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THE IMPORTANCE OF MEDICAL LABORATORIES IN DISEASE DIAGNOSIS

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1. Introduction

Pathologist Paul Bachner calls medical laboratories the ‘’black box’’ of healthcare. ‘’It may not be very glamorous, and it is often overlooked, but it is the engine room,’’ he writes. ‘’It is where most of the evidence comes from that drives medical decision-making’’. The reality is even starker than Bachner points out: ‘’20-70-90’’. About 20% of the nation’s medical budget is spent on pathology (70% of in-patient care and as much as 90% of health decisions made by doctors are influenced by pathology). So why then are laboratories and their staff so undervalued and sequestered away from the action? This is written with a (fortunate) degree of ignorance since I am not a pathologist, nor even a clinician. However, as a public health worker, I have been forced to face the fact that without accurate laboratory services, much of what public health aspires to may be strangled at birth (Strain & H. Ravalico, 2021). All of us who work in health aspire to help individuals, patients, improve patient outcomes, and yet we know how sparse is the knowledge base about what really works. Unless the best possible diagnosis of a disease has been made, why would we expect that a treatment discovered in a research study will work on most of the patients with the same disease in clinical practice? I find no mention of pathology in the World Bank’s vast tome on investing in health. Big mistake. Similarly, one can scour the four volumes of the 1993 World Development Report: Investing in Health and there is little mention of laboratory services. With the welcome advent and practice of providing antiretroviral treatment in countries with large numbers of HIV positive individuals, how to measure the effectiveness of that treatment without sophisticated laboratory back up? With the availability of super cheap antibiotics, how to measure increasing levels of anti-microbial resistance without investment in operational research laboratory services? So, what follows is still much ignorance, but hopefully an opening up of some of the issues faced in relation to medical laboratory services, at least in low- and middle-income countries.

1.2 2. Role of Medical Laboratories in Disease Diagnosis

A medical laboratory serves as a critical support system to healthcare providers, furnishing vital information regarding a patient’s health. Accurate and reliable diagnostic testing is necessary to

confirm clinical suspicions and to facilitate the provision of appropriate patient care (Tomo et al., 2020). Since first establishing a patient's referral relationship with a laboratory through a request, the clinician or other healthcare provider will be the recipient of the laboratory's test results that concern a particular patient. In this regard, a clinical laboratory serves as a "point of care" for every healthcare team by managing the intricate details of each patient's test information, ensuring proper testing, and providing comprehensive reporting of test findings. In particular, it collects patient information (name, sex, age, etc.), and relevant clinical information, for example, the suspected disease or section, referring doctor's details (name, location, contact number, etc.). These details are used for patient identification, history checking, and to manage the outpatient diagnostic report dispatch with a clinician. With the aid of information technology, the laboratory record is stored in digital format, which facilitates the easy retrieval of past information and prevents the probable loss of a paper record. The gateway to the laboratory test commences with a patient, who is duly referred to the laboratory by the clinicians and consulting physician's advice. After visiting the laboratory, most tests require the collected clinical sample, and thus a well-trained phlebotomist is essential for skilled sample collection. It then delivers the collected sample to the associated departments for the analysis of work. Subsequently, after completion of the specific test, the unusual and supposed results are sent to the technical and/or clinical supervisor for a re-check and validation process. Finally, the validated results are dispatched to the referring clinician or consulting physician by the given delivery date using a courier service.

2. 1. Types of Medical Laboratories

Medical laboratories are an essential part of the health care industry. Each type of laboratory has independent functions and operations that enable a diverse diagnostic ecosystem. When a medical professional orders a diagnostic test, the specimen they collect is sent to an appropriate laboratory for processing and analysis. Based on the requested test and healthcare setting, there are different kinds of laboratories to which the specimen may be sent. This subsection categorizes the main, overarching types of medical laboratories (clinical, research, specialized), then later sections detail laboratory functions for more nuanced understanding.

