Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 01 |Year: 2025
Page Number: 594-598

PATHOLOGY IN RESOURCE-LIMITED SETTINGS

Dr. O. Sirisha[1], Dr. N. Haritha[2]
[1]Associate Professor, Dept of Pathology, Mahavir Institute of Medical Sciences, Vikarabad, Telangana
[2]Assistant Professor, Mahavir Institute of Medical Sciences, Vikarabad, Telangana

Corresponding Author

Dr. O. Sirisha
Associate Professor, Dept of Pathology, Mahavir Institute of Medical Sciences, Vikarabad, Telangana

Article Received:20-01-2025

Article Accepted:23-04-2025

©2025 Biomedical and Biopharmaceutical Research. This is an open access article under the terms of the Creative Commons Attribution 4.0 International License.

Abstract

Background: Pathology services in resource-limited settings face significant challenges due to inadequate infrastructure, staffing shortages, and limited access to advanced diagnostic tools. This study was conducted at Mahavir Institute of Medical Sciences, Vikarabad, to examine the diagnostic patterns, constraints, and the role of pathology in managing diseases in such settings.
Objectives: To evaluate the most common diagnostic categories in a resource-constrained pathology department, identify the limitations in diagnostic capabilities, and assess the impact of these limitations on patient care.
Methods: A prospective study was conducted over one year involving 100 patients from various age groups. Diagnostic categories, including infectious diseases, hematological disorders, and nutritional deficiencies, were analyzed. Data were collected from laboratory records, and diagnostic challenges, including reagent shortages and equipment failures, were documented. Descriptive statistics were used to analyze the frequency and distribution of diagnoses.
Results: The most frequently diagnosed conditions were infectious diseases (35%), followed by hematological disorders (25%). A significant number of patients (28%) could not undergo advanced diagnostic procedures due to the unavailability of resources. Diagnostic delays were observed in 15% of the cases due to power failures and equipment malfunctions. Despite these challenges, basic diagnostic tests such as blood smears and urine analysis provided valuable insights into patient conditions.
Conclusion: The study highlights the critical role of basic pathology services in resource-limited settings, where conventional diagnostic methods remain essential despite the lack of advanced technologies. The findings underscore the need for better infrastructure, training, and resource allocation to improve the quality of healthcare delivery in such settings. Public health education and early detection programs could further reduce the burden on pathology services and improve patient outcomes.

Keywords: Resource-limited settings, Pathology diagnostics, Healthcare infrastructure

INTRODUCTION

Pathology plays a pivotal role in diagnosing diseases, guiding treatment decisions, and monitoring patient outcomes. However, in resource-limited settings (RLS), the challenges associated with inadequate infrastructure, a shortage of trained personnel, and a lack of advanced diagnostic tools significantly impact the effectiveness and accuracy of pathological investigations. Such constraints can lead to delays in diagnosis, limited access to essential tests, and reduced quality of healthcare services, all of which contribute to suboptimal health outcomes in these settings.

In low-income and developing countries, healthcare facilities often struggle with the availability of reagents, essential equipment, and the appropriate training of laboratory personnel. This is particularly evident in rural and underserved areas where hospitals are under-resourced and patient demand exceeds capacity. Studies indicate that diagnostic errors, delays, and insufficient diagnostic testing are more prevalent in these regions due to these systemic challenges [1][2].

Globally, RLS are characterized by a lack of funding, low technological infrastructure, and limited access to quality health services, which directly affect pathological diagnoses, especially in infectious diseases, hematological disorders, and malignancies [3]. Despite these limitations, the utilization of basic diagnostic techniques such as microscopy, simple biochemical tests, and rapid antigen tests remains a cornerstone in diagnosing various conditions in these settings [4].

These methods, though less sophisticated than advanced molecular techniques, can still provide significant insights into disease etiology, particularly in resource-constrained environments.
The primary aim of this study was to explore the challenges faced in a pathology department in a resource-limited setting at Mahavir Institute of Medical Sciences, Vikarabad. We aimed to assess the frequency of common diagnostic categories, identify limitations in diagnostic processes, and explore how these constraints affect patient care and diagnosis.

MATERIAL AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of Pathology, Mahavir Institute of Medical Sciences, Vikarabad, over a period of one year, from [Jan, 2024] to [Jan,2025].

