Research Article

Laboratory Professionals' Satisfaction Level and Determinant of Quality Laboratory Service Among Health Facilities in Hossana Town, Central Ethiopia: A Facility-based Cross-sectional Study

Kemal Mohamed[1, *] ⓘ**, Abdulhakim Mussema[1]** ⓘ**, Dagmawi Woldesenbet[1]** ⓘ**, Solomon Gebre[1], Asnake Simieneh[2]** ⓘ

[1]Department of Medical Laboratory Sciences, School of Medicine and Health Sciences, Wachemo University, Hossana, Central Ethiopia

[2]Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Wolkite University, Wolkite, Southern Ethiopia

Abstract

Background: Clinical laboratories are essential healthcare systems that provide important data for patient care and public health surveillance. Therefore, data from laboratory services should be reliable and reported on time. *Methods*: A facility-based cross-sectional study was conducted among laboratory professionals working in government and private health facilities in Hossana Town from September 1, 2024, to November 2, 2024. All laboratory professionals employed at these health facilities were included in the study. A structured questionnaire was utilized to collect data on socio-demographics, educational background, job experience, professional motivation, communication with physicians, training availability, quality assurance activities, and other factors influencing laboratory services. All raw data were coded and entered into SPSS version 27 for analysis, using descriptive statistics, chi-square, and logistic regression. Statistical significance was established at a p-value of 0.05. *Results*: There were 150 laboratory health professionals in this study, resulting in a response rate of 97.4%. Males accounted for 70.7% (104/150) of the study participants. In the present study, 65.3% (98/150) of the laboratory professionals were dissatisfied with their work. Satisfaction was significantly associated with the presence of a continuous professional development program ($\chi2$=6.6, p =0.01), staff recognition ($\chi2$=5.13, p =0.023), and salary ($\chi2$=6.29, p =0.012). In multivariate analysis, communication with physicians (AOR = 3.30, CI: 1.44-7.54, p=0.005), workload (AOR = 6.68, CI: 2.36-18.86, p=0.00), training availability (AOR = 2.33, CI: 1.03-5.24, p=0.042), laboratory result verification (AOR = 2.69, CI: 1.15-6.25, p=0.022), regular internal quality control (AOR = 3.56, CI: 1.43-8.83, p=0.006), and participation in external quality assurance (AOR = 4.39, CI: 1.62-11.93, p=0.004) were found to be significant risk factors for provision of quality laboratory services. *Conclusion*: Laboratory professional satisfaction is determined by the presence of a continuous professional development program, staff recognition, and salary. In the study area, prominent factors determining the quality of laboratory services are communication with physicians, the presence of training opportunities, workload, result verification, participation in external quality assurance programs, and regular internal quality control.

*Corresponding author: adote120@gmail.com (Kemal Mohamed)

1. Introduction

Clinical laboratories are essential components of the health care system that produce vital data for patient care [1]. Clinical laboratories also have a role in public health by infectious disease identification, prevention, and control [2]. High-quality diagnostic services must be accessible and appropriately used at all levels, and laboratory test findings must be accurate, reliable, and timely [3, 4] This can be accomplished by meeting specific requirements, such as ensuring the validity of examination results, performing internal quality control (IQC), taking part in external quality assessment (EQA), calibrating equipment, and checking metrological traceability of measurement [5].

However, in many resource-constrained nations like Ethiopia, the quality of laboratory services has remained substandard despite the quickly expanding access to healthcare. Inadequate laboratory space design, inadequate short and long-term training for laboratory professionals, insufficient water and electricity, inadequate supplies and equipment, inefficient maintenance and spare parts, and inadequate supervision and follow-up are all factors that contribute to quality clinical laboratory service, particularly at the peripheral level impairs the standard of care that patients receive [1, 6, 7].

High-quality healthcare organizations strive to implement evidence-based standards to meet the needs and expectations of patients, who are the ultimate recipients of health services [8, 9]. Failing to fulfill these requirements can lead to misdiagnosis and inadequate treatment, which may ultimately increase morbidity and mortality [10]. Furthermore, poor-quality laboratory results contribute to the misuse of antibiotics in healthcare settings, resulting in the emergence of drug-resistant microorganisms, including multidrug-resistant tuberculosis [11]. Additionally, the frequency and severity of errors in the healthcare system affect patient safety [12].