Clinical laboratories, also known as "medical laboratories," "pathology laboratories," or "diagnostic laboratories," are the most widely recognized. When people think of laboratories, this type is what typically comes to mind. Clinical laboratories usually offer a wide range of tests for blood, urine, body tissues, and excretions. These laboratories focus on patient specimen testing and analyzing for the purpose of disease diagnosis and directed patient treatment. Most clinics or hospitals have an on-site clinical laboratory in order to provide fast turn-around results for emergency testing. Essentially every patient specimen that is collected by a healthcare provider undergoes testing in a clinical laboratory. There is also the distinct subset of these laboratories that function as stand-alone operations and accept specimen couriers from numerous healthcare providers (Tomo et al., 2020).

Research laboratories, also known as "laboratory research," "biological research laboratories," or "wet labs," are less well known. These laboratories are designed for conducting studies and scientific research. For example, researchers may be studying possible causes or risk factors for certain diseases, or developing more accurate and innovative testing methods for disease-producing organisms (Merrick et al., 2013). Studies in research laboratories advance medical and scientific knowledge. In some cases, they may offer commercial diagnostic services which will

then fall under the category of a clinical laboratory. Due to their nature of containing experiments, access is usually restricted to those who work or study in the research laboratory.

Specialty laboratories, also known as specialized, reference, or esoteric laboratories, are the least perceptibly recognized by the public. These laboratories are distinct in that they focus on highly detailed specialized diagnostic testing. Specialty laboratories may concentrate on a particular disease or infectious organism(s). In other cases, they may concentrate on particularly complicated or complex testing. Due to the specific and complicated testing that is always evolving, these laboratories normally make use of the latest and most advanced technology. Patient specimen testing, results, and any additional information on treatment decisions via consultation with a medical professional are provided.

2.2. Key Functions of Medical Laboratories

Clinical laboratory testing plays a crucial role in diagnosing diseases, ensuring their prevention, and controlling their timely treatment (Merrick et al., 2013). Besides collecting samples and applying quality testing methods, the most important outcome from sample analysis is the accurate data reporting and its interpretation. This information is intended to the patient clinical pictures for reliable suspicions, confirmations, or exclusions of diseases, followed by therapy monitoring. Analyzing suspected illness often requires a full laboratory testing package including well-known routine analytical exams, but often there is also a need for tailored specialized analyses. This is regulated by the fact that there could be more than one explanation of the testing results obtained that would lead to various disease diagnosis decisions. The special-cause samples submitted for testing also require special decision-making protocols, extending from agreed analytical methods use with a clinician explanation before and after testing. For better surveillance and epidemiology, the laboratory would use robust data statistical analysis tools having the patient clinical and demographical information on the one hand, and sample analysis results on the other. Besides supporting the direct patients' diagnosis, a laboratory could also support R&D operations in the medical science of the corresponding illness on the behalf of the full data analysis. Much of laboratory operations are as a result of the routinely conducted analyses, but not enclosed with the patient identification and treatment and hence could not be described within a short period.

Public Health Laboratories (PHLs) are a critical component of the US public health system. They frequently serve under the radar or unknown, levels of decision-making hierarchy both in public health and hospital systems. PHLs crucially participate in disaster response and bioterrorism preparedness, conferring their ability for rapid, measured, and aggressive action in such circumstances. Citizens are also familiar with PHLs through their Food Safety testing services and could be more than often looking for assurances concerning the food safety of restaurant meals.

2.3. Diagnostic Techniques and Technologies

Medical laboratories exist primarily for carrying out one of the following functions, which is fundamental to human health: try to determine whether the patient has a disease, try to determine the extent or spread of the disease in that patient. Disease diagnosis is often sought after the signs and symptoms of an ill patient are noted, either by a general physician or by the patient. Thus disease diagnosis acts as a harbinger of disease in the human body. Development of disease within the human body prompts the research for medicine, which in turn cannot be achieved without a medical laboratory. In essence, the laboratory serves as the cornerstone of all medical practice.

