

HANDS ON TRAINING FOR PRE-ANALYTIC SAMPLE OF HISTOPATHOLOGY AND CYTOLOGY EXAMINATION IN JAMBI CITY

Fairuz¹, Hasna Dewi¹, Lipinwati², Hanina³, Miftahurrahma⁴

¹Histopathology departement, Faculty of Medicine and Health Science, Universitas Jambi

²Microbiology departement, Faculty of Medicine and Health Science, Universitas Jambi

³Parasitology departement, Faculty of Medicine and Health Science, Universitas Jambi

⁴Surgery departement, Faculty of Medicine and Health Science, Universitas Jambi

Corresponding author email: fairuz_fkik@unja.ac.id

ABSTRACT

The pre-analytic stage is an important stage in the anatomical pathology examination. in the specimen are prepared by the assistant nurse surgeon or clinician or laboratory analyst who receives the cytology sample, so it is necessary to provide correct and appropriate information for them and training in handling these samples is carried out. This activity is carried out to improve the understanding of health workers in managing samples and tissues at the pre-analytical stage. In this training, a standard operating procedure (SOP) for pre-analytical handling of histopathology and cytology samples will also be prepared, which is expected to be recognized by the association as an SOP for its members that applies in Jambi province. The method implemented is direct training on tissue and fluid samples and evaluation is carried out by assessing the pre-test and post-test after the activity is carried out. The results of the activity assessment showed a significant increase in the understanding and knowledge of the participants in the activity by looking at the increase in the pre-test and post-test scores. There is an increase in the understanding and knowledge of the training participants regarding the management of tissue and fluid samples at the pre-analytical stage.

Keywords: Training, Pre-analytic, Histopathology, Cytology

ABSTRAK

Tahap pra-analitik merupakan tahap penting dalam pemeriksaan patologi anatomi. spesimen disiapkan oleh asisten perawat bedah atau dokter spesialis atau analis laboratorium yang menerima sampel sitologi, sehingga perlu memberikan informasi yang benar dan tepat kepada mereka serta dilakukan pelatihan dalam penanganan sampel tersebut. Kegiatan ini dilakukan untuk meningkatkan pemahaman tenaga kesehatan dalam mengelola sampel dan jaringan pada tahap pra analitik. Dalam pelatihan ini juga akan disusun prosedur operasi standar (SOP) penanganan pra analitik sampel histopatologi dan sitologi yang diharapkan dapat diakui oleh asosiasi sebagai SOP bagi anggotanya yang berlaku di provinsi Jambi. Metode yang dilaksanakan adalah pelatihan langsung pada sampel jaringan dan cairan dan dilakukan evaluasi dengan melakukan penilaian pre-test dan post-test setelah kegiatan dilaksanakan. Hasil penilaian kegiatan menunjukkan adanya peningkatan pemahaman dan pengetahuan peserta kegiatan yang signifikan dengan melihat peningkatan nilai pre-test dan post-test. Kesimoulan dari kegiatan ini adalah terdapat peningkatan pemahaman dan pengetahuan peserta pelatihan mengenai pengelolaan sampel jaringan dan cairan pada tahap pra-analitik.

Kata kunci: Pelatihan, Pra-analitik, Histopatologi, Sitologi

INTRODUCTION

Anatomical Pathology is a branch of biomedical science that studies disease by analyzing the structure and process of disease in humans. As a basic science, Anatomical Pathology examines specimens taken from living patients to establish a diagnosis or determine the cause of death through clinical autopsy. It also plays a role in diagnosing disease through the analysis of biological materials, such as tissues, cells, or fluids, with certain systematic procedures. The tissue or cell specimens taken are examined using a light microscope by an Pathologist, and the results are presented in a report to the clinician who sent the specimen. Examination in Anatomical Pathology includes histopathology, cytology, frozen section, histochemistry, immunohistochemistry, and molecular examination. Histopathology, which is the examination of specimens obtained through anesthesia or post-mortem procedures (clinical autopsy), is considered the gold standard in the diagnosis of disease.^{1,2} Cytology examination involves the analysis of cells from body fluids, such as pap smears in gynecology, as well as non-gynecological cytology examinations, such as Fine Needle Aspiration Cytology (FNAC), sputum, pleural effusion, transthoracic biopsy (TTB), and transthoracic needle aspiration (TTNA).³⁻⁵