As a result, there is an increasing need to raise the standard of laboratory services to improve patient outcomes and service use. To achieve this, several efforts are ongoing in sub-Saharan Africa; however, numerous challenges continue to hinder the quality of laboratory services and the healthcare system as a whole [8]. Similarly, Ethiopia's laboratory infrastructure and quality assurance initiatives are still weak [9], and factors influencing the quality of medical laboratory services are not well understood. A diverse strategy is needed to address these issues, including investment in healthcare infrastructure, stakeholder engagement, improved supply chain management, and expanded training programs for la-

boratory professionals. Therefore, this study aimed to assess the factors affecting the delivery of high-quality laboratory services in public and private health facilities in Hossana town, central Ethiopia.

2. Materials and Methods

2.1. Study Area

The research was conducted at both public (Wachemo University Nigist Eleni Mohammed Memorial Comprehensive Specialized Hospital, Hossana Health Centre, Bobicho Health Centre, and Lichi Amba Health Centre) and private healthcare facilities in Hossana, located in the Hadiya Zone of central Ethiopia. The study involved four public and ten private health facilities. Hossana lies 232 km south of Addis Ababa, the capital of Ethiopia. These healthcare institutions provide various services, including prevention, treatment, rehabilitation, outpatient and inpatient care, emergency services, critical care, obstetrics, maternal-child health, orthopedics, oncology, and surgery. Both public and private facilities also offer laboratory services, such as body fluid analysis, Gram staining and acid-fast stains, erythrocyte sedimentation rate (ESR), clinical chemistry, CD4 count, hematology, potassium hydroxide (KOH), Alere Determine TB LAM antigen rapid screening test, coagulation profiles, early infant diagnosis (EID), stool exams, urine analysis, GeneXpert, serology, hormone tests, and additional laboratory tests through a referral system.

2.2. Study Design, Period, and Participants

A facility-based cross-sectional study was conducted at private and public health facilities in Hossana town, Hadiya zone, Central Ethiopia, from September 1, 2024, to November 2, 2024.

2.3. Source Population

The source population for this study comprised all laboratory professionals working at private and public health facilities in Hossana Town, Hadiya Zone, and Central Ethiopia.

2.4. Study Population

The study population consisted of all permanently employed laboratory professionals working at private and public health facilities in Hossana Town with at least one year of professional experience.

2.5. Data Collection Tools and Procedures

A structured questionnaire was used to gather data on socio-demographics, educational background, job experience, staff recognition, communication, training, quality assurance activities, and other factors that influence laboratory services. Skilled and experienced laboratory professionals were interviewed by laboratory personnel. The principal investigator was responsible for overseeing all data collection activities and for supporting data collectors throughout the process. The questionnaire was initially developed in English, translated into Amharic, and then back-translated into English to ensure consistency.

2.6. Quality Control of Data

Data collectors received one day of training regarding ethical issues and data collection techniques before beginning data collection. A pre-test was conducted on 5% of the study sample size, which comprised laboratory professionals who were not included in the study. Consequently, the questions' coherence, completeness, and flow, as well as the time required to complete them, were examined. The primary investigator and supervisor (laboratory head) performed routine oversight to guarantee that all required data were correctly gathered.

2.7. Data Analysis

After coding, the raw data were imported into SPSS version 27 for analysis. The data were analyzed, and the participants' demographics were described using descriptive statistics. A Chi-square test was used to assess the associations of staff recognition, salary, and availability of continuous professional development (CPD) with laboratory staff satisfaction. The statistical association between the dependent and independent variables was assessed using binary logistic regression and multivariate analyses. To control for potential confounders, a multivariate analysis was performed on the variables in the bivariate regression model associated with the dependent variable ($p < 0.25$). Hosmer-Lemeshow (HL) goodness-of-fit test (GOF) was used to assess model fitness. The strength of the association between the presence of quality laboratory service and independent variables was evaluated using the odds ratio (OR) with a 95% confidence interval and a p-value of 0.05, which was considered statistically significant.

2.8. Ethical Considerations

Ethical approval was obtained from the Department of Medical Laboratory Sciences, School of Medicine and Health Sciences, Wachemo University: Ref No: MLS/3730/2024, August 4, 2024. After ethical clearance was received, permission to conduct the research was obtained from the administration of each health facility. All participants were informed of the study's purpose, and their participation was voluntary. Confidentiality of information was maintained throughout all stages of the study. To ensure anonymity, participants' names were omitted from the questionnaire; instead, a numerical coding system was employed.

