

REGULATORY FRAMEWORK IN PAKISTAN: ANALYSIS OF MEDICAL LABORATORY FACILITIES, QUALITY ASSURANCE AND FUTURE RECOMMENDATION

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Submitted May 16, 2025; Revised July 12, 2025; Accepted July 17, 2025; Published September 20, 2025

ABSTRACT

The regulatory framework for clinical laboratories in Pakistan is essential for monitoring the reliability and quality of demonstration services, which are essential for the effective provision of healthcare. To enhance comprehension of the functioning of clinical research institutes throughout the country, an exhaustive assessment of the current administration should be considered. The article focuses on strategies for affirming the quality of the administrative structure. An essential part of running a research center is quality confirmation i.e. internal and external quality assessment, which incorporates all the means and techniques that ensure ideal, accurate, and reliable test discoveries. The difficulties encountered by research centers in following these standards are wrapped up in the article, with an emphasis on field locations with few assets.

It also examines the shortcomings and inadequacies of the current management system. The implementation of directives is particularly costly and fraught with conflict, even if there are only a few administrative organizations. Patient safety and the overall profitability of medical care have been jeopardized by undisputed cases of inadequate duplication of research facilities. The article stresses that it is essential to have a more complete and coordinated administrative structure that can provide a unified attitude and support to research centers in general throughout the country. The article contains a number of recommendations for the future that are planned to work on the management system and raise the expectations of the administrations of the research centers in Pakistan due to these problems. By implementing the proposed improvements and aiming to address existing shortcomings, the nation can strengthen the effectiveness of its medical care framework and work on the strength of its peoples.

Keywords: Laboratory Facilities, Quality Assurance, Medical Laboratory Infrastructure.

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INTRODUCTION

Clinical laboratories are pivotal in modern medicine, transforming medical laboratory technology into a rapidly expanding

scientific field [1]. The first official, fully functional clinical laboratory for the evaluation of human bodily fluids was

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established in 1896 at the Johns Hopkins Hospital in Baltimore [2]. Founded in 1957, the West Pakistan National Health Faculty was the first institution to provide certificates and diplomas in laboratory medicine. The School of Health Technology came next in 1961 [3]. Established at Pakistan's National Medicine Laboratories (now National Institute of Health), the first School of Medical Technology offered a one-year diploma in medical laboratory Technology (MLT) [4]. Early in the 1970s, the Jinnah Graduate Medical Institute in Karachi hosted a medical laboratory technology bachelor's degree program started by the Pakistani government. Later on, this two-year program was expanded to a four-year BS (Hons.) program in clinical laboratory science and medical laboratory technology. Students pursuing a degree in medical laboratory science have many career options in a variety of healthcare fields [3]. In Pakistan, the standard of laboratory services provided by both public and private healthcare facilities, especially in large metropolitan centers, has been an issue for a while [5]. Effective patient care, disease management, and public health surveillance all depend on accurate and trustworthy diagnostic testing. The nation's laboratory facilities have struggled to meet the required standards, leading to insufficient healthcare results [5]. The goal of the twenty-first century is to make healthcare systems patient-centered, unbiased, competent, and efficient. While laboratory science is essential for diagnosis, treatment, prevention, patient care and treatment present challenges [6]. There are constant discussions about service quality and customer satisfaction because of the high cost of medical care and the absence of standardization in Pakistani medical services. In the healthcare industry, there are two franchise networks—Green Star and Green Key—but local investors are primarily responsible for most franchise sales. In spite of Pakistan's growing need for health care services, there are currently

no foreign players in this market. While developed nations spend five to fourteen percent of their GDP on health care, we only spend 2.8 percent [7].

The primary objective of this review is to gather and evaluate reports, scientific publications, and other published evidence that can be useful in describing the state of the nation regarding medical laboratories facilities, quality assurance. The study aims to assess the enhancement of test results quality by National External Quality Assessment Programme (NEQAPP) in Pakistan.