Conventionally, the detection and analysis of disease-causing agents have proceeded by various manual techniques. The causative microorganisms are usually too small to be seen by the naked eye. Therefore, it has been customary to magnify such objects thousands of times using a light microscope. This traditional technique of disease diagnosis through a microscope is fittingly known as microscopy. However, many bacteria are also not detectable through microscopy because, like viruses, their size is much less. In that case, the spread of such disease-causing agents on a culture medium like petri-dish is allowed to grow in order to be visualized. These traditional means for disease diagnosis through observation/investigation of bacteria and its growth on culture media are understandably known as culture techniques (A. Pence & Liesman, 2020). However, with the advancements in technology and brute computational power, many magnitudes greater techniques and technologies have been developed to alleviate unwarranted circumstances. A very powerful molecular technique based on homogeneous nucleic acid amplification reactions is currently available and is designated as PCR (K. Krishna & M. Cunnion, 2012). Recent further advances from PCR are techniques like Real-Time-PCR and Next-Generation-Sequencing. While by far not an exhaustive list, these techniques represent very powerful tools; the range of available techniques is increasing almost daily. Although, it is not to say that the ways are completely paved. The automation in these processes is still to emerge. One promising area is 'Lab-on-Chip', where things as small as a chip are under processing of various laboratory analyses. The role of this technology in increasing the efficiency and robustness and thus decreasing the time needed to conduct the analysis is of paramount importance. The Nano-Mechanicals has set up not only a laboratory on-chip but a whole laboratory on a "single chip". In a mere future, the benefits derived from such a technology are completely beyond imagination. At present, an emerging technology in medical laboratory science is being adapted, which is faster, economical, and of much improved accuracy compared with conventional methods. Emphasis is also given on its adaptability and the requirement of an on-time tract. The use of proper methodology, accordingly, must be integrated with technology in line with the clinical practices. Furthermore, in contrast to other biomedical staff, laboratory personnel are continuously doing things and are required to be continually on the lookout for technological developments in their patch.

1.3 3. Impact of Medical Laboratories on Patient Care

Laboratory medicine is critical in forming a diagnosis, guiding the treatment and monitoring the ongoing management of clinical conditions. Diagnostic accuracy and efficacy are improved by continuous innovation and developments, led by pathology, in the science of laboratory testing. Patient outcomes are positively impacted by timely research and development of next-generation tests and computational algorithms that assist clinical decision making by facilitating treatment guidelines (L. Kaul et al., 2017). A patient's prognosis and treatment effectiveness can be directly related to the reliability of laboratory test results. Laboratory tests are performed on a broad variety of specimen types, in addition to assays used previously or developed in-house, and according to treatment guidelines. Timely laboratory services also allow quicker patient triage, leading to more efficient and cost-effective care and resources. Detection of cancer or pre-cancer through screening tests, diagnostic imaging or blood tests allows for early intervention, increased efficacy and ultimately, improved patient outcomes. Following diagnosis, laboratory tests can safely and non-invasively monitor the effectiveness of long-term treatments, such as many chemotherapies, and inform if treatment regimens need to be amended or changed (Strain & H. Ravalico, 2021). The science of laboratory testing in clinical medicine has progressed significantly since the initial creation of CLIA in 1988. To foster the highest quality of testing, professional organizations and

laboratories proactively work with manufacturers to maintain and enhance assay performance. Furthermore, there is a need for the Food and Drug Administration (FDA) to reform regulations and policies to promote the development of safe and effective laboratory tests. The laboratory development and clinical use of a selective serotonin reuptake inhibitor (SSRI) genotyping assay is described, illustrating how regulatory enforcement has significantly limited the types of genetic analyses that can be provided in clinical practice despite the availability of comprehensive genotyping information. The concept of traceability is upheld by statutes and regulations as the foundation of metrological standards, as it ensures the comparability of test results over time and space and fosters consumer confidence. Consequently, the discussed regulatory environment is inadequate and inconsistent with the currently accepted practices in the field. Promulgation of clear, concise guidelines for clinical testing laboratories would facilitate compliance with regulatory requirements and enhance patient care, offering an approach for the processes necessary to develop pharmacogenetic tests and suggestions for FDA action.