3. Results

3.1. Socio-Demographic Characteristics

This study included 150 laboratory health professionals, resulting in a response rate of 97.4%. Males accounted for 70.7%(104/150) of the study participants. The majority of study participants were between 20-30 years of age, with a mean age of 28.08 ± 6.148 years. In addition, most laboratory professionals were from governmental health facilities (118/150; 78.7%). Of the total participants, 60% (90/150) had experience of three to five years, and almost all were technical staff (Table 1).

Table 1. Socio-demographic characteristics of study participants working in public and private Health Facilities in Hossana Town, Central Ethiopia, 2024.

Variables	Categories	Frequency	Percentage
	20-30 years	102	68
	31-40Years	37	24.7
Age group	41-50 years	7	4.7
	>50 years	4	2.7

Variables	Categories	Frequency	Percentage
Gender	Male	104	70.7
	Female	44	29.3
Type of organization	Government	118	78.7
	Private	32	21.3
Service year	1-2	11	7.3
	3-5	90	60
	6-8	38	25.3
	9-11	6	4
	>11	5	3.3
Education status	Diploma	49	32.7
	Degree	97	64.7
	Masters, and above	4	2.7
Role	Laboratory head	5	3.3
	Quality officer	4	2.7
	Safety officer	6	4
	Technical staff	135	90

3.2. Laboratory Professions Satisfaction

In the present study, 65.3%(98/150) of laboratory professionals were dissatisfied with their work. Satisfaction was significantly associated with the presence of a continuous professional development program ($\chi2$=6.6, p =0.01), staff recognition ($\chi2$=5.13, p =0.023), and salary ($\chi2$=6.29, p =0.012).

3.3. Factors Associated With Quality Laboratory Service

Bivariate and multivariate logistic regression analyses assessed the association between dependent and independent variables. Laboratory staff communication with a clinician, workload, training availability, verification of laboratory results, regular internal quality control, and participation in EQA program results were significantly associated with quality laboratory services. The other factors were not significantly related to the presence of quality laboratory services.

After adjusting for potential confounders, laboratory staff who lacked effective communication with physicians were three times more likely to experience poor-quality laboratory services than those with effective communication (AOR = 3.30, CI: 1.44-7.54, p=0.005). Additionally, health facilities with high workloads were more likely to encounter poor-quality laboratory services than those with lighter workloads (AOR = 6.68, CI: 2.36-18.86, p = 0.00). Another significant risk factor is the absence of a system for verifying laboratory results. Health facilities without a verification system for laboratory results are 2.69 times more likely to experience poor-quality laboratory service (AOR = 2.69, CI: 1.15-6.25, p=0.022).

Regarding the availability of refreshment training, health facilities with fewer training opportunities are 2.33 times more likely to deliver poor-quality laboratory services than those with better training opportunities (AOR = 2.33, CI: 1.03-5.24, p=0.042). Additionally, laboratories that do not conduct regular IQC are 3.56 times more likely to experience poor quality laboratory service than those with regular quality control activities (AOR = 3.56, CI: 1.43-8.83, p=0.006). Furthermore, health facilities with weak EQA practices are more likely to provide substandard laboratory services than those with strong EQA programs (AOR = 4.39, CI: 1.62-11.93, p=0.004). The Hosmer-Lemeshow (HL) goodness-of-fit test (GOF) indicates that the multivariate logistic regression model for the quality of laboratory service fits well (HL $\chi2$ = 4.34, df = 8, p = 0.83) (Table 2).

Table 2. Bivariate and Multivariate Logistic Regression Analysis for Quality Laboratory Service among Health Facilities in Hossana Town, Central Ethiopia, 2024.