Histopathology preparations go through three phases: pre-analytic, analytical, and post-analytic. The pre-analytic phase plays an important role in the accuracy of Anatomical Pathology diagnosis, contributing up to 75%. This stage includes the initial processes such as collecting, packaging, and sending specimens to the



laboratory. The accuracy and completeness of the procedures in the pre-analytic phase will determine the quality of the examination results and reduce the possibility of misdiagnosis. In other words, the success and accuracy of the diagnosis depend greatly on the steps taken since the specimen was first collected from the patient. The analytical and post-analytical phases, although important, only contribute 10% and 15% respectively to the overall accuracy. Fixation is the first step in the pre-analytical phase. After the specimen is removed, fixation is necessary to preserve the structure and antigenicity of the target molecules, which are essential for further examination, including molecular. Inappropriate fixation, either too short or too long, can damage the target protein or reduce immunoreactivity, leading to misdiagnosis.⁶⁻⁸ Fixation is one of the most important steps in the pre-analytical phase, because the goal of this process is how to keep the tissue in the same condition as when it was in the patient's body even though it has been separated. In order to achieve this goal, the tissue removed from the patient's body must be fixed immediately. This process is a complex chemical process. Tissue consists of cellular and extracellular components consisting of peptide elements, proteins, lipids and phospholipids (cell membranes), carbohydrates and carbohydrate complexes, various types of RNA and DNA. These elements will react during the fixation process and depend on the type and fixation agent used. Some of these elements will react chemically with the fixation material, then undergo a "cross-linking" process.⁹⁻¹² These changes include shrinkage, swelling and hardening of various components. However, changes will occur again when the tissue is further processed. For example, when tissue is placed in a 10% formalin fixation solution, the tissue will experience a slight shrinkage but when the tissue enters tissue maturation, the specimen is likely to shrink back to 20% - 30% of its volume. The fixation process carried out on certain tissues can also affect the elements that will be stained with various histochemical and immunohistochemical reagents. From the various roles and effects of fixation, it is necessary to pay attention to the final purpose of the tissue to be processed, cut and stained whether the structure or chemical components.¹³⁻¹⁶ Biomedical research requires a good specimen handling role, for research in the biomedical field, including disease therapy research. Therefore, the pre-analytical phase specimen handling procedure must be handled very carefully by adequately trained and experienced personnel. The degenerative process begins as soon as the tissue is out of the body's control and loses its blood supply. This degenerative process is called the process of metabolic decline or metabolic cessation which leads to cell death and cell destruction. In addition to the degenerative process, the loss and diffusion of solutes in the cell must be avoided as much as possible by the mechanism of precipitation or coagulation of these components with the mechanism of "cross-linking" with other insoluble structural components. The tissue must be protected from damage due to the tissue maturation process including infiltration at high temperatures in liquid paraffin. In addition to structural damage, the most important thing is to maintain the tissue from damage that can eliminate (false negative) or cause reactivity (false positive) to staining and other reagents including antibodies and nucleic acid probes.^{10,17-20}

In the pre-analytical phase, the clinician is responsible for transporting the specimens that have been taken, while the operating room nurse, surgical assistant nurse, and laboratory analyst have a very important role in handling the samples. The operating room nurse and surgical assistant nurse are responsible for the careful collection and packaging of the specimens, while the laboratory analyst plays a role in ensuring that the initial processing of the samples follows the correct procedures. Therefore, it is important to provide adequate training and accurate information regarding these procedures, to ensure that sample processing in the Pathology Anatomical Laboratory is carried out appropriately and accurately. In this community service activity, collaboration was carried out with partners who are very involved in the pre-analytical process of samples to the anatomical pathology laboratory, starting from the fixation process to delivery. Operating room nurses who are members of the Himpunan Perawat Kamar Bedah Indone (HIPKABI) and medical laboratory technology analysts who are members of the Persatuan Ahli Tenaga Laboratorium Medik Indonesia (PATELKI) are partners in this community service.