SITUATION IN PAKISTAN

Like many developing nations, Pakistan encounters substantial obstacles in maintaining the quality of laboratory services. In countries such as Pakistan, where the cost of medical testing and treatment is an important concern for the normal public, prompt diagnosis can help reduce costs and lower the burden of disease on an already strained health system. The accuracy of lab results is essential for the confidence of clinicians, as well as for the timely and accurate diagnosis and treatment of patients and avoid errors in analysis [8]. In 1966 the National Institute of Health (NIH) and the Armed Forces Institute of Pathology (AFIP) in an effort to reduce the chance of mistakes in laboratory results, as well as to include and encourage the standardization of clinical laboratory practices procedures in Pakistan by offering reasonably priced outside quality control offerings. It also aims to meet regulatory and accreditation requirements while delivering improved patient care and high-quality clinical lab results in Pakistan and it includes 181 labs [9].

MEDICAL LABORATORY SECTORS OF PAKISTAN

The public and private sectors in Pakistan each provide 9.31 and 24.80 US dollars per person, respectively [10]. Pakistan's government established the Allied Health Professionals Council (AHPC) in April 2023 to regulate the professional conduct,

education, and training of allied health professionals, including laboratory technologists [11]. Pakistan allocates a mere gross domestic product (GDP) of 0.5% to healthcare. Pakistan National Accreditation Council (PNAC) and Pakistan Standards and Quality Control Authority (PSQCA) are two organizations that pass through the ministrative and science technology MoST's administrative purview [12]. In 2000 Pakistan Standards and Quality Control Authority (PSQCA) was formed.

REGULATORY INFRASTRUCTURE FOR MEDICAL LABORATORIES

The main obstacles that laboratory services face in developing countries are inadequate people, poor facilities, and the absence of laboratory procedures, strategic plans, and consolidated national management systems for quality. In countries with limited resources, national laboratories experience a steep reduction in infrastructure with each consecutive laboratory tier, and national governments have a distributed role in overseeing these laboratories. The physical structure of laboratories will see fewer upgrades throughout time, including maintenance of currently constructed buildings and the construction of much-needed new facilities [13].

To lower mistakes in handling data, analyzing it, and display, technological breakthroughs in performance metrics are needed. Though technology can support External Quality Assessment program (EQAP), its implementation is often challenging and might yield less than optimal results. Organizational traits, leadership, and political and economic issues are only a few of the numerous variables that affect how these technologies are implemented. Equipment and laboratory reagents are the first necessities for the supply of clinical laboratory services. In low-income countries, about 50 and 96% of medical equipment is broken or not in use, depending on the institution. The difficulties in implementing EQA Programme include aging equipment,

incorrect handling and use of medical devices, frequent power outages, inadequate operator training, a lack of preventive care, a shortage of spare parts, inadequate maintenance capacity, and a lack of knowledge about advanced technology are contributing factors to breakdowns in equipment [13].

Scientific progress is predicated on the idea that measurements should be repeatable, or that researchers in different labs with comparable infrastructure, resources, and experience should be able to reproduce published work's findings with a reasonable degree of confidence. They should also allow investigators in other labs to replicate the experiment under identical conditions and corroborate or refute the results. However, it was brought attention to a crisis in scientific reproducibility, and a lack of transparency in presenting can result in uncertainty in the planning of experiments, data collection, processing, and interpretation [14].

The necessity to find innovative instruments that are efficient in lowering mistake rates and improving patient safety has come to the attention of laboratory professionals and scientific associations working in laboratory medicine throughout the world. In 2009, the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) Working Group "Laboratory Errors and Patient Safety" (WG-LEPS) executed a Model of Quality indicators (MQI) for use in medical laboratories worldwide with the goal of enhancing activities designed to control and measure the quality of laboratory performance [15].

SIGNIFICANCE OF QUALITY ASSURANCE IN MEDICAL LABORATORIES

Role of Medical Laboratories in Disease Diagnosis and Management

Lab testing is a major component of current healthcare institutions. Test results offer unbiased data to assist in clinical decision-making, which can lead to more effective interventions and improved patient

outcomes. Furthermore, a significant contributor to diagnostic errors is the lack of processes in many systems for monitoring missed or delayed results, and lack of communication between patients and physicians is another issue. The failure to follow up on lab results that result in missed diagnoses has major implications for patient safety, according to a 2011 systematic review about missing test results in acute care in the past few decades, a great deal of work has been done to improve the safety and quality of laboratory testing procedures by getting rid of mistakes that can arise during the request, analysis, reporting, and interpretation stages of the process. Still, 12% of errors are thought to happen prior to the material being collected and handled at the lab, and 5% happen after the findings are generated and forwarded to the provider who made the request [16].