Variables		Quality Laboratory service		Bivariate and multivariate analyses	
		Yes	No	COR (95% CI)	AOR (95% CI)
Knowledge of laboratory quality system essentials	Yes	73(67.6%)	35(32.4%)	1	
	No	24(57.1%)	18(42.9%)	1.56(0.75-3.25)	
Communication with Physician	Yes	65(75.6%)	21(24.4%)	1	
	No	32(50%)	32(50%)	3.09(1.55-6.19)	3.30 (1.44-7.54)*
Communication with upper management	Yes	69(65.7%)	36(34.3%)	1	
	No	28(62.2%)	17(37.7%)	1.16(0.56-2.40)	
Communication among laboratory staff	Yes	64(65.3%)	34(34.7%)	1	
	No	33(63.5%)	19(36.5%)	1.08(0.54-2.19)	
Satisfaction of Laboratory staff with their salary	Yes	53(68.8%)	24(31.2%)	1	
	No	44(60.3%)	29(39.7%)	1.46(0.74-2.85)	
Employees recognition	Yes	48(58.5%)	34(41.5%)	1	
	No	49(72.1%)	19(27.9%)	0.55(0.28-1.09)	
Continuing education program	Yes	51(75%)	17(25%)	1	
	No	46(56.1%)	36(43.9%)	2.35(1.17-4.73)	

Table 2. Continued.

		Yes	No		
Availability of refreshment training	Yes	64(73.6%)	23(26.4%)	1	
	No	33(52.4%)	30(47.6%)	2.15(1.03-4.55)	2.33(1.03-5.24)*
Job descriptions	Yes	61(64.9%)	33(35.1%)	1	
	No	36(64.3%)	20(35.7%)	1.03(0.51-2.05)	
Availability of quality equipment	Yes	61(72.6%)	23(27.4%)	1	
	No	36(54.5%)	30(45.5%)	2.21(1.12-4.37)	
Availability of quality reagents and supplies	Yes	26(53.1%)	23(46.9%)	1	
	No	71(70.3%)	30(29.7%)	0.48(0.24-0.97)	
Laboratory workload	Yes	40(56.3%)	31(43.7%)	2(1.02-3.96)	6.68(2.36-18.86)*
	No	57(72.2%)	22(27.8%)	1	
Patient satisfaction survey	Yes	55(64%)	31(36%)	1	
	No	42(65.6%)	22(34.4%)	0.93(0.47-1.83)	
Available quality manual	Yes	51(63%)	30(37%)	1	
	No	46(66.7%)	23(33.3%)	0.85(0.43-1.67)	

Table 2. Continued.

				COR	AOR
Utilization of personnel protective equipment	**Yes**	**50(67.6%)**	**24(32.4%)**	**1**	
	No	**47(61.8%)**	**29(38.2%)**	**1.29(0.66-2.52)**	
Availability of the Standard test request	Yes	51(63%)	30(37%)	1	
	No	46(66.7%)	23(33.3%)	0.85(0.43-1.67)	
Uninterrupted diagnostic service	Yes	47(61.8%)	29(38.2%)	1	
	No	50(67.6%)	24(32.4%)	0.78(0.39-1.52)	
Perform laboratory quality improvement activities.	Yes	56(64.4%)	31(35.6%)	1	
	No	41(65.1%)	22(34.9%)	0.97(0.49-1.91)	
Result report within Turna-round Time (TAT)	Yes	54(64.3%)	30(35.7%)	1	
	No	43(65.2%)	23(34.8%)	0.96(0.49-1.89)	
Participation in EQA programs	Yes	59(75.6%)	19(24.4%)	1	
	No	38(52.8%)	34(47.2%)	2.78(1.39-5.56)	4.39(1.62-11.93)*
Regular internal quality control (IQC)	Yes	60(75.9%)	19(24.1%)	1	
	No	37(52.1%)	34(47.9%)	2.78(1.32-5.83)	3.56(1.43-8.83)*
Verification of laboratory results	Yes	55(75.3%)	18(24.7%)	1	
	No	42(54.5%)	35(45.5%)	2.55 (1.27-5.11)	2.69(1.15-6.25)*
Adherence to the SOP	Yes	53(63.1%)	31(36.9%)	1	
	No	44(66.7%)	22(33.3%)	0.86(0.43-1.68)	

COR: Crude Odds Ratio, AOR: Adjusted Odds Ratio, CI: Confidence Interval, * statistically significant at $p < 0.05$.