Hands-on training and preparation of standard operating procedures (SOPs) for the pre-analytical handling of histopathology and cytology samples are expected to improve the competence of the members along with the preparation of SOPs for the pre-analytical stage of histopathology and cytology samples that apply in Jambi province. This supports the main performance indicator (IKU) 3, namely the number of research outputs and community service that have successfully received international recognition or are implemented by the community per number of lecturers.

METHODS

This community service method is carried out by presenting directly to participants about the importance of the pre-analytical phase. In addition, a hands-on workshop is also held so that participants can practice performing tissue lamellation correctly and adequate fixation methods, so that they can produce good quality paraffin blocks and ultimately the tissue on the slides can be diagnosed correctly, and patients can get adequate therapy. This activity is carried out in a place with lay out to group training. The training was conducted at the Skills Laboratory of the Faculty of Medicine and Health Sciences, Universitas Jambi (FKIK UNJA), on Saturday, October 12, 2024. The participants were namely the Himpunan Perawat Kamar Bedah



Indonesia (HIPKABI) and Persatuan Ahli Tenaga Laboratorium Medik Indonesia (PATELKI) in Jambi city in collaboration with Persatuan Dokter Spesialis Patologi Indonesia (PDSPA) Jambi

The implementation stages and activity phases were:

1. Coordination and consolidation with community service partners, namely the Indonesian Association of Biomedical Laboratory Scientists (HIPKABI) and the Indonesian Association of Health Laboratory Technologists (PATELKI), to determine the structure and content of the training activities.
2. Administration of a pre-test to evaluate participants' baseline knowledge.
3. Delivery of skills training sessions comprising theoretical instruction and demonstrations of indirect specimen handling techniques.
4. Practical sessions on the handling of tissue and fluid specimens, facilitated by qualified expert speakers.
5. Post-test administration to assess participants' knowledge acquisition and comprehension following the training.
6. Monitoring and evaluation of the training activities, followed by data analysis and documentation of outcomes in the form of a comprehensive report and expected deliverables.

The number of participants in the direct sample handling training was 42 people, coming from various hospital and clinic institutions in the city of Jambi.

RESULTS AND DISCUSSION

A total of 42 participants were obtained. The majority participant was in the 31–40-year age group (57.1%), female (69%), MITRA hospitals institution (23.9%) with PATELKI partners (52.3%) (Table 1).

Table 1. Participant characteristic

No	VARIABLE	n	%	
1.	Age	20-30	16	38.1
		31-40	24	57.1
		41-50	2	4.8
		>50		
2.	Sex	Laki-laki	13	31
		Perempuan	29	69
3.	Institution	RSUD Raden Mattaher	3	7.1
		RS Kambang	3	7.1
		RSI Arafah	5	11.9
		RS Mitra	10	23.9
		RS Baiturrahim	1	2.4
		RS Bhayangkara	3	7.1
		RS dr.Bratanata	3	7.1
		RSUD HAMBANG	3	7.1
		RSUD H.Abd Manap	3	7.1
		RS Theresia	1	2.4
		RS Siloam	2	4.8
		LABKESDA JAMBI	2	4.8
		LAB Klinik Prodia	1	2.4
		Klinik Pratama UNJA	1	2.4
POLTEKKES JAMBI	1	2.4		
4.	Service Partner	HIPKABI	20	47.7
		PATELKI	22	52.3

The evaluation results demonstrated a significant improvement in participants' knowledge following the training intervention. The mean pretest score of 70.00 increased to 95.24 in the posttest assessment. Of the 42 participants, almost all experienced an increase in scores, with an average increase of about 25 points. Following the assessment of pre-test and post-test data, a significant improvement in understanding of tissue and fluid specimen management was observed, with an average increase of 74.5%. The range of score improvements varied between 10 to 40 points (Table 2).