Primary care practices are the backbone of many healthcare systems and offer the majority of medical care in most nations. Because laboratories are typically located on-site at hospitals, it is easier to adhere to best practices, which guarantees patient safety and quality of care. In primary care settings, however, laboratory testing procedures are typically dispersed, with various activities carried out at various sites by various staff members and physicians [16].

The procedure for laboratory testing is intricate and involves a number of tasks. The total testing process (TTP) consists of nine steps: 1) placing the test order; 2) gathering the sample; 3) identifying; 4) transporting; 5) preparing the specimen; 6) conducting the test 7) reporting, 8) deciphering the outcome, and 9) the provider's course of action with the patient. Depending on the infrastructure and environment, steps 1 through 7 may happen in a different order. The pre-analytical phase, which consists of activities before laboratory work, the intra-analytical phase, which consists of laboratory work, and the post-analytical phase, which consists of activities after laboratory work, generally

make up the testing process. The primary responsibilities include filling out a lab request form, verifying the patient's identity, gathering the biological specimen appropriately, identifying the samples that are gathered, labeling them for processing, and sending them to the lab. After that, the lab personnel sorts and gets the specimens ready for the intra-analytical stage. The post-analytical step starts when the laboratory personnel enters, checks, and approves the results being sent back to the requesting clinician after the tests have been completed in the lab. The residual error rates for the pre- and post-analytical stages are 2.2% and 2%, respectively [16]. Value measurements need to be well defined and standardized in order to eloquently illustrate the importance of lab medicine across clinical settings. The Working Committee on the Impact of Laboratory Medicine on Clinical Administration and Outcomes (TF-ICO) of the International Federation for Clinical Chemistry and Laboratory Medicine (IFCC) was founded in 2012 with the goals of "evaluating the available evidence that promotes the impact of laboratory medicine in healthcare, and developing study design for new retrospectively and prospective studies capable of providing evidence of the contribution made by laboratory medicine." Key instances of evidence that promotes the value of lab testing were provided in a review by TF-ICO. These examples included risk stratification (cardiovascular disease, for example), diagnosis (kidney disease, infection), treatment selection (pharmacogenetics, antibiotics), and screening (prenatal and cancer, for example) [17].

Impact of Quality Assurance on Patient Outcomes

There is bias in the data provided by different labs using the same testing equipment, patients may receive the wrong diagnosis. Adopting EQA programs can reduce this risk when these inconsistencies are identified using commutable samples.

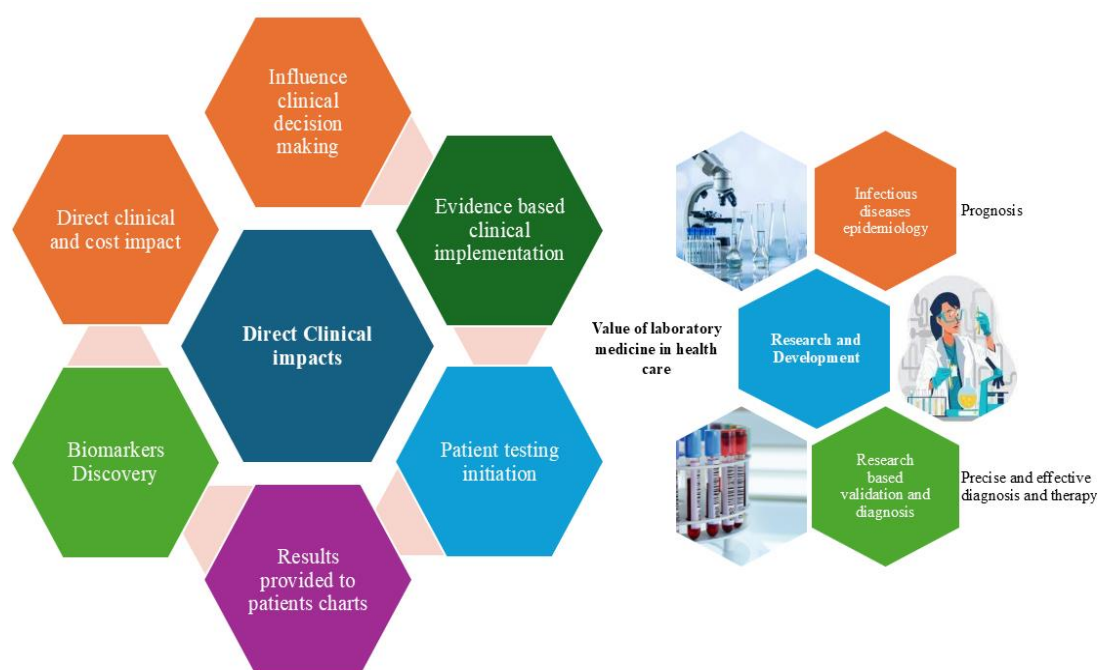


Figure 1: Overview of the significance of laboratory medicine in the clinical decisions and patient care and research and development in clinical prognosis, diagnosis and therapeutics.