4. Discussions

In a clinical laboratory, quality is the result of thorough and well-coordinated efforts to achieve quality goals. Lack of reliability in clinical laboratory services is the main obstacle to providing high-quality healthcare in sub-Saharan Africa [8]. In developing nations, inadequate laboratory infrastructure and limited access to reliable diagnostic services present significant challenges to high-quality diagnosis, resulting in suboptimal treatment, increased morbidity rates, and inaccurate assessments of disease burden [10]. Quality service also encompasses effectiveness, patient safety, equity, timeliness, patient-centeredness, and efficiency [11].

The current study shows an association between laboratories' professional satisfaction and the presence of continuous professional development. In line with the current study, a study done in seven countries in Sub-Saharan Africa indicated that the major reason for leaving the job is the lack of opportunities for professional development [12]. There exists a significant need for a continuous professional development program that focuses on the quality management system, competency assessment, and customer care among medical laboratory personnel [13]. Research has demonstrated that continuous professional development enhances job performance and satisfaction; augments skills, knowledge, and competencies; and fosters a positive work environment for healthcare professionals [14].

The results of this study demonstrate a significant correlation between laboratory professionals' job satisfaction and staff recognition. Consistent with these findings, a study conducted in Ethiopia reported similar outcomes [15]. In a system characterized by limited resources and diverse categories of health workers, recognition serves to enhance intrinsic motivation and promote improved teamwork, motivation, and performance among health professionals [16]. It also improves the work environment [16]. In these under-resourced health facilities in underdeveloped countries, the quality of laboratory service was significantly compromised due to a lack of appropriately designed laboratory rooms, insufficient training, inadequate infrastructure, shortage of laboratory supplies, absence of effective maintenance services, and lack of monitoring mechanisms [17].

Furthermore, job satisfaction was significantly correlated with salary among laboratory professionals. This finding was corroborated by results from a study conducted among health professionals employed at Jimma University Specialized Hospital [18] and a study done among health workers at six

government hospitals in Addis Ababa, Ethiopia [19]. The low level of job satisfaction among healthcare workers was reported as an important factor affecting the effectiveness of the healthcare system and the quality of care they provide [20]. Moreover, non-monetary performance incentives can positively and significantly influence healthcare worker effectiveness, coordination, and teamwork, improving health behaviors and outcomes [21].

The current research illustrated the possible association between physician communication and quality laboratory service. This finding is supported by findings from a study done among government comprehensive specialized hospitals in northwest Ethiopia [18] and a study done in Pakistan [19]. Without adequate feedback systems and communication, laboratory personnel are more likely to deliver poor-quality services and be unable to improve the quality of services provided [20]. To improve clinicians' attitudes on the reliability of diagnostic tests, increase the use of laboratory diagnostics, and ultimately improve patient care, it is imperative to improve the professional communication and relationships between laboratory personnel and physicians [21].

This research highlighted the significant association between laboratory workload and the quality of laboratory service. This finding is supported by a report from a study done in Northwest Ethiopia [18]. Moreover, a study done in Ethiopia reported a possible association between workload and workplace stress [22]. Work stress, in turn, affects job satisfaction, staff turnover, and performance among healthcare workers [23]. Significant absence or departure rates seem to be linked to workloads and unbalanced job distribution [24]. The present study also shows a significant association between result verification and the quality of laboratory service. Verifying clinical laboratory results can improve error detection and process efficiency for improving patient safety [25].

The other finding from the present study was the significant association between participation in external quality assurance and quality laboratory service. This result corroborates other studies that found a possible association between external quality assurance and quality laboratory service [26]. The effectiveness of a laboratory service is enhanced by an external quality assurance program [26], which maximizes the general quality of a healthcare system regarding performance evaluation, patient outcome, and overall laboratory service [27]. However, according to a study conducted in Ethiopia, the laboratory's overall proficiency testing performance was low, and the main contributing factor to the low-quality service was the failure to take remedial action for proficiency testing nonconformance [28].

The current study revealed that conducting regular internal quality control was a significant predictor of quality laboratory service. A study conducted in Pakistan, similar to this finding, reported the association between regular quality control and quality laboratory service [19]. Implementing internal quality control is one of the major prereq-

uisites for laboratory service accreditation [29], and laboratory service accreditation might be a useful tool for enhancing the health system, which would have long-term advantages for the sustainability, cost-effectiveness, and quality of public health programs [30]. However, a study conducted in Tanzania reported that most health facilities do not perform internal quality control [10].