3.1. Timely and Accurate Diagnosis

Clinical laboratories play a crucial role in many health system activities. 70% of health care decisions depend on laboratory results, and a clinician's ability to promptly and accurately diagnose, treat, and monitor patient conditions can decrease patient morbidity and mortality. Inadequate laboratory services have been shown to contribute to false diagnoses, poor treatment outcomes, unnecessary costs, and negative health impacts. However, improved laboratory services can lead to more prudent use of resources, reductions in unnecessary treatment, improvements in health through quicker diagnoses, the streamlining of treatment options, enhanced monitoring of patients receiving treatment, the detection of antibiotic resistance patterns, and epidemic tracking. In most low- and middle- income countries, many health systems do not have a robust approach to managing laboratory services at primary care facilities, which extends to rural health clinics often offered the most basic services. Consequently, those outside of major urban centers often face limited or non-existent access to quality laboratory testing. However, the provision of rapid laboratory results does not ensure their effective use. Six main criteria for an effective laboratory medicine service exist – of which appropriate communication of results to clinicians constitutes a key element. Where a laboratory service is not available at the same location as the patient consults the healthcare provider, laboratory tests are frequently requested on a slip of paper and results returned via the same, or, in some cases, by phone - neither of which is secure or timely. This often results in incorrect or unexplained results and unclear implications for the clinician in-house. In the absence of evident connections between laboratory tests and symptoms, patients commonly distrust advice to pursue further testing that might require travel to a district or provincial town. In response, they may visit traditional healers or other informal healthcare providers promising quick and simple solutions.

3.2. Treatment Monitoring and Management

In disease monitoring, laboratories use imaging tests, genetic markers, inflammatory markers or tumor markers for tracking the progress of a disease or the growth of undesired cells. Such tests or markers can indicate a change in a disease, such as a progressive cancer or an alteration in the lifestyle that may be affecting a pathology. In treatment monitoring, laboratories can show the response to a drug or therapy by monitoring parameters that the disease is directly affecting. So, as the treatment begins, the disease-specific parameters will trend towards a health state. And because of that, there may be an improvement or deterioration of the illness and therefore a need to adjust the medication (Avivar, 2012). Medical clinics and private practices outsource the bulk

of their diagnostic tests to medical laboratories, the increasing lab plus the role in adjustment of medication, increasing the market of treatment monitoring and disease management. A proper diagnosis and effective treatment requires an increasing number of tests. For instance, the lab market is the largest among the pathology staff under the structure of a hospital. The general lab network also plays a key role in chronic disease management and personalized medicine. Throughout regular tests, the lab network tracks the disease progression or well-being state adjusting the treatments if needed.

The lab market is expected to increase 25% by 2025, as tests are more investigated, synthetized and studied by research biotech companies. For each clinical condition, there will be exclusives marker panels. Such panels can be very wide and include genetic markers, serological markers or even imaging tests. Medical laboratories provide the essential data for clinicians to base adjustments on medications, therapies, or interventions. As a health condition progresses, physicians tailor their treatment on the patient's response; lab markers can play a determinant role in that adjustment. Patients need regular exams to check their adherence to a treatment cycle. A number of illnesses can be efficiently treated just by following strictly the therapeutic protocol. This is particularly useful during a chemotherapy cycle, where the therapy is extremely toxic and it is applied at the full capacity that the patient can stand without causing severe damages. Run too soon or too little treatments may not achieve any success, while, with regular exams, the therapist can be assured that the drugs are being surely delivered at the right frequency.