Variances can be caused by particular laboratory processes, variances in analytical specificity, imprecision in the test, or the repeatability of the calibrators. However, the enormous number of samples needed for plenty of collaborating laboratories limits the amount of optimal EQA material that can be prepared. Furthermore, the staining capability assessment becomes more challenging as the quality of the stained smear images declines. The selection of assay material for cell counting machines presents another difficulty in providing EQA for laboratory testing. Moreover, participating institutions are not allowed to employ EQA goods as controls for testing because they are not authorized control materials. The two primary elements of an effective EQA program are the use of verified easily reachable samples and the assignment of a target value calculated via a reference measurement procedure or by comparing with an authorized reference material. The EQA sample is deemed commutable when results from multiple methods are equivalent to those using patient specimens with an equal number of analytes. Large samples volumes, a broad range of measure

concentrations, and sample stability requirements have forced providers to use stabilizer-treated materials augmented with non-human materials, resulting in EQA samples that cannot be interchanged with real clinical samples. In the absence of readily accessible samples, technique accuracy cannot be evaluated. It is difficult to assign a goal measurement for noncommutable EQA samples [13].

Quality Assurance Program

The term “quality” is primarily used to check reliability of performance of Medical laboratories [15]. Quality Management System (QMS) can be divided into quality control (QC) and quality assurance (QA). Quality assurance program comprises of External Quality Assessment (EQA) and internal quality control (IQC). These two are essential elements for process optimization, quality control, and the delivery of high-quality medical care [13]. As per the ISO 9000 (2015) standard, quality assurance (QA) deals with the tasks that the laboratory performs to guarantee that the quality requirements will be met, while quality control (QC) specifies the specific actions that are taken to verify and document that the standards have been met.

CITAC (the Cooperation on International Traceability in Analytical Chemistry) and EuraChem (A Focus for Chemical Analysis in Europe) have both adopted these definitions (Barwick, 2020). Generally speaking, QC procedures are used both during and after data acquisition, and QA procedures are used both before and during data acquisition. To be more precise, quality assurance (QA) is concerned with procedures and methods that guarantee high-quality output. Standardized training, instrument system suitability tests (SSTs), calibration, employing high-quality, verified standard operating procedures (SOPs) that are documented and used throughout the study, and conducting routine lab audits are a few instances of quality assurance (QA). Measures or observations made to objectively show that the quality process of management has been completed are called quality control measures (QC measurements). Analyzing QC samples such reference standards, duplicate extracted samples, pooled samples, and blanks are a few examples of QC measurements, but they are not the only ones [14].

A good laboratory is ensured by participation in and enhancement of analytical quality through EQA. The EQA is a system that compares the overall performance of a laboratory to the expected standard standards of a particular profession on a periodic basis. It assesses linearity, trueness, and intra- and interlaboratory variances; it makes technique distinctions; and it monitors continuous harmonization initiatives. It is a procedure whereby commutable samples are routinely delivered to laboratories in a group for analysis. The results are then reported back to the participating laboratories and compared to a given value, the anticipated target value, or other laboratories in the group. Due to the fact that most laboratory tests are completed and most laboratory workers are familiar with the technique, proficiency testing (PT) is the most frequent way to implement this.

External quality evaluation is the foundation of a laboratory's entire quality management system (QMS), which is required by the Clinical and Laboratory Standard Institute and an International Organization for Standards and Technologies (ISO) 15189 accreditation [13].

EQA suppliers are required by ISO/IEC 17043 to establish and supervise certain conditions in order to preserve the accuracy of the EQA specimens during transportation. It needs to be packaged according to national and international hazardous material regulations. It is recommended to employ these packing methods and to periodically verify the transportation temperature of packages comprising EQA samples using indicator strips [13].

