

## RESEARCH ARTICLE

### FEEDBACK ON FINAL-YEAR MEDICAL LABORATORY STUDENTS' INTERNSHIP IN HAEMATOLOGY AND MICROBIOLOGY, IN BAMENDA

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**ABSTRACT:** Introduction: Clinical internship is an important component of medical laboratory science (MLS) training because it provides students with opportunities to translate theoretical knowledge into supervised laboratory practice. This study assessed the reported internship experiences of final-year MLS students from different training institutions in Bamenda, with particular attention to exposure to instruments, laboratory techniques, instructions, responsibilities, and opportunities for hands-on participation. Methods: A cross-sectional descriptive study was conducted from 1 March to 31 May 2023 among final-year MLS students undertaking internship training in Bamenda. Participants were recruited using a non-probability/convenience approach. A self-administered study-specific questionnaire was used to collect information on internship experiences and reported exposure to laboratory instruments and techniques. A total of 420 students participated. Data were double entered into Excel and summarized using frequencies and percentages. Results: Out of the 485 students approached, 420 (86.6%) participated. Bachelor's students constituted 290 (69.05%) and HND students 130 (30.95%). The microscope was the most frequently operated instrument in both Microbiology (402/420, 95.71%) and Hematology (384/420, 91.43%). Reported participation in individual techniques varied substantially, with many students' indicating observation without performance or reporting neither observation nor performance for several procedures. Conclusion: The findings indicate variable opportunities for hands-on participation during internship training. The results support strengthening pre-internship orientation, supervision and feedback, structured allocation of practical tasks, and access to appropriate laboratory resources.

**Keywords:** Medical laboratory science; internship; interns; Microbiology; Hematology.

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## **INTRODUCTION:**

Graduates of medical laboratory science programs are specialists responsible for performing clinical laboratory procedures, making it crucial for students to acquire appropriate knowledge and practical skills during internship. Clinical internship provides an opportunity to integrate theoretical learning with supervised practice and to develop competence in real-world laboratory environments <sup>[1]</sup>. However, gaps between classroom teaching and clinical practice may affect students' preparedness for professional work.

Various approaches have been explored to improve learning in medical laboratory programs. Competency-focused clinical laboratory teaching combined with case-based learning has been associated with improved theoretical and practical assessment outcomes <sup>[2]</sup>. Problem-based learning has also been evaluated in clinical laboratory education and has been associated with improved academic and clinical assessment outcomes and student satisfaction <sup>[3]</sup>. A comprehensive approach to laboratory education is therefore important for the development of competent medical laboratory professionals <sup>[4]</sup>.

The quality of internship training may also be influenced by the involvement of educational and clinical instructors at internship sites <sup>[5,6]</sup>. Clinical instructors contribute to communication, the learning environment, assessment, instructional delivery and student engagement <sup>[7]</sup>. Other reported challenges include workload and staff shortages, which may reduce the time available for supervised practical participation <sup>[8]</sup>. Resource constraints, increasing student enrolment and limited staff-student contact may also affect the quality of clinical training <sup>[9]</sup>. Previous work has emphasized the importance of ensuring that students' expected skills are clearly communicated to clinical supervisors and that clinical training is aligned with curriculum requirements <sup>[6,10,11]</sup>.

Medical laboratory training in Cameroon involves students from different educational institutions and training pathways. Differences in opportunities to observe procedures, receive feedback and practise skills may therefore occur across internship settings <sup>[12,13]</sup>. The present study was conducted to describe the internship experiences of final-year medical laboratory science students in Bamenda, with particular emphasis on reported exposure to laboratory instruments and opportunities to observe and perform laboratory techniques.

## **METHODOLOGY:**

### **Ethical Considerations**

The study was conducted in accordance with the Declaration of Helsinki and applicable ethical requirements. Written informed consent to participate was obtained from all participants before inclusion in the study. Data were anonymized to protect participants' confidentiality and privacy. The manuscript reports only aggregated, anonymized survey findings; no separately identifiable participant information is presented.

### **Study Design and Setting**

This was a cross-sectional descriptive study conducted from 1 March to 31 May 2023 among final-year MLS students undertaking internship training in Bamenda. Participants were recruited using a non-probability convenience approach based on availability and accessibility. Students were surveyed at Bamenda Regional Hospital, Nkwen District Hospital and St. Blaise Catholic Hospital.