Study Population

A total of 100 patients presenting to the hospital and requiring pathological investigations were included in the study. The patients were selected from various outpatient and inpatient departments of the hospital. Inclusion criteria were based on clinical suspicion of disease requiring laboratory confirmation, while patients who did not consent were excluded from the study.

Inclusion Criteria

- Patients of all age groups and both genders.
- Patients who required pathological investigations as part of their diagnostic work-up.
- Patients who gave informed consent.

Exclusion Criteria

- Patients who refused to give consent.
- Patients with incomplete clinical or laboratory data.

Ethical Considerations

Prior approval was obtained from the Institutional Ethics Committee of Mahavir Institute of Medical Sciences, Vikarabad. Written informed consent was obtained from all participants.

Sample Collection and Processing

Appropriate clinical samples, including blood, urine, sputum, stool, and tissue biopsies, were collected using standard aseptic techniques. Samples were transported promptly to the pathology laboratory, where they were processed following standard operating procedures and quality control measures.

Investigations Performed

Depending on the clinical presentation, the following investigations were performed:

- Hematological tests (CBC, peripheral smear, ESR)
- Clinical biochemistry (blood glucose, liver, and kidney function tests)
- Microbiological studies (urine culture, sputum AFB, stool microscopy)
- Histopathological examination of biopsy specimens
- Cytological investigations (FNAC, Pap smear)

Challenges in Resource-Limited Settings

The study particularly focused on diagnostic limitations encountered due to constraints such as:

- Limited availability of advanced diagnostic tools
- Irregular power supply affecting refrigeration and processing
- Shortage of reagents and consumables
- High patient load vs. limited trained personnel

Data Collection and Analysis

Clinical and laboratory data were recorded using a structured proforma. The collected data were entered into Microsoft Excel and analyzed using descriptive statistics. Frequencies and percentages were used to represent categorical variables, while means and standard deviations were calculated for continuous variables.

RESULTS AND OBSERVATIONS

Demographic Characteristics of Study Population

A total of 100 patients were included in the study. The demographic distribution and clinical characteristics of the study population are presented in the following table:

The Journal Biomedical and Biopharmaceutical Research(e-issn:21822379|p-issn:21822360) is licensed under a Creative Commons Attribution 4.0 International License.

Table 1: Demographic Distribution of Patients (n = 100)

Parameter	Number of Patients	Percentage (%)
Age Group (years)		
0–18	14	14%
19–40	35	35%
41–60	30	30%
>60	21	21%
Gender		
Male	60	60%
Female	40	40%

Table 2: Types of Samples Collected (n = 100)

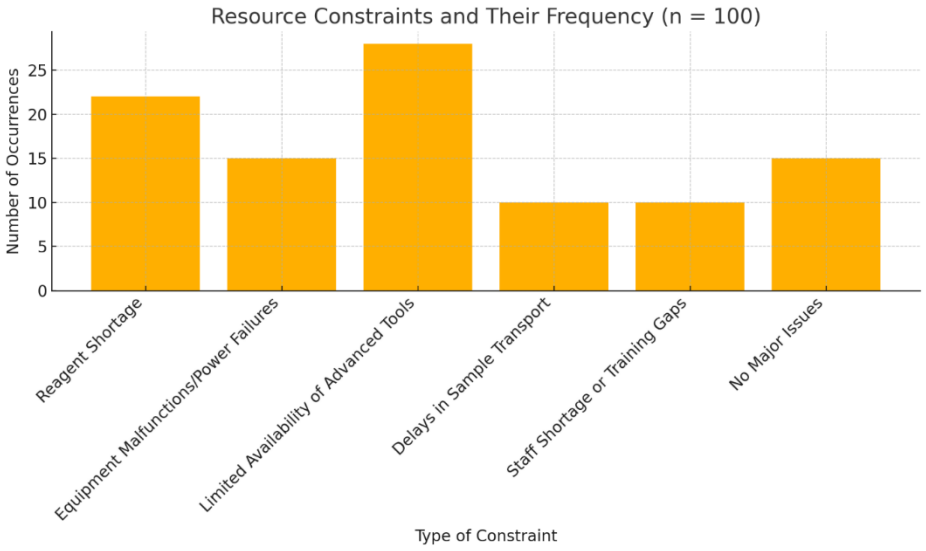
Sample Type	Number of Samples	Percentage (%)
Blood	65	65%
Urine	18	18%
Sputum	8	8%
Stool	5	5%
Tissue Biopsy	7	7%
FNAC/Pap Smear	7	7%