3.3. Preventive Medicine and Public Health

Learning medical laboratory science provides an understanding not only of disease diagnosis but also of preventing and controlling diseases for public health. When infectious organisms leading to illness attack a human body, the battle between the organisms and the immune system starts and a disease condition occurs. Laboratory tests are embodied with blood collection, measurement, microscopy, culturing or antigen-antibody reactions on a molecular basis. This process for disease diagnosis is performed not only for patients with apparent disease potential but also for risk assessment or confirmation of the existence of disease for asymptomatic persons. Because this early detection and treatment can be available, laboratory contributes to the recovery of the patients or more cost-effective treatment. Recently, the accumulation of test results in the laboratory and social insurance, promoting evidence-based medicine, are widely used in the formulation of health policies, including the guidelines on medical treatment or prevention and treatment. This indicates a close interaction between the laboratory side and the public health field.

Principles of preventive medicine and public health are investigated from the view of laboratory medicine. The principle of public health is that community medicine exposed health problems in the community, and studied, carried through, and collected and, also, analyzed the statistics of health information to demand the function or the activity about the improvement of the barrier in community. The public health focuses on infection diseases, especially the study for the control to the infectious diseases such as AIDS, the cholera, and a canvasser virus include the avian flu, EHEC, and SARS. Laboratory can respond to detect specimens, vaccinations for the population without any clinical cure, epidemiological study, making of the health promotion food and other analysis of the necessity data. Public health examines public situation about livelong health, and take the exam approach to public situation, it decide public health actions in public situation, and entail it treatment by the labor and another systems. The improvement of the public health is a multidisciplinary task conversant by training and by day to day experience, in the duration of the

training the persons has been trained in a health sector, food sector as well in the communication sector (Merrick et al., 2013).

The principles of preventive medicine encompass a new area of relation between disease and lifestyle. Modern precautionary medicine is based on a relation among the risk factors and the scientists of the various diseases, and consists of moving the patients from the risk situation, or if this is not possible, continuing with continuous medical controls and the drug treatments in the attempt to block the evolution from precancerous situations to cancer. The laboratories contributes the data about the biochemical, histophatology in early case bring treatment facilitate. Precaution is based on the continuous measure of the potential risk factors agent that it is supposed would be to procure clinical manifestation of the patients. A population effort is the less effective from the strictly economic points of view but continuous with the medical actions that it is possible in the assessment to have a high cost and is proper to define inside the public health system.

1.4 4. Quality Control and Assurance in Medical Laboratories

Diagnostic accuracy is of utmost importance when it comes to treating illness. Extensive training and research have led to significant leaps in the healthcare field, particularly in fighting the spread of disease. With a variety of modern diagnostics methods, countless breakthroughs in medical history can be linked to these – including the ability to diagnose and fight infection, genetic research, and simple early diagnostics for a range of conditions that were previously untreatable. But of course, as with many fields, the devil is in the details. One key that is often overlooked is not just the quality of the diagnostics themselves, but also the quality of the organization conducting the tests.

Ensuring ongoing patient safety, medical laboratories follow a plethora of quality control and quality assurance measures every day. These aim to guarantee the reliability of test results as well as the preparedness of the staff and the state of the laboratory's equipment. In order to verify that the laboratory is able to meet these standards continuously and also that the quality requirements in place are set high enough, accreditation bodies regularly conduct assessments – comparisons of the laboratory's protocols and standards to benchmarks set by medical authorities. Apart from these routine audits, medical laboratories also themselves take part in more specialized quality assurance methods, such as regular calibration of equipment or scheduled proficiency testing. Obviously, these quality measures help to maintain the quality of the services provided by the laboratory. They directly improve patient safety – misdiagnosis of a hazardous contagious disease, delayed diagnosis of cancer, exposure to failed surgery that could have been avoided – these are the aura of malpractice and, at the very least, unwanted recovery of costs. Apart from that, for a plethora of conditions, largely treatable if diagnosed early, an undiagnosed state could lead to development of a chronic disease, disability, or even death. As adherence to quality measures directly impacts the credibility of test results, these measures – properly implemented – also serve as protection for legal prosecution of harm caused through a laboratory error as a result of a discrepancy of the test results. Due to all these reasons, quality management in medical laboratories is given strong emphasis by governmental institutions, medical societies and laboratory professionals worldwide. In modern diagnostic laboratories, quality management principles are applied to all levels of testing. To ensure the accuracy and reliability of test results, the entire testing process is controlled starting from the preanalytical phase and client ordering to the postanalytical phase. Shooting the importance of continuous training of personnel in the domain of quality management; ensuring access to literature, workshops or conferences on that

