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A study of pre-analytical errors in a public hospital biochemistry laboratory according to their causes and units

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Abstract

The clinical laboratory is an important stakeholder in the patient management process with a direct impact on patient care by providing evidence and data for diagnosis and treatment. Identifying reliable quality indicators in clinical laboratories is an important step in enabling users to measure the quality of laboratory service. Any error in the pre-analytical process affects other processes and jeopardizes patient safety. This study aimed to examine the number of specimen rejections in clinical laboratories, their reasons, and their range according to the departments. The study was a descriptive retrospective study. The population of the study consisted of samples rejected from the Biochemistry Laboratory of a teaching and research hospital in 2021. Data were analyzed using percentage and frequency analysis. The study recommends that practices to minimize errors in the pre-analytical process should be carried out urgently by the management and a training plan for sample collection should established.

Keywords: Clot; hemolysis; patient safety; pre-analytical process; sample rejection.

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1. Introduction

The clinical laboratory, which is considered the first step of the clinical decision-making process, is an important stakeholder in the patient management process that has a direct impact on the approach to the patient by providing evidence and data for diagnosis and treatment (Aita et al., 2017; Chavan et al., 2019; Wehkamp et al., 2021). There is a direct relationship between effective patient management and the accuracy, reliability, and timeliness reporting of test results, that is laboratory quality (Ates and Aba, 2019; Megan et al., 2021).

Identifying reliable quality indicators in clinical laboratories is an important step in ensuring that the quality of laboratory services is measured by users (Aksoy et al., 2021). Thus, error sources are monitored. Laboratory error processes can monitor as pre-analytical, analytical, and post-analytical processes (Lippi et al., 2011).

The pre-analytical process is the pre-test phase, which includes the process outside the laboratory and inside the laboratory until the test is performed, and errors at this stage account for close to 70% of the total error rate in the laboratory (Dilshika et al., 2020). The development and standardization of analytical techniques, health information technologies, and quality management processes have reduced the error rate in the analytical and post-analytical processes (Cornelius et al., 2021; Satılmıs et al., 2015; Chavan et al., 2019; Maher et al., 2020). Most of the errors in the pre-analytical process involve processes that occur during sampling. The majority of deficiencies and errors during sample collection are human-induced errors and it is important to track this process for improvement. Any error in the pre-analytical process affects other processes and jeopardizes patient safety (Jung et al., 2023; Biryol, 2022; Getaway et al., 2023).

1.1. Purpose of study

To identify and track these nonconformities in clinical quality management systems and to have a continuous improvement process, it is necessary to address the monitoring of these indicators. This study aims to investigate the number of sample rejections in the central biochemistry laboratory of a training and research hospital serving in the field of cardiac diseases, the reasons for these rejections, and the range according to the department from which they were collected. It thought that the results will raise awareness about on-the-job training to reduce error rates.

2. Materials and methods

The study is a descriptive, retrospective study. The population of the study consists of samples rejected in 2021 from the Biochemistry Laboratory of Kartal Kosuyolu High Specialty Training and Research Hospital in Istanbul, Turkey. No sample selection was made in the study and the data were obtained from laboratory records for the period January 01 - December 31, 2021. Data were classified in six-month periods according to the reasons for rejection and the units from which the samples were taken. The data was analyzed by percentage and frequency analysis.

2.1. The ethical dimension of the research

Permission was sought to use the data obtained from the hospital administration. Details of the owners of the sample remained anonymous.

3. Results

Percentages of rejected samples compared to total samples calculated (Number of samples rejected/ The total number of samples received x 100). Accordingly, the total number of samples for the first six-month period is n=597696 and the ratio of rejected samples to total samples is 0.27%. For the second six-month period, the total number of samples is n=721608 and the ratio of rejected samples to total samples is 0.29%.

When the reasons and numbers of sample rejections were analyzed; the total number of sample rejections for the first six-month period was n=1595 and it determined that clotted sample (32.09%) was higher than the other reasons for sample rejection. The total number of sample rejections for the second six-month period

was n=2106 and it determined that clotted sample (36.51%) was higher than the other reasons for sample rejection (Table 1).

Table 1

Reasons and numbers of sample rejection

Reason for Rejection	Quantity of Rejection Samples					
	First 6 months (n:1592)	%	Second 6 months (n: 2106)	%	Sum (n: 3698)	%
Sample with hemolysis	186	11,68	191	9,07	377	10,19
Clotted sample	511	32,09	769	36,51	1280	34,61
Level inappropriate	153	9,61	529	25,12	682	18,44
Insufficient sample	342	21,48	284	13,49	626	16,93
Untimely sample	110	6,90	65	3,09	175	4,73
Others	290	18,21	268	12,73	558	15,09
Sum	1592	100	2106	100	3698	100

When the unit-based range of rejected samples was analyzed, it found that inpatient wards were higher than other units in both the first six-month period (44.97%) and the second six-month period (41.36%) (Table 2).