Interventions for Delivery of Quality Results

The effective provision of healthcare services is contingent upon the evaluation, harmonization, and remediation of laboratory service quality. The external quality evaluation guarantees the validity of test results and attempts to address any deficiencies through interlaboratory comparisons. An efficient EQA program is ultimately responsible for all the actions and processes carried out in medical laboratories to increase the consistency of test results. EQA covers employee training, reagent and equipment acquisition and maintenance, analytical processes, result reporting, and interpretation in order to ensure quality. An international standard that outlines management standards and requires EQA providers to set up and manage these kinds of programs has been developed. However, national and international QMSs have lately been used by public health laboratories in resource-constrained nations to provide quality laboratory services, including participation in EQA initiatives. Nonetheless, there is a lack of awareness in underdeveloped nations on the importance of implementing high-quality laboratory testing for patient

care. Governments must thus recognize the importance of laboratory testing and provide enough funds to guaranteeing quality. Establishing a national quality assurance program, fostering the development of local program management expertise, and encouraging local competency test item preparation whenever feasible are all necessary to accomplish this goal [13]. Other scientists may feel more confident reproducing the results or using the data in additional research, whether directly (shared data) or by inference (meta-analysis), if the analytical methods used are clearly reported and the laboratory practices are transparent [14].

SCOPE AND SIGNIFICANCE

Relevance of the Study for Stakeholders

Reports of evaluation and proper staff participation are essential to an efficient EQA. In order to alert the laboratory to any performance issues, it is expected that EQA suppliers will keep the department head informed and contact with them. Any new challenges should be communicated to general laboratory staff, along with information about the laboratory's performance. Channels of communication regarding EQA performance and challenges in laboratories must be established. Unfortunately, the main obstacle to implementing an EQA program is that most staff members lack the necessary knowledge and experience and do not completely comprehend the purpose of PT, which makes it difficult to identify deficiencies based on EQA feedback. In addition to a lack of strategic plans, comprehensive national quality management systems, and laboratory regulations, institutional constraints influencing the delivery of EQA include a lack of competent personnel and inadequate facilities. While these challenges hinder the effective use of PT, neither national central laboratories nor regulatory authorities are responding to them; this may be because the poor performance of the laboratory escapes the regulatory bodies' notice [13].

Impact on Healthcare Quality and Patient Safety

A strategy to improve the quality of technology-based health services is an approach that aims to increase efficiency, effectiveness and overall quality of services provided to patients. Conceptually, this strategy involves the communication technology and application of information in various aspects of health services, from patient data management to the development of clinical decision support systems. The technology not only supports more precise and faster decision making by health workers, but also facilitates better access to health information for patients. Patient satisfaction reflects patients' positive perceptions of their experience in receiving health services, while patient safety refers to efforts to prevent unwanted injuries or complications during the medical care process. Patient satisfaction is an indicator of the success of quality management strategies. There is a substantial correlation between patient satisfaction and pharmacist performance, and this correlation is mediated by the pharmacist's performance in the patient safety culture. In addition, it showed a direct correlation between the safety of patients and family contentment, suggesting that elevated patient safety levels raise family member satisfaction levels. Additionally, researchers supported a positive relationship between patient safety initiatives and patient satisfaction, highlighting that strong safety practices lead to increased levels of patient satisfaction. Overall, these findings demonstrate a strong interdependence between patient satisfaction and patient safety [18].

KEY CHALLENGES AND ISSUES

Medical laboratories are vital to the healthcare system because they offer fast, reliable diagnostic data that is needed for illness detection, management, and prevention. However, there are a number of regulatory and quality assurance issues that

Pakistani medical laboratories must deal with, which reduces their effectiveness and reliability. Medical laboratory technologists are skilled allied health professionals who possess a unique capacity to integrate their expertise in science and medicine with practical abilities in order to perform and interpret clinical laboratory tests. MLTs play a critical role in maintaining the operational effectiveness of clinical laboratories and the efficient provision of healthcare to the general public, as evidenced by the fact that laboratory results influence roughly 70% of choices regarding patient treatment [19].