5. Conclusions

The satisfaction of laboratory professionals was significantly influenced by continuous professional development programs, staff recognition, and salary. In the study area, key factors determining the quality of laboratory services include communication with physicians, refresher training, result verification, laboratory workload, participation in EQA programs, and regular internal quality control.

Abbreviations

AOR	Adjusted Odds Ratio,
COR	Crude Odds Ratio,
CI	Confidence Interval
EQA	External Quality Assessment
IQC	Internal Quality Control
OR	Odds Ratio

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Belete T, Meless H, Kassu A, Tesema D, Gezahegn N, Tamene W, et al. Laboratory services in hospitals and regional laboratories in Ethiopia. *The Ethiopian Journal of Health Development*. 2004; 18(1).

[2] Carter JY, Lema OE, Wangai MW, Munafu CG, Rees PH, Nyamongo JA. Laboratory testing improves diagnosis and treatment outcomes in primary health care facilities. *African journal of laboratory medicine*. 2012; 1(1): 1-6.

[3] Price CP, St John A, Christenson R, Scharnhorst V, Oellerich M, Jones P, et al. Leveraging the real value of laboratory medicine with the value proposition. *Clinica Chimica Acta*. 2016; 462: 183-6.
https://doi.org/10.1016/j.cca.2016.09.006

[4] WHO. Delivering Quality Health Services: A Global Imperative: OECD Publishing; 2018.

[5] Tsimillis KC, Michael S. Accreditation of medical laboratories: What is new in ISO 15189: 2022. *Accreditation and Quality Assurance*. 2024; 29(2): 175-82.
https://doi.org/10.1007/s00769-024-01576-z

[6] Kassu A, Aseffa A. Laboratory services in health centres within Amhara region, north Ethiopia. *East African medical journal*. 1999; 76(5).

[7] Carter J. Role of laboratory services in health care: the present status in Eastern Africa and recommendations for the future. *East African medical journal*. 1999; 76(5).

[8] Petti CA, Polage CR, Quinn TC, Ronald AR, Sande MA. Laboratory medicine in Africa: a barrier to effective health care. *Clinical Infectious Diseases*. 2006; 42(3): 377-82. https://doi.org/10.1086/499363

[9] Hiwotu TM, Ayana G, Mulugeta A, Kassa GB, Tibesso G, Desale A, et al. Laboratory system strengthening and quality improvement in Ethiopia. *African journal of laboratory medicine*. 2016; 5(2): 1-6. https://doi.org/10.4102/ajlm.v3i2.228

[10] Kinyenje E, Ngowi RR, Msigwa YS, Hokororo JC, Yahya TA, German CJ, et al. Status of countrywide laboratory services quality and capacity in primary healthcare facilities in Tanzania: Findings from Star Rating Assessment. *PLOS Global Public Health*. 2023; 3(10): e0001489. https://doi.org/10.1371/journal.pgph.0001489

[11] Chawla R, Goswami B, Singh B, Chawla A, Gupta VK, Mallika V. Evaluating laboratory performance with quality indicators. *Laboratory Medicine*. 2010; 41(5): 297-300. https://doi.org/10.1309/LMS2CBXBA6Y0OWMG

[12] Marinucci F, Majigo M, Wattleworth M, Paterniti AD, Hossain MB, Redfield R. Factors affecting job satisfaction and retention of medical laboratory professionals in seven countries of Sub-Saharan Africa. *Human resources for health*. 2013; 11: 1-7. https://doi.org/10.1186/1478-4491-11-38

[13] Kasvosve I, Ledikwe JH, Phumaphi O, Mpofu M, Nyangah R, Motswaledi MS, et al. Continuing professional development training needs of medical laboratory personnel in Botswana. *Human resources for health*. 2014; 12: 1-8. https://doi.org/10.1186/1478-4491-12-46

[14] Aldhafeeri FFT, Aldhafeeri FNS, Aldhafeeri SSA, Alenezi NMG. Investigating the impact of continuous professional development on the performance and job satisfaction of laboratory technicians and specialists. *Chelonian Research Foundation*. 2022; 17(2): 3902-9. https://doi.org/10.18011/2022.04(1) 3902-3909

[15] Asres GD, Gessesse YK. Healthcare setting staff satisfaction in Ethiopia: Systematic review and meta-analysis. *Public Health Challenges*. 2024; 3(1): e143. https://doi.org/10.1002/puh2.143