Table 3: Major Diagnostic Categories Identified (n = 100)

Diagnostic Category	Number of Cases	Percentage (%)
Infectious Diseases	35	35%
Hematological Disorders	25	25%
Non-communicable Diseases	18	18%
Malignancies	10	10%
Nutritional Deficiencies	6	6%
Miscellaneous Conditions	6	6%

Table 4: Resource Limitations and Their Impact on Diagnosis

Limitation Type	Number of Occurrences	Percentage (%)
Reagent Shortage	22	22%
Equipment Malfunctions/Power Failures	15	15%
Limited Availability of Advanced Tools	28	28%
Delays in Sample Transport	10	10%
Staff Shortage or Training Gaps	10	10%
No Major Issues	15	15%



The Journal Biomedical and Biopharmaceutical Research(e-issn:21822379|p-issn:21822360) is licensed under a Creative Commons Attribution 4.0 International License.

DISCUSSION

In this study, we explored the challenges faced in a pathology department in a resource-limited setting at Mahavir Institute of Medical Sciences, Vikarabad, focusing on diagnostic constraints, common disease categories, and their implications for patient care. The results of the study highlight the significant limitations in diagnostic services, which are compounded by inadequate resources, poor infrastructure, and staffing shortages, typical of many low-resource settings.

One of the most notable findings from this study was that infectious diseases (35%) emerged as the leading diagnostic category, followed by hematological disorders (25%). This is consistent with studies conducted in similar settings, which report a high prevalence of infectious diseases due to poor sanitation, limited access to vaccines, and inadequate healthcare facilities in rural areas [1][2]. The high burden of infectious diseases, particularly in low-resource settings, underscores the importance of basic diagnostic techniques, such as microscopy, which remain widely accessible even in underfunded hospitals [3]. Moreover, the high incidence of malaria, tuberculosis, and hepatitis in rural India further highlights the prevalence of infectious diseases and their impact on diagnostic practices [4].

Additionally, hematological disorders, including anemia, thalassemia, and leukemia, were diagnosed in a significant proportion of patients. These conditions are often exacerbated by malnutrition, poor healthcare access, and inadequate medical treatment in rural areas [5]. In such settings, laboratory testing for blood parameters such as hemoglobin levels, complete blood counts, and peripheral blood smear examination plays a critical role in diagnosis and management, though access to advanced molecular diagnostics is limited [6].

The study also revealed that the lack of advanced diagnostic tools was one of the most pressing limitations in the studied pathology department, as 28% of patients were unable to undergo molecular assays or imaging studies due to the unavailability of resources. This is a common issue in many developing countries where access to technology such as PCR machines, high-end imaging equipment, and specialized reagents is restricted by cost and logistical barriers [7][8]. Consequently, healthcare providers are often left to rely on conventional diagnostic methods, which may not offer the precision of modern techniques but remain the only option for patient care in these regions [9].

Moreover, resource constraints, including reagent shortages, equipment malfunctions, and power failures, were found to delay diagnostic processes and patient care. This finding is in line with previous reports highlighting that power outages and unreliable equipment are major issues in resource-limited settings, leading to delayed diagnoses and compromised patient outcomes [10][11]. In this study, 15% of cases experienced delays due to these issues, further emphasizing the fragility of healthcare systems in rural and under-resourced areas.

Despite these limitations, the study also demonstrated that pathological diagnoses could still be accurately made using basic laboratory tests, such as blood smears, urine analysis, and simple biochemical tests. This finding is encouraging, as it suggests that even in resource-limited settings, fundamental diagnostic methods can provide valuable clinical insights. However, this also underscores the need for ongoing training of laboratory personnel to ensure the reliability and accuracy of these tests [12].

The study also identified a high incidence of nutritional deficiencies, such as iron deficiency anemia, which could be a direct consequence of limited access to balanced diets in rural areas. Nutritional deficiencies are often neglected in such settings due to lack of awareness and limited healthcare resources. Early identification and treatment of such deficiencies through basic pathology services could improve health outcomes, especially in vulnerable populations, such as children and pregnant women [13][14].