subject is specifically targeted to enhance the quality of the testing procedure. As a result of this talks offer regarding quality management in medical laboratories. And if we look at statistics from patient organization, the laboratory known to adhere to a quality approach is indeed a necessary requirement when considering the diagnostics phase as an entry point to healthcare, especially when the sum of money is taken into account. Assistance by the patient organization to guarantee the best level of independence of the assessment regarding the patient management, considering that medico-marketing makes such procedures greatly fallacious is not the only reason that may hinder patients to choose this or that laboratory.

Again, if viewing the consumer aspects of national dialog outcomes, the chosen test should be equivalent whatever the laboratory in which it is performed. The laboratory should also have technical skills regarding the range of tests it provides, whilst respecting a necessary budget limit. And then comes the question of quality IT ensuring the respect for the privacy of patient data. Dumping the blatant and quite old cases of neglect or carelessness where the laboratory fails to recognize an obvious mistake in the results, a comprehensive overview of the diagnostics should not disregard the theoretical and material bases of the tests performed. A cold chain maintained for the venous sample while waiting for that analyses in the clinical chemistry laboratory, the possible necessity to perform some tests in urgent conditions, and the precision of the diagnosis driven from the results (time, therapeutic response, need for reassessment) are all indicative of a quality approach, as well as the general cleanliness and organization in the laboratory. Stand-alone anatomy pathologist laboratories are far from financial activities, mostly because they rely on a punctuality and size update of the equipment. This reflects utterly on the results delivered, inadequate immature technical skills that are unfit for a certain type of tests, tests performed off-site mostly yearly because of the cost of the equipment and perhaps an autonomy that is not conceivable within such a restrictive framework. All of which can be obtained from a quality medical laboratory that relies on employment who mandate the required monitoring equipment and who gain from the regular additional at the relevant medical meetings. The overall quality of the services is assessed by default from the excellence of the tests, whether it be the satisfaction of the result's quality of the professional who selected the test, the actual methodology provided, or simply the time required for obtaining them. That quality is most likely safeguarded – and the customer's advocate – when adhering to impartial evaluation of the tests performed. And those considering this review procedure, the answer is more generally assessed to the effect of care on quality.

1.5 5. Emerging Trends and Innovations in Medical Laboratory Science

Medical laboratory science is unique in its incorporation of innovative technologies from various scientific and engineering disciplines to solve complex biological problems. Like in many other areas of science and technology, this field is constantly evolving, keeping pace with – or even ahead of – other healthcare disciplines. The present era has witnessed and will continue to see disruptive innovations that change the way laboratory tests are developed and performed, anticipate patient susceptibility, and guide clinical decisions. Some of these innovations supplement current laboratory testing paradigms, others challenge them. Altogether, these emerging trends embody an aspect of medical laboratory science that makes it a dynamic element within the landscape of healthcare.

Advances in artificial intelligence and machine learning algorithms have led to the digital transformation of pathology and the diagnostics of medical imaging data. The diagnostic process,

and by consequence laboratory testing, is progressively being executed by artificially intelligent means. Platforms have been designed that utilize machine learning to rapidly generate differential diagnoses for medical symptoms based on demographic data, medical history, and other potentially relevant clinical data. Such data-driven computational methods can improve the classification, accuracy, and prediction of diseases compared to traditional knowledge-based methods. Furthermore, with the advancement of genomics testing, personalized medicine is emerging as a new paradigm. Mass production of personalized medication offers a vision of the future healthcare system. On the other hand, laboratory testing paradigms are also evolving, in efforts to keep up (Ueli Blatter et al., 2022). Natural bodily orifice specimens collection devices are developed for diagnostic testing. Microfluidic, lab-on-a-chip devices, as well as point-of-care testings, have the potential to revolutionize the way diseases are diagnosed. Those devices are generally minimally invasive, less expensive, and lead to patient convenience.