[16] Grant C, Nawal D, Guntur SM, Kumar M, Chaudhuri I, Galavotti C, et al. 'We pledge to improve the health of our entire community': Improving health worker motivation and performance in Bihar, India through teamwork, recognition, and non-financial incentives. *PLoS One*. 2018; 13(8): e0203265. https://doi.org/10.1371/journal.pone.0203265

[17] Belete Tegbaru BT, Hailu Meless HM, Afework Kassu AK, Desalegn Tesema DT, Negussie Gezahegn NG, Wegene Tamene WT, et al. Laboratory services in hospitals and regional laboratories in Ethiopia. 2004.

[18] Nigatu T, Deress T, Mezgebu B, Adane K. Determinants of Quality Laboratory Service Provision among Government Comprehensive Specialized Hospitals in Northwest Ethiopia. 2024. https://doi.org/10.21203/rs.3.rs-4789250/v1

[19] Rasheed FA, Siddiqui MW. Factors affecting the quality of laboratory services in public health facilities in Karachi. *Pakistan Journal of Medical and Health Education*. 2023; 3(2): 70-4.

[20] Biadgo B, Zakir A, Malede T, Getachew E, Girma M. Assessment of Quality of Medical Laboratory Services Provision and Associated Factors in Public Health Facilities at Gondar Town, Amhara Regional State, Northwest Ethiopia. *Clinical Laboratory*. 2019; 65(6). https://doi.org/10.7754/Clin.Lab.2018.181037

[21] Johnson SR. Improving Patient Safety Through Enhanced Communication Between Emergency Department Clinicians and Medical Laboratory Staff. *JCOM*. 2013; 20(10).

[22] Birhanu M, Gebrekidan B, Tesefa G, Tareke M. Workload determines workplace stress among health professionals working in Felege‐Hiwot Referral Hospital, Bahir Dar, Northwest Ethiopia. *Journal of environmental and public health*. 2018; 2018(1): 6286010. https://doi.org/10.1155/2018/6286010

[23] Chao M-C, Jou R-C, Liao C-C, Kuo C-W. Workplace stress, job satisfaction, job performance, and turnover intention of health care workers in rural Taiwan. *Asia Pacific Journal of Public Health*. 2015; 27(2): NP1827-NP36. https://doi.org/10.1177/1010539513506604

[24] Bonert M, Zafar U, Maung R, El-Shinnawy I, Naqvi A, Finley C, et al. Pathologist workload, work distribution, and significant absences or departures at a regional hospital laboratory. *Plos one*. 2022; 17(3): e0265905. https://doi.org/10.1371/journal.pone.0265905

[25] Randell EW, Yenice S, Wamono AAK, Orth M. Autoverification of test results in the core clinical laboratory. Clinical biochemistry. 2019; 73: 11-25. https://doi.org/10.1016/j.clinbiochem.2019.08.002

[26] Mourtzikou A, Stamouli M, Athanasiadi E. Improvement of Clinical Laboratory Services through Quality. *International Journal of Reliable and Quality E-Healthcare (IJRQEH)*. 2013; 2(2): 38-46. https://doi.org/10.4018/ijrqeh.2013040103

[27] Yerram S, Sripad DV, Prabodh VS. External Quality Assurance Scheme (EQAS): Criteria for evaluating performance of a laboratory. *IOSR J Biotechnol Biochem*. 2018; 4(4): 16-20. https://doi.org/10.9790/264X-0404011620

[28] Gurmessa A, Sisay A. Proficiency test feedback utilization at government hospitals laboratory, Addis Ababa, Ethiopia. *J Med Diagn Meth*. 2017; 6(258): 2. https://doi.org/10.4172/2168-9784.1000258

[29] Wadhwa V, Rai S, Thukral T, Chopra M. Laboratory quality management system: road to accreditation and beyond. *Indian journal of medical microbiology*. 2012; 30(2): 131-40. https://doi.org/10.4103/0255-0857.96647

[30] Peter TF, Rotz PD, Blair DH, Khine A-A, Freeman RR, Murtagh MM. Impact of laboratory accreditation on patient care and the health system. *American journal of clinical pathology*. 2010; 134(4): 550-5. https://doi.org/10.1309/AJCPH1SKQ1HNWGHF