Paired t-tests were used to compare pre- and post-test scores within each group. Unpaired t-tests were used to compare score changes between groups. A two-tailed p-value of less than 0.05 was considered statistically significant. All participants completed the study, and no adverse events were reported.

3. Results

At baseline, both ILTP and control groups had comparable scores across knowledge, skills, and communication domains, with no statistically significant differences (**Figure 2**).

After the two-week posting, the ILTP group showed marked improvement in all areas. Knowledge scores increased from 54.3% to 82.4%. Laboratory skill scores rose from 51.6% to 79.8%. In contrast, the control group showed minimal change, with knowledge scores increasing from 53.8% to 56.2% and skill scores from 50.9% to 53.4%. The ILTP group showed significant improvement in communication scores, rising from 3.2 to 4.5 per station, while the control group showed no meaningful change; 28 of 30 ILTP interns improved across all domains compared to 8 of 30 in the control group.

4. Discussion

This study developed and evaluated a structured pathology and microbiology training module, the Intern LabMaster Training Program (ILTP), for medical interns. Interns who underwent the ILTP showed significant improvements in knowledge, laboratory skills, and communication abilities compared to those in routine postings. These findings show that even a brief, structured intervention during internship can address key gaps in laboratory medicine training.

The gain in knowledge test scores among ILTP interns highlights that essential pathology and microbiology concepts were not adequately retained or clinically contextualized during undergraduate training. This module helped interns connect theory with practical application. Our results are in line with previous studies showing structured modules can enhance learning,[13] such as case-based learning in microbiology and online modules for diagnostic reasoning.[14,15]

ILTP interns significantly improved in practical tasks like blood grouping, slide interpretation, and FNAC preparation. In contrast, control group interns showed minimal change. This reinforces the importance of “learning by doing” in lab-based disciplines. Prior research has shown that structured training for clinical staff improves diagnostic accuracy and reduces errors.[16-18] Our findings support these results in the context of early-career doctors.

Figure 2: Comparison of mean pre-test and post-test scores (in percentage of maximum) for the intervention group versus control group across three competency domains

A notable feature of ILTP was the inclusion of communication and professionalism within a technical module. Role-play exercises in lab contexts improved interns' ability to explain tests, give feedback, and communicate results clearly. Communication OSPE scores improved significantly in the ILTP group. This aligns with earlier studies where interns trained with demonstration–observation–performance methods improved communication and confidence.[19,20]

These results support the integration of pathology and microbiology into structured internship modules. Our module aligns with the goals of competency-based medical education (CBME),[21] emphasizing measurable learning outcomes in knowledge, skills, and attitudes. ILTP also provides a practical way to implement the National Medical Commission's requirement for laboratory medicine exposure during internship.

Similar concerns about undertraining in lab medicine exist internationally. In the U.S., formal lab medicine teaching is often limited. A 2023 white paper by the Association of Pathology Chairs called for stronger integration of lab medicine into medical training.[22] Our study adds evidence from a resource-limited setting and shows that such integration is feasible, effective, and scalable. In countries like the UK, lab medicine is emphasized during undergraduate training.[23] Early exposure through internship could help clinicians use diagnostic tools more effectively.[24] Our module could serve as a model for adaptation in similar global settings.

5. Strengths and Limitation

The study used a prospective design with a control group, objective assessments (MCQs and OSPEs), and pre-post comparison. The module was comprehensive yet feasible, using in-house faculty and resources. It was delivered without the need for expensive infrastructure, making it replicable in similar settings. This was a single-institution study with a small sample. Results may vary in different settings. Also, we measured outcomes only immediately after the posting. The long-term retention of knowledge and skills remains unknown. Some subjectivity in communication OSPEs may have influenced scores. Motivation bias in the ILTP group may have contributed to better performance. Lastly, we did not measure impact on real patient outcomes, though this would be valuable in future studies.

6. Conclusion

Internship is a crucial period to strengthen practical and professional competencies. This study shows that a focused module in laboratory medicine can produce measurable improvements in knowledge, skills, and communication. ILTP offers a feasible, scalable model to enhance clinical training and diagnostic literacy. With minimal resources, it delivers significant educational value. Wider implementation and further evaluation are encouraged to ensure that all future physicians are well-equipped to use laboratory services effectively in patient care.

7. Source of Funding

None.

8. Conflict of Interest

None.

9. Ethical Approval

This study was approved by Institutional ethical approval committee with ref. no. MGM/IEC- 07/2025.