### **Study Population**

Participants were final-year students enrolled in bachelor's degree and higher national diploma (HND) MLS programs from twelve training institutions in Bamenda.

### **Sample Size**

The Cochran's formula was used to calculate the sample size at 95% confidence interval.

$$N = \frac{z^2 p(1 - p)}{d^2}$$

N = required sample size

Z = confidence Interval 95% (1.96)

P = Estimated proportion of the final year students actively participating in the internship program (0.5)

d = Margin of error: 0.05 for  $\pm 5\%$

Hence

$$N = \frac{(1.96)^2 \times (0.5) \times (1-0.5)}{(0.05)^2} = .9604$$

N = 384.16

Minimum sample size is 384.

### Data Collection Instrument

Data were collected using a structured, self-administered Internship Experience and Clinical Laboratory Training Scale developed specifically for this study. The instrument was designed to systematically assess final-year medical laboratory science students' experiences during clinical internship, with emphasis on the quality and adequacy of supervision, clarity of instructions, allocation of responsibilities, opportunities for observation and hands-on performance of laboratory procedures, access to laboratory equipment and perceived educational benefit of the internship. The scale was developed from the study objectives, relevant literature on clinical and laboratory-based health-professions education, and the expected competencies of final-year medical laboratory science students. The initial item pool was reviewed by a panel of experts in medical laboratory science, medical education and clinical laboratory practice to establish content validity, relevance, clarity and comprehensiveness. Items considered ambiguous, redundant or insufficiently relevant were revised or removed following expert review. The revised questionnaire was pre-tested among a group of final-year medical laboratory science students who were not included in the main study. Feedback from the pre-test was used to assess item comprehension, wording, response options and administration time, and to make further modifications before the main data collection.

### Data Management and Analysis

Questionnaires were double-entered into excel to identify and correct data-entry discrepancies. Categorical variables were summarized using frequencies and percentages.

### RESULTS:

A total of 485 students were approached; 420 (86.6%) consented to participate and 65 (13.4%) did not participate. Among those who declined, 30 (46.15%) cited questionnaire length, 26 (40.00%) did not return the questionnaire and 9 (13.85%) refused without giving a reason.

Among participants, 225 (53.57%) were females and 195 (46.43%) males. Most participants were aged 18–25 years (333, 79.29%), were single (371, 88.33%), and were Christian (400, 95.24%). Bachelor's students accounted for 290 (69.05%) and HND students for 130 (30.95%).

The University of Bamenda contributed 188 (44.76%) participants and private higher institutions contributed 232 (55.24%). Most participants undertook internship at Bamenda Regional Hospital (315, 75.00%), followed by Nkwen District Hospital (65, 15.48%) and St. Blaise Catholic Hospital (40, 9.52%).

### Internship Experience

Across the two laboratory sections, 192/420 (45.71%) reported that instructions on activities were clearly discussed, 210/420 (50%) reported that instructions were clear to some extent, and 18/420 (4.29%) reported that instructions were not clear. For overall internship opinion, 99/420 (23.57%) described the training as excellent, 279/420 (66.43%) as good, 39/420 (9.29%) as adequately planned and 3/420 (0.71%) as poorly planned. For responsibilities, 237/420 (56.43%) reported that responsibilities matched their abilities, 138/420 (32.86%) reported that some responsibilities were above their abilities and 45/420 (10.71%) reported that responsibilities were too limited. For perceived benefit, 204/420 (48.57%) reported gaining maximum benefit and 216/420 (51.43%) reported gaining benefit to some degree; none reported no benefit.

### Use of Laboratory Instruments

In Haematology, the microscope was used by 384 (91.43%), followed by the ESR stand and Westergren pipette by 372 (88.57%). Other reported exposure included centrifuge and micropipettes (342 each, 81.43%) and the automated haematology analyser (330, 78.57%). Lower exposure was reported for the Sahli pipette (42, 10.00%), flow cytometer (66, 15.71%) and automatic ESR equipment (72, 17.14%). **Table.1**

In Microbiology, the most frequently used instruments were the microscope (402, 95.71%) and centrifuge (354, 84.29%). Other reported exposure included incubator (324, 77.14%), refrigerator (294, 70.00%) and Bunsen burner (288, 68.57%). Lower exposure was reported for the densitometer (66, 15.71%), vortex mixer (78, 18.57%) and colony counter (78, 18.57%). **Table.2,3**