Nonetheless, compared to other medical disciplines in Pakistan, laboratory medicine faces the difficulty of receiving little recognition for its teaching efforts. Furthermore, a myth has arisen as a result of the growing automation of laboratory procedures: MLTs just manage automated systems and don't participate in the analytical process. Automation streamlines routine operations, but it does not lessen the technical expertise, critical thinking, or troubleshooting talents that MLTs offer to the diagnostic process. This demonstrates the untapped potential of MLTs to make substantial contributions to research, innovation, and integrated clinical management. The workforce in medical laboratory technology is currently confronted with several major challenges, including recruiting and retaining personnel, offering opportunities for career advancement, supplying insufficient educational and professional development opportunities, lacking a standardized curriculum and assessment, and restricting access to ongoing education and training [20, 21].

In light the growing automation and technological advances in the field of lab science, which includes Artificial intelligence and precision engineering, it is essential that new methods be developed in addition to highlighting their specific to the topic specialized training, expertise, and

ability in enhancing the latest advances in technology. This necessitates a wide range of training, including scientific, administration, and managerial development, in order for MLTs to assume a more active part in clinical laboratories [20]. The lack of resources for training and education, however, severely restricts this. MLT training and education have received very little attention in Pakistan. The lack of a certification or regulatory structure that sets it apart from other nationally recognized health fields, such as nursing, medicine, dentistry, and pharmacy, makes it even more difficult for it to keep up with the rapid advancements in technology [22, 23]. To put it simply, Pakistan currently has 7,000 qualified MLTs working there. In clinical laboratories, technicians with less than two years of technical education are employed as a low-cost labor source to help with the persistent shortage of human resources [23].

Moreover, it seems that training programs do not always provide practical, hands-on experience, which makes it harder to apply academic knowledge in real-world situations. Pakistan faces significant challenges in upholding the standard of laboratory services offered by its healthcare system, similar to that of many underdeveloped countries. Reliable diagnostic testing is necessary for disease management, public health surveillance, and efficient patient treatment. Numerous noteworthy issues were identified by the survey, including insufficient resources (64.3%), inadequate management support (57.3%), defective equipment (53.4%), a heavy workload (41.1%), a failure to calibrate equipment (38.3%), and insufficient expertise (23.3%) (Table 1) [24]. The significance of laboratory standardization and accreditation has been acknowledged on a global scale, and numerous nations have put in place national accreditation procedures to guarantee the dependability and quality of laboratory services.

Table 1: Proportion of key issues in the setup of laboratories.

Issue	Percentage%
Resource Shortages	64.3
Excessive Workload	41.1
Substandard Equipment	53.4
Insufficient Knowledge	23.3
Absence of Equipment Calibration	38.3
Inadequate Management Support	57.3

Research on Pakistan's laboratory service quality offers important insights into the major difficulties the healthcare system faces, particularly with regard to diagnosis [24]. The study highlights the value of quality management systems, accreditation, and standardization in raising the dependability and effectiveness of laboratory services, which is essential for improving patient outcomes [25].

FUTURE DIRECTIONS

Clinical laboratories in Pakistan are about to undergo a major change. For these exploration habitats to keep on being significant and capable, they should meet different major necessities, including working on the labor force, authoritative consistency, joining customized medications, and keeping up with the subsequent advancement. In the accompanying areas, these essentials will be analyzed exhaustively.

Innovative Diagnostic Technologies

The worldwide field of clinical exploration establishments is changing because of the introduction of cutting edge indicative developments. These advances need to be used in Pakistani laboratories in order to increase diagnostic efficiency and accuracy. Digital pathology, molecular diagnostics, and next-generation sequencing (NGS) are examples of essential technologies. NGS, for instance, empowers extensive genomic confirmation, which is significant for individualized drugs. High level pathology utilizes man-made intelligence computations and PC supported symbolism to additionally work on the exactness of tissue assessment [26].

Assurance of Quality and Accreditation

It is central to guarantee that clinical exploration organizations follow an elevated degree of significant worth. The consistency of exploration offices as per worldwide standards is guaranteed by the approval of trustworthy affiliation like the College of American Pathologists (CAP) and the International Standardization Organization (ISO). This requires thorough inside surveys, moderate personnel arrangement, and adherence to laid out techniques that work on the dependability of all examination results [27].

Automated Systems and Robotics

To lessen human blunder and increment the capability of the exploration community, mechanical innovation and automated hardware are major. Capability and precision are improved when dull undertakings, for example, breezing through data and dealing with assessments are taken over by automated frameworks. Mechanical arms and automated analyzers accelerate techniques, yet in addition decrease the gamble of mistakes and tainting, guaranteeing more precise outcomes [28].