References

1. Plebani M. Laboratory medicine: value for patients is the goal. *Clin Chem*. 2007;53:1873–4.
2. Smith BR, Aguero-Rosenfeld M, Anastasi J, Baron B, Berg A, Bock JL, et al. Educating medical students in laboratory medicine: a proposed curriculum. *Am J Clin Pathol*. 2010;133:533–42.
3. Molinaro RJ, Winkler AM, Kraft CS, Fantz CR, Stowell SR, Ritchie JC, et al. Teaching laboratory medicine to medical students: implementation and evaluation. *Arch Pathol Lab Med*. 2012;136:1423–9.
4. Howanitz PJ. Errors in laboratory medicine: practical lessons to improve patient safety. *Arch Pathol Lab Med*. 2005;129:1252–61.
5. Laposata M. Patient-specific narrative interpretations of complex clinical laboratory evaluations: who is competent to provide them? *Clin Chem*. 2004;50:471–2.
6. National Medical Commission (India). Compulsory Rotating Medical Internship Regulations, 2021 [Internet]. New Delhi: National Medical Commission; 2021. Available from: https://www.nmc.org.in/MCIRest/open/getDocument?path=/Documents/Public/Portal/LatestNews/231280.pdf.
7. Chaudhuri A, Deb Roy A, Manivasakan S, Mondal H. Structured online systematic review training for medical students: An elective module in physiology. *Cureus*. 2024;16:e66078.
8. Medical Council of India. Vision 2015 [Internet]. New Delhi: Medical Council of India; 2015. Available from: https://www.nmc.org.in/wp-content/uploads/2018/01/MCI_booklet.pdf.
9. Talbert ML, Ashwood ER, Brownlee NA, Clark JR, Horowitz RE, Lepoff RB, et al. resident preparation for practice: A white paper from the College of American Pathologists and Association of Pathology chairs. *Arch Pathol Lab Med*. 2009;133(7):1139–47.
10. Smith BR, Kamoun M, Hickner J. Laboratory medicine education at U.S. medical schools: A 2014 status report. *Acad Med*. 2016;91(1):107–12.
11. Moxley A, Baxter L, White P. Improving medical student preparedness for practice in line with the General Medical Council's outcomes for graduates: a pilot study. *Future Healthc J*. 2019;6(Suppl2):18–9.
12. Post CS, Abbott SE, Lew M. The "Pathology Passport": a redesign of the pathology elective experience to enhance medical student engagement and understanding of pathology as a clinical practice. *Acad Pathol*. 2024;11(2):100123.
13. Nayak VKR, Shetty PP, Balamurugan V, Belle VS, Maradi R, Nayak KR. Clinical laboratory shadowing- an elective program in undergraduate health professions training: perception, strengths and challenges. *BMC Med Educ*. 2024;24(1):1324.
14. Bruns DE. Improving training in laboratory medicine. *Clin Chim Acta*. 2008;393(1):3–4.
15. Gilkes L, Kealley N, Frayne J. Teaching and assessment of clinical diagnostic reasoning in medical students. *Med Teach*. 2022;44(6):650–6.

16. Alcalá Minagorre PJ, Salmerón Fernández MJ, Domingo Garau A, Díaz Pernas P, Nebot Marzal CM, Pino Ramírez RM, et al. Strategies for improving diagnostic safety and clinical reasoning. *An Pediatr (Engl Ed)*. 2025;102(4):503827.
17. Alhuseen ZKCA, Kazim NHH, Brih AMN, Arkan OSA. The impact of laboratory staff training on reducing error rates in clinical laboratories. *OBAT J Ris Ilmu Farm Dan Kesehat*. 2025;3(4):8–14.
18. Abimanyi-Ochom J, Bohingamu Mudiyanselage S, Catchpool M, Firipis M, Wanni Arachchige Dona S, Watts JJ. Strategies to reduce diagnostic errors: a systematic review. *BMC Med Inform Decis Mak*. 2019;19(1):174.
19. Mohammadi E, Shahsavari H, Mirzazadeh A, Sohrabpour AA, Mortaz Hejri S. Improving role modeling in clinical teachers: a narrative literature review. *J Adv Med Educ Prof*. 2020;8(1):1–9.
20. Benbassat J. Role modeling in medical education: the importance of a reflective imitation. *Acad Med*. 2014;89(4):550–4.
21. Soundariya K, Nishanthi A, Mahendran R, Vimal M. Evaluation of competency-based medical education (CBME) curriculum implementation for Phase II medical undergraduates: a qualitative study. *J Adv Med Educ Prof*. 2025;13(1):36–48.
22. Christian RJ, Baccon J, Knollmann-Ritschel B, Elliott K, Laposata M, Conran RM. The need for laboratory medicine in the undergraduate medical education curriculum: a white paper from the Association of Pathology Chairs. *Med Sci Educ*. 2023;34(1):193–200.
23. The Royal College of Pathologists. Pathology undergraduate curriculum 2019 [Internet]. London: The Royal College of Pathologists; 2019 [cited 2025 June 22]. Available from: https://www.rcpath.org/static/e23e33e9-0251-4f9f-bbf5-7427c1f68d1d/Pathology-Undergraduate-Curriculum.pdf.
24. Beeching NJ, Rautelin H, Stahl J-P, Leegaard TM. Training and assessment of medical specialists in clinical microbiology and infectious diseases in Europe. *Clin Microbiol Infect*. 2021;27(11):1581–8.

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