**Table 1. Reported exposure to Haematology techniques**

| Laboratory technique     | Observed only, n (%) | Observed and performed, n (%) | Neither n (%) |
|--------------------------|----------------------|-------------------------------|---------------|
| Full blood count         | 54 (12.86)           | 195 (46.43)                   | 171 (40.71)   |
| Hb measurement           | 42 (10.00)           | 162 (38.57)                   | 216 (51.43)   |
| Making blood films       | 66 (15.71)           | 123 (29.29)                   | 231 (55.00)   |
| Giemsa staining          | 30 (7.14)            | 162 (38.57)                   | 228 (54.29)   |
| Wright's staining        | 96 (22.86)           | 84 (20.00)                    | 240 (57.14)   |
| ESR test                 | 36 (8.57)            | 159 (37.86)                   | 225 (53.57)   |
| Blood picture microscopy | 126 (30.00)          | 105 (25.00)                   | 189 (45.00)   |
| Hb solubility test       | 102 (24.29)          | 33 (7.86)                     | 285 (67.86)   |
| Osmotic fragility test   | 96 (22.86)           | 18 (4.29)                     | 306 (72.86)   |
| Hb electrophoresis       | 216 (51.43)          | 72 (17.14)                    | 132 (31.43)   |
| Bleeding time test       | 114 (27.14)          | 99 (23.57)                    | 207 (49.29)   |
| Thrombin time test       | 150 (35.71)          | 57 (13.57)                    | 213 (50.71)   |
| Prothrombin time test    | 186 (44.29)          | 36 (8.57)                     | 198 (47.14)   |
| Activated                | 144 (34.29)          | 24 (5.71)                     | 252 (62.86)   |

|                                  |             |             |             |         |
|----------------------------------|-------------|-------------|-------------|---------|
| partial thromboplastin time test |             |             |             | (60.00) |
| Manual differential count        | 144 (34.29) | 54 (12.86)  | 222 (52.86) |         |
| Manual WBC count                 | 102 (24.29) | 111 (26.43) | 207 (49.29) |         |
| Manual RBC count                 | 54 (12.86)  | 72 (17.14)  | 294 (70.00) |         |
| Manual platelet count            | 84 (20.00)  | 54 (12.86)  | 282 (67.14) |         |

**Table 2. Reported exposure to Microbiology techniques: culture, specimen processing and identification**

| Laboratory technique                   | Observed only, n (%) | Observed and performed, n (%) | Neither, n (%) |
|----------------------------------------|----------------------|-------------------------------|----------------|
| Culture of blood                       | 288 (68.57)          | 72 (17.14)                    | 60 (14.29)     |
| Culture of effusions                   | 294 (70.00)          | 48 (11.43)                    | 78 (18.57)     |
| Culture of urogenital specimens        | 246 (58.57)          | 126 (30.00)                   | 48 (11.43)     |
| Culture of stool                       | 240 (57.14)          | 168 (40.00)                   | 12 (2.86)      |
| Culture of skin scraping               | 270 (64.29)          | 96 (22.86)                    | 54 (12.86)     |
| Handling and transportation of samples | 84 (20.00)           | 252 (60.00)                   | 84 (20.00)     |
| Culture on basic media                 | 234 (55.71)          | 126 (30.00)                   | 60 (14.29)     |
| Culture on enriched media              | 222 (52.86)          | 96 (22.86)                    | 102 (24.29)    |
| Culture on selective media             | 222 (52.86)          | 102 (24.29)                   | 96 (22.86)     |
| Culture on indicator media             | 210 (50.00)          | 72 (17.14)                    | 138 (32.86)    |
| Culture on transport media             | 204 (48.57)          | 78 (18.57)                    | 138 (32.86)    |
| Culture on identification media        | 186 (44.29)          | 72 (17.14)                    | 162 (38.57)    |
| Reporting cultures                     | 222 (52.86)          | 96 (22.86)                    | 102 (24.29)    |
| Antimicrobial susceptibility testing   | 198 (47.14)          | 90 (21.43)                    | 132 (31.43)    |
| Gram staining                          | 90 (21.43)           | 276 (65.71)                   | 54 (12.86)     |
| Coagulase test                         | 198 (47.14)          | 90 (21.43)                    | 132 (31.43)    |
| Urease test                            | 138 (32.86)          | 54 (12.86)                    | 228 (54.29)    |
| DNA-ase test                           | 138 (32.86)          | 18 (4.29)                     | 264 (62.86)    |

|                          |             |            |             |
|--------------------------|-------------|------------|-------------|
| Bile solubility test     | 114 (27.14) | 6 (1.43)   | 300 (71.43) |
| Citrate utilization test | 102 (24.29) | 18 (4.29)  | 300 (71.43) |
| Indole test              | 120 (28.57) | 24 (5.71)  | 276 (65.71) |
| Oxidase test             | 168 (40.00) | 60 (14.29) | 192 (45.71) |