Table 2

Range of rejected samples by department

Department	First 6 months (n:1592)	%	Second 6 months (n: 2106)	%	Sum (n: 3698)	%
Emergency	160	10,05	255	12,11	415	11,22
Intensive Care Units	521	32,73	732	34,76	1253	33,88
Polyclinics	195	12,25	248	11,78	443	11,98
Inpatient Services	716	44,97	871	41,36	1587	42,92
Sum	1592	100	2106	100	3698	100

4. Discussion

As a result of the study, it determined that the first reason for sample rejection in the first six months was clotted samples and the second reason was insufficient sample collection. In the second six-month period, the first reason for sample rejection was again clotted samples, and the second reason for sample rejection was inappropriate level. This was thought to be due to a lack of knowledge on the correct use of the materials used in blood collection and inadequate blood collection experience. The most common types of errors in the pre-analytical process include hemolyzed, clotted, inadequate sample collection, incorrect tube handling, and mislabeling (Dale and Novis, 2002).

Similar to our finding, Çokluk et al. (2021) reported that the main reasons for sample rejection in the pre-analytical process were clotted sample, hemolyzed sample, and incorrect filling level; the reasons for clotted sample reported as non-compliance with the tube filling line and not turning the tube upside down. Abbas et al. (2017) classified the reasons for sample rejection into four main groups technique-related, information-related, request form-related, and reason-uncertain errors; and stated that clotted and hemolyzed samples resulted from errors related to phlebotomy technique, while incorrect volume samples and incorrect sample tube use resulted from information-related errors.

When the range of the departments that sent inappropriate samples was analyzed, it found that inpatient wards ranked first and intensive care units ranked second in both periods. This situation was thought to be because of healthcare staff negligence due to the heavy workload and lack of knowledge about the blood sampling procedure (Kumah et al., 2020). Moore and Foss (2003) state that the probability of human error increases when staff are fatigued, overloaded, stressed, distracted, poorly or incompletely trained, or

incompetent for any other reason. Also, Berg et al. (2011) reported that healthcare staff, even if trained, sometimes do not follow sampling procedures for various reasons and do not pay due care.

5. Conclusion

The risk of errors in the pre-analytical process of laboratory tests can affect laboratory results and jeopardize patient safety. Also, repeated sampling due to errors leads to an increased workload of healthcare professionals, increased costs, and decreased service quality. Thus, it is a very important issue to emphasize.

Based on the results of this research, the following can be suggested:

- The management should carry out studies to minimize errors in the pre-analytical process.
- Appropriate material supply for sampling should be ensured.
- On-the-job training should be provided to the healthcare staff, especially nurses, on the common causes of errors in blood sampling.
- A training plan should be established to make this training continuous

Limitations were related to data taken from laboratory records and no observation of the sampling process was made.

References

Abbas, M., Mukinda, F.K. & Namane, M. (2017). The effect of phlebotomy training on blood sample rejection and phlebotomy knowledge of primary health care providers in Cape Town: A quasi-experimental study. *African Journal of Primary Health Care & Family Medicine*, *9*(1), 1-10. https://journals.co.za/doi/abs/10.4102/phcfm.v9i1.1242

Aita, A., Padoan, A., Antonelli, G., Sciacovelli, L. & Plebani, M. (2017). Patient safety and risk management in medical laboratories: theory and practical application. *Journal of Laboratory and Precision Medicine, 2,* 75. https://cdn.amegroups.cn/journals/jlpm/files/journals/27/articles/3827/public/3827-PB2-6347-R2.pdf

Aksoy, H., Ozturk, A., Tarhan, D., Dolukup, I. & Baser, D.A. (2021). Biochemistry laboratory errors and patient safety: Turkey data. *Turk J Biochem, 46*(4), 377-385. https://www.degruyter.com/document/doi/10.1515/tjb-2020-0193/html

Ates, Y. & Aba, G. (2019). Patoloji laboratuvar rutininde akılcı laboratuvar kullanımı: tetkik istemlerinin retrospektif değerlendirmesi. *Suleyman Demirel Universitesi Vizyoner Dergisi, 10*(25), 612-630. https://dergipark.org.tr/en/pub/vizyoner/article/612043

Berg, J.E., Ahee, P. & Berg, J.D. (2011). Variation in phlebotomy techniques in emergency medicine and the incidence of haemolysed samples. *Ann Clin Biochem*, *48,* 562-565. https://journals.sagepub.com/doi/abs/10.1258/acb.2011.011099

Biryol, S. (2022). Tıbbi laboratuvarlarda meydana gelen hatalar: preanalitik sureç ve onlemler. *Paramedik ve Acil Sağlık Hizmetleri Dergisi, 3*(2), 74-83. https://dergipark.org.tr/en/pub/pashid/issue/70707/1052143

Chavan, P.D., Bhat, V.G., Poladia P.P., Tiwari, M.R. & Naresh, C. (2019). Reduction in sample rejections at the preanalytical phase - Impact of training in a tertiary care oncology center. *J Lab Physicians, 11*(3), 229-233. https://www.thieme-connect.com/products/ejournals/abstract/10.4103/JLP.JLP_4_19