Collaborative Research Proposals

To stimulate development in symptomatic techniques, public and worldwide establishments ought to be urged to develop a culture of cooperative exploration. Cooperative exploration projects can possibly create new symptomatic instruments and find biomarkers. This sort of association permits labs to do more research and advance science all over the worldwide [29].

Sensitivity to Culture

Clinical labs should perceive and compensate social contrasts in persistent contact. Giving preparation to raise social mindfulness among representatives guarantees respectful and caring correspondence. This works on the general degree of administration conveyance while cultivating great associations with patients [30].

Modernization of Technology

To keep up with advances in clinical diagnosis, technology must be continuously updated. Laboratories can provide state-of-the-art services if funds are allocated to purchase state-of-the-art hardware and software. To remain competitive in the diagnostics industry, it is necessary to keep pace with technological progress [31].

Artificial Intelligence Integration

Clinical determination could be totally different by computerized reasoning (artificial intelligence). Computer based intelligence frameworks can assist with design acknowledgment, prescient investigation, and information translation, which can work on symptomatic effectiveness and exactness. Interests in man-made intelligence empowered innovation put research facilities at the front of advancement and work on their generally demonstrative abilities [32].

Integration of Telemedicine

Admittance to demonstrative offices can be significantly improved by coordinating telemedicine into medical facility administrations, particularly in far off areas. The formation of strong advanced stages that work with correspondence with telemedicine suppliers will empower the dispersal of electronic outcomes and far off meetings. This separates geological boundaries and permits patients to get fast finding and follow-up from anyplace [33].

Patient-First Approach

Dealing with open minded satisfaction and confidence in research place undertakings requires the execution of a patient-driven procedure. This integrates ensuring that examinations are made unequivocally and

quickly, granting effectively, and watching out for patient concerns at the earliest open door. The steadfastness and legitimacy of exploration focus organizations can be exceptionally worked on by giving a smooth and truly zeroing in experience on patients [34].

Effective Management of Supply Chain

The quick conveyance of key reagents and gear is guaranteed by productive store network the board. One method for diminishing disturbance is to lay out dependable stock chains and fall backs. To guarantee that lab activities can go on without interference, collaboration with solid providers and routine stock checks are basic [35].

Future-Reliant Approaches

Establishing protocols for research initiatives with an eye on the future is necessary for long-term similarity. This enables you to monitor global models, focus in on specific areas to observe notable improvements in scope, and adjust to changes. In the developing field of clinical diagnostics, predicting future circumstances and obstacles guarantees the importance and prosperity of exploratory habitats in the future [36].

CONCLUSION

In order for the Pakistan's medical laboratories centers to be reliable and of the highest quality, the regulatory framework that manages them must be completely changed. Improving regulatory systems and introducing effective approval methods are important to facilitate the rest of the clinical diagnosis. The current situation has shown that coherence with quality standards is fragmented, which affects the accuracy of verifiable results. To ensure continued adherence to established techniques, certification associations need to step up their efforts and conduct successive reviews and investigations. Government agencies, medical care providers and administrative agencies must work together to promote large-scale, multi-layered agreements. One of the main goals of this partnership should be to teach and prepare

laboratory staff members so they can adhere to magnificent concepts by giving them the necessary knowledge and abilities. Modern frameworks and innovation are equally vital since they enable laboratories to generate precise results rapidly.

The medical laboratories in Pakistan encounter various obstacles concerning quality control and policies, which impact their capacity to provide exact and accurate demonstration administrations. By resolving these issues, Pakistan might improve the quality of medical care provided to its dependents and broaden the scope of its clinical laboratories.

Pakistan's aim to achieve competence in medical laboratory services is ultimately a challenging effort requiring persistent commitment from every major partner. By enforcing strict regulations, allowing

quality confirmation agreements, and advancing participation, Pakistan could begin to lead the pack in building a strong and model medical services framework. All individuals can look forward to a better and better future in this life-changing experience, even with its difficulties.

Author(s) Contribution: Initial manuscript writing, Qurrat-Ul-Ain, formal analysis, Malik Muhammad Ameer Abdullah, manuscript visualization, Zunaira Mansha, revision and editing, Rameesha Nazir, proof reading and corrections, Waseem Haider and Ayesha Jawad.

Funding: No funding involved.

Ethical Approval: Not applicable

Conflict of Interest: Nil.

Consent for Publication: All authors approved the manuscript for publication.

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