**Table 3. Reported exposure to additional Microbiology techniques**

| Laboratory technique           | Observed only, n (%) | Observed and performed, n (%) | Neither n (%) |
|--------------------------------|----------------------|-------------------------------|---------------|
| Preparation of culture media   | 192 (45.71)          | 132 (31.43)                   | 96 (22.86)    |
| Sterilization of culture media | 156 (37.14)          | 156 (37.14)                   | 108 (25.71)   |
| Dispensing culture media       | 192 (45.71)          | 144 (34.29)                   | 84 (20.00)    |
| Inoculation of culture media   | 174 (41.43)          | 150 (35.71)                   | 96 (22.86)    |
| Aseptic techniques             | 132 (31.43)          | 132 (31.43)                   | 156 (37.14)   |
| Ziehl-Neelsen staining         | 138 (32.86)          | 84 (20.00)                    | 198 (47.14)   |
| Methylene blue staining        | 120 (28.57)          | 96 (22.86)                    | 204 (48.57)   |
| Catalase test                  | 138 (32.86)          | 96 (22.86)                    | 186 (44.29)   |

## DISCUSSION:

The present study provides a descriptive account of internship experiences among 420 final-year medical laboratory science (MLS) students drawn from multiple training institutions and internship sites in Bamenda. Participants generally reported moderately positive experiences regarding instructions, assigned responsibilities and perceived benefits of internship. However, the technique-specific findings demonstrated considerable variation in opportunities for hands-on participation. This finding is important because clinical internship is intended to provide students with opportunities to integrate theoretical knowledge with practical laboratory skills and to develop competence in authentic clinical environments. Previous studies of medical laboratory education have similarly emphasized the importance of structured clinical exposure and

competency-oriented practical training in preparing students for professional practice [1,5,6]. Competency-oriented laboratory teaching and problem-based learning have also been reported to improve students' practical and clinical learning outcomes [2,3]. The relatively positive perceptions of internship reported by participants may reflect the contribution of structured clinical exposure to professional learning. Previous research has shown that students value clinical placements because they provide opportunities to apply classroom knowledge in real-world settings and to develop practical skills that are difficult to acquire through theoretical instruction alone [4,8,11]. In medical education more broadly, practical skills training and subsequent clinical exposure are complementary components of professional preparation, with students often perceiving clinical environments as particularly valuable for transferring practical skills into authentic practice [14]. These findings support the importance of maintaining well-organized internship programs that provide students with clearly defined learning objectives, appropriate supervision and opportunities to participate in relevant laboratory activities.

The study also demonstrated substantial differences in exposure to laboratory instruments. The microscope was the most frequently reported instrument used in both Haematology and Microbiology, whereas several specialized or automated instruments had substantially lower reported exposure. In Haematology, the ESR stand and Westergren pipette were reportedly used by 88.57% of participants, compared with only 17.14% who reported operating automatic ESR equipment. The variation in exposure to laboratory equipment may nevertheless have implications for students' practical preparedness. Medical laboratory training requires progressive exposure to both basic and more advanced laboratory technologies, particularly as modern diagnostic laboratories increasingly incorporate automated and specialized platforms. A recent study of laboratory professionals' training needs emphasized the importance of aligning training

with the competencies required in contemporary laboratory practice [6]. Similarly, research on medical laboratory internship programs has highlighted the importance of providing students with opportunities to develop practical competencies in authentic laboratory environments [5,15]. The present findings therefore support the need for internship programs to ensure that students have equitable opportunities to encounter the range of procedures and technologies relevant to their expected professional competencies.