Çokluk, E., Sekeroğlu, R., Tuncer, F.B., Guneysu, F., Çillioğlu, S. & Boz, M. (2021). Venoz numune almada preanalitik hataların tespiti; acil servis deneyimi. *Muğla Sıtkı Koçman Universitesi Tıp Dergisi, 8*(1), 34-39. https://dergipark.org.tr/en/pub/muskutd/article/839406

Ewuoso, C., Hall, S. & Dierickx, E. (2021) How do healthcare professionals respond to ethical challenges regarding information management? A review of empirical studies, Global Bioethics, 32:1, 67-84, DOI: 10.1080/11287462.2021.1909820

Ay, G., Akbal, S. & Akbal, O.Y. (2023). A study of pre-analytical errors in a public hospital biochemistry laboratory according to their causes and units. *International Journal of Emerging Trends in Health Sciences. 7*(2), 28-32. https://doi.org/10.18844/ijeths.v7i2.9030

Dale, J.C. & Novis, D.A. (2002). Outpatient phlebotomy success and reasons for specimen rejection: A Q-probes study. *Arch Pathol Lab Med, 126,* 416-419. https://meridian.allenpress.com/aplm/article-abstract/126/4/416/453391

Dilshika, L.K.M., Bandara, W.V.R.T.D.G. & Karunanayaka, A.D.S.S. (2020). A study on sample rejection rates due to pre-analytical errors: associated factors and knowledge, attitudes, and practices of nurses on blood sample collection for hematology at a teaching hospital in Sri Lanka. *Journal of Health Sciences and Innovative Research, 1*(1), 24-30. http://www.dr.lib.sjp.ac.lk/handle/123456789/9401

Getawa, S., Aynalem, M., Melku, M. & Adane, T. (2023). Blood specimen rejection rate in clinical laboratory: A systematic review and meta-analysis. *Practical Laboratory Medicine*, 33(2023) e00303. https://www.sciencedirect.com/science/article/pii/S2352551722000427

Jung, S. J., Song, J. E., Bae, S. H., Lee, Y., Gwon, S. H., & Park, J. H. (2023). Simulation-based training program on patient safety management: A quasi-experimental study among new intensive care unit nurses. *Nurse Education Today*, *126*, 105823. https://www.sciencedirect.com/science/article/pii/S026069172300117X

Kumah, E., Ankomah, S. E., Fusheini, A., Sarpong, E. K., Anyimadu, E., Quist, A. & Koomson, B. (2020). Frameworks for health systems performance assessment: how comprehensive is Ghana's holistic assessment tool? *Global health research and policy*, *5*(1), 1-12. https://ghrp.biomedcentral.com/articles/10.1186/s41256-020-00139-2

Lippi, G., Chance, J.J., Church, S., Dazzi, P., Fontana, R., Giavarina, D., Grankvist, K., Huisman, W., Kouri, T., Palicka, V., Plebani, M., Puro, V., Salvagno, G.L., Sandberg, S., Sikaris, K., Watson, I., Stankovic, A.K. & Simundic, A.M. (2011). Preanalytical quality improvement: from dream to reality. *Clin Chem Lab Med, 49*(7), 1113-26. https://www.degruyter.com/document/doi/10.1515/CCLM.2011.600/html

Maher, A., Salarianzadeh, M. H., Moghaddam, A. V., Jafari, M. & Zaboli, R. (2020). Towards improving hospital managers' performance in Iran: history of a pioneer program among EMRO countries. *International Journal of Health Policy and Management*, *9*(9), 409. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7557423/

McVay, M. A., Cooper, K. B., Carrera Seoane, M., Donahue, M. L., & Scherer, L. D. (2021). Transparent reporting of hypotheses and analyses in behavioral medicine research: An audit of publications in 2018 and 2008. *Health psychology and behavioral medicine*, *9*(1), 285-297. DOI: 10.1080/21642850.2021.1907186

Moore, S.B. & Foss, M.L. (2003). Error management: theory and application in transfusion medicine at a tertiary–care institution. *Archives of Pathology & Laboratory Medicine, 127,* 1517-1522. https://meridian.allenpress.com/aplm/article-abstract/127/11/1517/454571

Satılmıs, O.K., Macit, Y., Serteser, M. & Unsal, İ. (2015). Tıbbi laboratuvarda pre-analitik hatalar-ornek alımı. *Sağ. Perf. Kal. Derg., 9,* 19-26. https://dergipark.org.tr/en/pub/spkd/issue/29267/313394

Wehkamp, K., Kuhn, E., Petzina, R., Buyx, A. & Rogge, A. (2021). Enhancing patient safety by integrating ethical dimensions to Critical Incident Reporting Systems. *BMC medical ethics*, *22*, 1-8. https://link.springer.com/article/10.1186/s12910-021-00593-8