1.6 6. Challenges and Future Directions

The inability to fully diagnose a patient's condition is a frustrating sentiment felt by both clinicians and laboratorians alike. Whenever a laboratory is unable to supply a certain test due to resourcing issues or diagnostic limitations, a chain reaction of barriers evolves. This can stymie a patient's road to recovery, often resulting in recurring healthcare encounters and wasted time and resources for both patients and providers. With the rise of emerging, and sometimes too-rapidly-adopted, healthcare technologies, laboratories have to delicately balance embracing integration while not stifling the pace of results turnaround.

Much of this narrative centers around the significant regulatory changes or advancements that should be addressed in terms of better-suiting health institutions and laboratories in the face of ever-changing healthcare demands. While this manuscript will house some of its focus towards these elements, strict adherence to high-quality standards within this field is paramount and frequently overlooked. This is not just purely for public health reasons, but also to nurture the integrity of the work that is carried out. As such, maintaining a laboratory in top-tier shape necessitates a rolling plethora of responsibilities that can often go uncounted. Paradoxically, the fact that laboratories can act as a disincentive for patients to seek further medical help is often a seemingly unappreciated facet of healthcare, yet can be additively valuable for a high-paced care system (Raoult et al., 2004). Multidisciplinary work with a variety of healthcare branches, including specialties seemingly of little-common with classical laboratory work such as psychology, can additionally assist in the better tailoring of diagnostic methods. On the latter point, the enhancement of proof-of-concept and maturation of contemporary laboratory assays, or the development and application of emerging technologies in disease detection encapsulates the majority of progression in the biological sciences (Strain & H. Ravalico, 2021). Timeline projections on the advancement or isolation of lab practices, however, unreasonably put too much in the way of the unassailable rise shift in laboratory sciences as a field. The adaptability and resilience of laboratory science means almost any ongoing condition in healthcare science is assessable and can be tackled; research and development will continually be the key to successful management of any potential future dilemmas in laboratory science.

1.7 7. Conclusion

The importance of an investigative, comprehensive medical laboratory in the diagnosis of a disease cannot be overemphasized. There are many aspects to the study of clinical laboratories as individual entities in the continuum of medical care delivery. The laboratory is a setting with the

transformational capacity to guide disease treatment choices (N. Okeke, 2016), building up or tearing down a patient's hope. The significant, direct role of medical laboratories on treatment must be accepted. It ensures essential safety in selecting the incorrect treatment while increasing the likelihood of picking the right prescription for burgeoning diseases. This is the clarity on the significance of the laboratory as a place to test medical specimens with the intention of obtaining suitable solutions for patient treatment. Effective treatment would clinically prove an accurate diagnosis of disease. This position highlights the crucial, direct role of medical laboratories in tests leading to an accurate and early disease diagnosis, ensuring suitable clinical treatment is given that significantly impacts the medical outcome. Hence, discussion demonstrates the importance of these blood diagnostic laboratories and the laboratory strategies applied by using objective method facts. It is imperative to have an understanding of the diagnostic disease laboratory since most of the treated predicated on the results of the lab reports.

From a popular point of view on disease diagnostics, conversations often presume a clinical diagnosis has been made upon a brief consultation with a patient doctor. However, such a diagnosis is often superficial or incomplete, predicated on the patient's verbal complaints, visible symptoms, and any readily available, traditional diagnostic technology results. Laboratorial examinations are a later step in disease diagnosis, transpiring frequently after a patient's first visit to the clinician (Strain & H. Ravalico, 2021). At the same time, nobody questions the significance and necessity of laboratory test results in disease-diagnosis practices, and the majority of disease treatment includes at least one blood diagnostic test. A clinical test is the uniquely objective method of examining patient samples and records the results that act on medical decision-making predicated on that data.

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