Table 2. Pre-test and post-test score

No participant	MITRA	Pretest	Posttest
1	HIPKABI /RS dr. Bratanata	90	90
2	HIPKABI/ RS dr. Bratanata	70	90
3	HIPKABI RS dr. Bratanata	90	90
4	HIPKABI / RSUD HAMBА	80	100
5	HIPKABI / RS Mitra	50	90
6	HIPKABI / RS Mitra	60	90
7	HIPKABI /RS Mitra	40	90
8	HIPKABI / RS Mitra	60	100
9	HIPKABI / RS Mitra	70	90
10	HIPKABI / RSUD Raden Mattaher	80	100
11	HIPKABI/ RSI Arafah	70	100
12	HIPKABI / RS Baiturrahim	40	50
13	HIPKABI / RSUD HAMBА	70	100
14	HIPKABI / RS Theresia	70	90
15	HIPKABI / RS Kambang	60	80
16	HIPKABI / RS Kambang	70	90
17	HIPKABI/ RS Kambang	50	100
18	HIPKABI / RSUD HAMBА	70	100
19	HIPKABI / RSUD Raden Mattaher	60	70
20	HIPKABI/ RS Manap	80	100
21	PATELKI/ RSI Arafah	80	100
22	PATELKI / RSI Arafah	80	100
23	PATELKI / RSI Arafah	90	90
24	PATELKI / RSI Arafah	70	100
25	PATELKI / RSUD Raden Mattaher	60	100
26	PATELKI / RSUD H. Abd Manap	80	100
27	PATELKI / RSUD H. Abd Manap	60	100
28	PATELKI / RS Bhayangkara	60	100
29	PATELKI / RS Bhayangkara	50	100
30	PATELKI / POLTEKKES JAMBИ	60	100
31	PATELKI / RS Siloam	90	100
32	PATELKI/ RS Siloam	80	100
33	PATELKI / RS Mitra	80	100
34	PATELKI / LABKESDA Kota JAMBИ	90	100
35	PATELKI / LABKESDA Kota JAMBИ	90	100
36	PATELKI / RS Mitra	80	100
37	PATELKI / RS Mitra	60	100
38	PATELKI / RS Mitra	70	100
39	PATELKI / RS Mitra	70	80
40	PATELKI / LAB KLINIK PRODIA	90	100
41	PATELKI / RS Bhayangkara	60	100
42	K PATELKI / Klinik Pratama UNJA	100	100

Nearly all participants showed an upward trend in their scores, indicating that the socialization and hands-on practice was effective in enhancing participants' comprehension and reinforcing key concepts related to sample management (Table 3 and Figure 1)

Table 3. Summary of Pretest and Posttest Scores

Parameter	Pretest (Mean ± SD)	Posttest (Mean ± SD)
Mean score	70.00 ± 13.85	95.24 ± 8.84
Minimal score	40	50
Maximal score	100	100



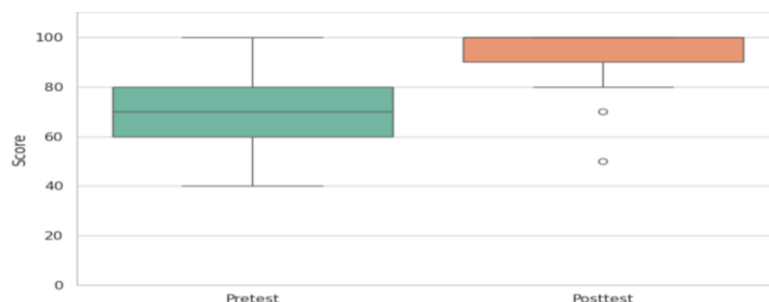


Figure 1. Score distribution: pretest vs posttest

This community service method is carried out by presenting directly to participants about the importance of the pre-analytical phase. In addition, a hands-on workshop is also held so that participants can practice performing tissue lamellation correctly and adequate fixation methods, so that they can produce good quality paraffin blocks and ultimately the tissue on the slides can be diagnosed correctly, and patients can get adequate therapy. In addition, before the presentation began, we distributed a seminar kit containing seminar materials so that participants could first get to know the topic that we would present, then we distributed a questionnaire containing 10 questions about the topic of the pre-analytical phase, after the seminar, discussion and workshop were finished, shortly before the event closed, we also distributed the same questions as an indicator to see whether the message we had conveyed had been understood by the invitees who were the target of this community services. During the event, seminar participants were quite active in asking questions and discussing with our team. In addition, from the participants' answers to the initial questionnaire, it showed that the average number of participants who answered the most questions correctly was 70.00 (**Table 3, Figure 1**).



Figure 2. Opening ceremony of the training activity, officiated by the Dean of the Faculty of Medicine and Health Sciences, Universitas Jambi (FKIK UNJA), accompanied by the invited resource persons and participants.