The findings concerning supervision and feedback are also important. Clinical supervision provides students with opportunities to receive guidance, observe professional practice, perform procedures under appropriate oversight and receive feedback on their performance. Evidence from health-professions education indicates that feedback can positively influence students' knowledge, attitudes and clinical skills, although the effectiveness of feedback depends on how it is structured and delivered [16]. A systematic review of feedback in medical education found an overall positive effect of feedback on student learning outcomes, while another systematic review identified several common principles associated with effective feedback within clinical supervision [17]. These findings provide support for strengthening structured feedback mechanisms during MLS internships rather than relying exclusively on informal observation or unsupervised participation.

The study population comprised students from several training institutions, academic pathways and internship sites. Bachelor's students represented 69.05% of the sample and HND students 30.95%, while 75.00% of participants undertook their internship at Bamenda Regional Hospital. Consequently, the pooled findings may not necessarily demonstrate differences in practical exposure attributable solely to differences in curriculum. Variation between institutions and internship sites may reflect differences in laboratory workload, available

equipment, patient volume, staff-to-student ratios, supervision arrangements, institutional policies and the range of diagnostic services offered. Previous studies have similarly emphasized the role of the clinical learning environment and supervisors in shaping students' internship experiences and opportunities for competency development [5-8]. Future studies should therefore examine these contextual factors separately rather than treating all internship environments as homogeneous. The observed differences in participation may have multiple explanations, including supervision arrangements, laboratory workload, availability of procedures, bench capacity, availability of reagents and equipment, institutional policies concerning student involvement, and student attendance. The relative contribution of these factors should be investigated directly in future studies. This interpretation is consistent with evidence emphasizing the importance of the learning environment, supervision and clinical opportunities in determining the quality of practical health-professions education [6-8,11].

The findings further support the importance of integrating theoretical preparation with supervised practical experience. Studies in medical laboratory education have reported benefits from competency-oriented teaching, case-based learning and problem-based learning, approaches that encourage students to connect theoretical knowledge with practical decision-making [2,3]. Likewise, simulation and skills-laboratory training can provide opportunities for repeated practice before or alongside clinical placement [14,18]. More recent evidence suggests that blended learning may also provide useful supplementary opportunities for skills training, although its effectiveness depends on appropriate integration with face-to-face practical experience [19]. Thus, rather than viewing internship as a replacement for classroom or laboratory-based skills training, MLS education may benefit from a continuum in which students receive foundational instruction, practise skills in controlled environments, and subsequently apply them under supervision in

clinical laboratories. The findings also have implications for the organization of internship programs. Clear learning objectives should be communicated to students and supervisors before placement, and students should be given structured opportunities to observe and subsequently perform relevant procedures under supervision. Clinical supervisors should be aware of the competencies expected of interns and should provide regular feedback on performance. Previous literature emphasizes the importance of clearly defined expectations, appropriate supervision and feedback in clinical training [6,7,10,11]. Such an approach may help reduce variability in students' learning opportunities across internship sites.

### Limitation of the Study

The cross-sectional design captures students' reported experiences at one point during internship and cannot establish causal relationships. Also, students were drawn from multiple institutions, academic programs and internship sites, but these factors were not modeled separately in the present analysis. Finally, the aggregate dataset did not permit reconstruction of the individual-level paired response matrices required for valid paired inferential comparisons.

### CONCLUSION:

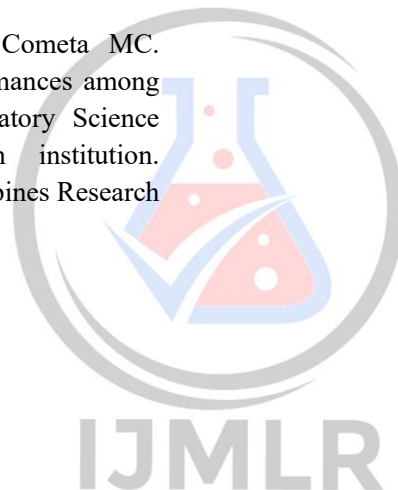
The study provides useful descriptive evidence concerning internship experiences and reported practical exposure among final-year MLS students in Bamenda. The findings identify substantial variation in opportunities to observe and perform laboratory procedures and highlight the importance of structured supervision, adequate laboratory resources, clearly defined learning objectives and equitable access to practical experiences. Future research should use validated measurement instruments, collect individual-level data, document attendance and reasons for non-performance, and explicitly examine the influence of academic program, training institution and

internship site on students' clinical laboratory learning experiences.

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