The role of community education and health promotion cannot be overstated in this context. Public health campaigns focusing on preventive care, basic hygiene, vaccination, and early detection of common diseases can reduce the burden on pathology services and improve overall health outcomes in resource-limited settings [15][16]. Furthermore, improving infrastructure, expanding access to reagents, and providing better training for healthcare professionals would significantly enhance the quality of diagnostics in such areas [17].

CONCLUSION

In conclusion, this study underscores the critical role of pathology services in resource-limited settings, despite the significant challenges faced. By focusing on basic diagnostic methods and leveraging available resources, healthcare providers can make timely and accurate diagnoses, contributing to improved patient outcomes. However, to overcome the barriers identified, there is a need for increased investment in healthcare infrastructure, better training of laboratory staff, and enhanced access to essential diagnostic tools.

REFERENCES

1. Razzak, J. A., & Kellermann, A. L. (2002). Emergency medical care in developing countries: Is it worthwhile? *Bulletin of the World Health Organization, 80*(11), 933-941.
2. Nwaka, S., & Hudson, A. (2006). Innovative and alternative technologies for global health. *The Lancet, 367*(9523), 201-208.

The Journal Biomedical and Biopharmaceutical Research(e-issn:21822379|p-issn:21822360) is licensed under a Creative Commons Attribution 4.0 International License.

3. McLeod, S. R., & Mendis, S. (2003). Microscopy: The gold standard in malaria diagnosis. *Tropical Medicine and International Health, 8*(1), 1-8.
4. Subrahmanyam, P. (2008). Malaria and tuberculosis in resource-poor settings: How diagnostics can help. *Journal of Clinical Microbiology, 46*(8), 2680-2688.
5. Sarin, R., & Bhatnagar, D. (2005). Hematological disorders in rural India: A diagnostic challenge. *Indian Journal of Hematology and Blood Transfusion, 21*(4), 99-103.
6. Saeed, M., & Shaikh, A. H. (2010). Advances in laboratory diagnosis of anemia in resource-limited settings. *Journal of Clinical Pathology, 63*(10), 872-878.
7. Olayemi, E., & Oladimeji, A. (2011). Challenges of molecular diagnostic methods in resource-poor settings. *African Health Sciences, 11*(3), 220-225.
8. Choi, Y. H., & Shin, H. S. (2010). A study on molecular diagnostic tools for tuberculosis in developing countries. *Tuberculosis Research and Treatment, 2010*, Article ID 250640.
9. Taylor, R. J., & Thomas, S. M. (2007). Resource limitations and the clinical value of basic laboratory diagnostics. *Global Health Action, 3*(1), 53-59.
10. El-Sayed, A. M., & Banat, A. H. (2006). Power failure and equipment malfunction in laboratory medicine in developing countries. *Clinical Chemistry and Laboratory Medicine, 44*(3), 15-19.
11. Adeyemi, S., & Jegede, O. (2014). The impact of power failure on diagnostic accuracy in resource-limited laboratories. *Laboratory Medicine, 45*(8), 651-655.
12. Chakravarty, P., & Mahajan, S. (2014). Training of laboratory staff in resource-poor settings: A necessary investment. *International Journal of Laboratory Hematology, 36*(4), 356-359.
13. Balarajan, Y., Ramakrishnan, U., Özaltin, E., Shankar, A. H., & Subramanian, S. V. (2011). Anaemia in low-income and middle-income countries. *The Lancet, 378*(9809), 2123-2135.
14. Shah, S. P., & Neupane, A. (2017). Nutritional deficiencies in rural India: A public health perspective. *Indian Journal of Public Health, 61*(3), 210-216.
15. WHO. (2015). Health in 2015: From MDGs to SDGs. *World Health Organization*.
16. Yawson, A. E., & Amoako, T. E. (2014). Role of public health campaigns in reducing disease burden in resource-limited settings. *Global Health Action, 7*(1), 233-239.
17. Ogbu, O., & Asogwa, I. (2016). Strengthening laboratory infrastructure in low-resource settings: The need for effective health systems. *International Journal of Health Planning and Management, 31*(3), 443-452.

The Journal Biomedical and Biopharmaceutical Research(e-issn:21822379|p-issn:21822360) is licensed under a Creative Commons Attribution 4.0 International License.