The average number of participants who gave correct answers to the questionnaire that we distributed after the seminar (post-test) increased to 95.24 (**Table 3, Figure 1**). From this fact, we hope that the material we present can be more easily understood by participants. Thus, it is hoped that the pre-analytical procedures carried out by participants at the institutions where each participant works can be better and standardized. Ultimately, it will affect the tissue process in the anatomical pathology laboratory, so that it will produce good paraffin blocks, more accurate patient tissue diagnosis and if immunohistochemical examination is carried out, the smear results will be of good quality. The results of this activity are in accordance with the community service of Murti (2023) and Prasetya et al (2024), there was an increase in knowledge after conducting counseling and training, an increase in participant knowledge of 15% based on the results of the pre-test and post-test, as well as positive impressions and messages and successfully improved understanding of the pre-analytical process and identified areas that require special attention in daily laboratory practice.^{21,22}





Figure 3. Hands-on practice session on the handling of tissue and fluid specimens.

In this training, training participants also experienced an increased understanding of how to prepare samples, according to a study Truong et al (2024), the study highlights the importance of identifying and addressing Preanalytical in the anatomical pathology laboratory setting as well as the potential benefits of implementing standardized documentation and quality improvement processes to address these deficiencies.²³⁻²⁵



Figure 4. Handover of technological and innovative products in the form of a guidebook on histopathology and cytology sample management to partner organizations HIPKABI and PATELKI.

CONCLUSION

The conclusion drawn from this activity is that the management of tissue and fluid specimens is still not well understood by healthcare workers directly involved in these examinations. The socialization efforts, in the form of direct training on specimen and fluid handling, were highly effective in enhancing participants' understanding of the standardization of health service management practices.



ACKNOWLEDGEMENTS

We are thankful to the Faculty of Medicine and Health Science at Jambi University for financial support (Research grant no. 708/UN21.11/PM.01.01/SPK/2024 date: 14 Juni 2024)

REFERENCES

1. Goldblum J, Lamps L, McKenney J, Myers JL. *Rosai and Ackerman's Surgical Pathology*. 11th ed. Philadelphia: Elsevier Inc; 2020. p. 2513-2580.
2. Allen DC, Cameron R. *Histopathology Specimen*. 3rd ed. Switzerland: Springer; 2017.
3. Inderiati EK. *Sitohistoteknologi*. 1 st ed. Jakarta: Kementerian Kesehatan Republik Indonesia; 2017.
4. Singh H. Fixation and Fixatives: Roles and Functions A Short Review. *Dent. J. Adv. Stud.* 2019;07:051-5.
5. Octary N, Sari I, Aristoteles. Liver Tissue Examination of Mice Using 10% BNF Fixation for 6 Hours and 16 Hours. *Jurnal Analisis Laboratorium Medis.* 2022; 7(2):104-9
6. Ireka Y, Agustina H, Aziz A, Hernowo B, Suryanti S. Comparison of fixation methods for preservation cytology specimens of cell block preparation using 10% neutral buffer formalin and 96% alcohol fixation in E-cadherin and Ki-67 immunohistochemical examination. *Open Access Maced. J. Med. Sci.* 2019;7: 3139–44.
7. Koonmee S, Sangkhamanon S, Intarawichian P, Aphivatanasiri C, Kunprom W, Sa-ngiamwibool P, Balthaisong S, Phuyao C, Prajumwongs P, Alaghebandan R and Thane M (2022) The Impact of Pre-analytical Quality Initiatives on Cholangiocarcinoma Diagnostics in Thailand. *Front. Public Health* 10:792847. doi: 10.3389/fpubh.2022
8. Perry C. et al. A Buffered Alcohol-Based Fixative for Histomorphologic and Molecular Applications. *J. Histochem. Cytochem.* 2016; 64:425–40.
9. Richter KN. Glyoxal as an alternative fixative to formaldehyde in immunostaining and super-resolution microscopy. *EMBO J.* 2018;37:139–59.
10. Chung JY. Histomorphological and Molecular Assessments of the Fixation Times Comparing Formalin and Ethanol-Based Fixatives. *J. Histochem Cytochem.* 2018;66:121–35.
11. Torlakovic EE. ICSH guidelines for the standardization of bone marrow immunohistochemistry. *Int. J. Lab. Hematol.* 2015; 431–49.
12. Miller, Rachel MS⁺; Thorne-Nuzzo, Trish BS⁺; Loftin, Isabell PhD⁺; McElhinny, Abigail PhD⁺; Towne, Penny MBA⁺; Clements, June MD⁺. Impact of Pre-Analytical Conditions on the Antigenicity of Lung Markers: ALK and MET. *Applied Immunohistochemistry & Molecular Morphology.* 2020; 28(5):p 331-338. DOI: 10.1097/PAI.0000000000000730
13. Jasani, Bharat & Huss, Ralf & Taylor, Clive. (2021). Analytical Phase: Principles for Immunohistochemistry (IHC). 10.1007/978-3-030-84087-7_9.
14. Lin F, Prichard J. *Handbook of Practical Immunohistochemistry*. 2nd ed. New York: Springer. 2015. 1–69p.
15. Dugad, Vivek, Deshmukh, Sayali, Bhosale, Anand et al. Pre-Analytical And Post-Analytical Errors In The Clinical Laboratory: A Systematic Review. *Journal of Pharmaceutical Negative Results.* 2022; 102: 1004.
16. Kurniawaty, N. F., Krisna Murti, Nora Ramkita, & Sandria. Correlation between the Pre-Analytical Stage and Quality of Breast Histopathology Specimen. *Jurnal RSMH Palembang.* 2024; 5(1):335-339.
17. Reeta Grover, Gadhavi BJ, Study of Pre-Analytical Errors in Laboratory & Steps to Improve Saudi J Pathol Microbiol. 2024; 9(1): 20-26
18. Wick MR. The hematoxylin and eosin stain in anatomic pathology-An often-neglected focus of quality assurance in the laboratory. *Semin Diagn Pathol.* 2019 Sep;36(5):303-311. doi: 10.1053/j.semmp.2019.06.003. Epub 2019 Jun 4. PMID: 31230963.
19. Costarelli L, Rizzo A, Bortul M, Pietribiasi F, Taffurelli M, Tinterri C et al. Pre-analytics, a national survey of Senonetwork Italia breast centers: Much still to do ahead. *European Journal of Surgical Oncology.*2021; 4 (2): 240-44
20. Mubarak M. Quality Assurance in Histopathology Laboratories. *J Clin Transl Pathol.* 2023;3(4):184-189
21. Krisna Murti, Nora Ramkita. Penyuluhan pentingnya fase pra-analitik di bidang Patologi Anatomi di Kota Prabumulih. *Hummed* 2023;4(2):80–89. DOI: 10.32539/Hummed.V4I2.102
22. Prasetya, D, Yundari, A. I. D. H, Puspawati, N. L. P. D, Asdiwinata, I. N. Peningkatan Pengetahuan Proses Pra-Analitik pada Ahli Teknologi Laboratorium Medis: Program Edukasi Berkelanjutan. *Bhakti Community Journal.* 2024;3(1): 22–33. <https://doi.org/10.36376/bcj.v3i1.32>
23. Truong T, Roopchard P, Olkhov-Mitsel E, Farahvash A, Sanders G, Jordan T, Ghorab Z, Slodkowska E, Downes MR. Redefining and capturing pre-analytic deficiencies in an anatomical pathology



- laboratory: a quality improvement initiative. *Virchows Arch.* 2024 May;484(5):743-751. doi: 10.1007/s00428-023-03611-9. Epub 2023 Aug 7. PMID: 37548751.
24. Perkasa TAB, Puspasari A, Priskila L, Tarigan NPI, Widyawati D, Neldi V. Exploration The Multifaceted Role Of Vitamins In Epigenetic Regulation: Insights Into DNA Methylation And Histone Modification. *Jmb. Med. Journal: Jur. Ked. dan. Kes.* 2025 May 28;13(1):76-90.
 25. Puspasari A, Herlambang H, Maharani C, Perkasa TAB, Enis RN, Tarawifa S, et al. The Genetic Variation of Ace Gene Rs4343 Has Lack Association With Pre-Eclampsia: Case-Control Study In Jambi Malay Population. *Jmb. Med. Journal: Jur. Ked. dan. Kes.* 2025 May 24;13(1):60-6.

