



## Role of Medical Laboratories in Disease Diagnosis

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### Abstract

In the setting of infectious disease emergencies, rapid and accurate identification of the causative agent is critical to optimizing antimicrobial therapy. The age of molecular diagnostics is now upon us: real-time PCR has become the gold standard for many infectious disease emergencies. Studies reporting the simultaneous detection of multiple agents are increasingly found in the medical literature. Such assays are typically laboratory-developed and, while providing even greater diagnostic and epidemiologic capability, are typically beyond the reach of a small clinical laboratory. The World Health Organization has developed a screening assay for 7 bioterrorism agents that utilizes real-time PCR and can be run on various commercial platforms. Assays are proceeding to public labs, 1st at the federal level and then at the state level.

In the setting of any sudden-onset disease, the accurate identification of the etiologic agent(s) becomes a question of great importance with urgent management and infection control implication (K. Krishna & M. Cunnion, 2012). As agents of infectious disease break loose from their traditional geographic limits, historical clinical presentations and epidemiological



clues also become less useful. In emerging infections, it is the laboratory that plays a vital role in early diagnosis. In the setting of an infectious disease disaster, the rapid identification of the causative agent is a critical step towards the optimization of antimicrobial therapy. A patient with a sudden onset of signs and symptoms suggesting a systemic or focal infection causing a severe or even life-threatening illness is frequently, either directly or through the emergency department, assessed in the laboratory by the basic methods in use for many decades.

**Keywords :** Clinical laboratory as an essential part of medical laboratories or simply as medical laboratories plays a key role in routine diagnostics as well as in diagnostic procedures during pandemics. For diagnosis, laboratory analyzes several body's available material like blood, urine, sputum, cerebrospinal fluid, tissues, etc. and reports its findings to attending clinicians. The diagnosis process typically consists of 3 or 4 steps. At first, the patient consults a clinician. The patient's present condition (complaints), history (personal, familial, etc.), clinical examination, and bed-side tests lead the clinician to opt for a supporting diagnosis testing plan. The clinician then sends the necessary body material, samples for testing, with advice about the tests needed. The laboratory handles the samples and performs tests and sends the results back to the clinicians. The clinician takes care of the patient according to the lab test results which initiates a loop where more testing maybe needed at later stages (Tomo et al., 2020). By rigorous testing of symptoms and better understanding of bio-markers in SARS-CoV-2 virus infection, testing regimen changes time to time, from initial CT-based only testing to present molecular testings. Multiple testing methodologies and testing kits are available for diagnosis covering a wide range of testing scenarios. And, clinical laboratories have to cater to these needs taking utmost care, so the attending clinicians are provided with the most reliable results on which patient management is decided. Parallely laboratories maintain a robust turnaround time (TAT) that is, the time taken from the patient's material received to results dispatched. The TAT depends on sample travel time, laboratories operational hours, the time required for sample preparation, w.r.t. to a specific testing machine/technique, and machine loading, etc. The guidelines callback time to time, packaging and handling guidelines of viral samples, and testing conducted with 2 samples of 1 sample tested positive to check for contamination.

## **1. Introduction to Medical Laboratories**

The major growth in medical laboratories throughout the world since 1980 has been the result of an increasing volume of laboratory tests. Automation is one of the modern methods used to cope with this huge volume, besides improving the laboratory technology and physical plant, and applying the principles of total quality management. The interest in medical laboratories is increasing every day, both among the public and health professionals, particularly in the clinical field. Adjustment to a rapidly changing environment has become the nature of



services in the clinical laboratory setting. Clinical laboratory testing is a loss leader and is traditionally measured in terms of its cost rather than its value to the patient. Clinical laboratory tests are involved in producing health care results as diagnostic tests. They must match patient test results in order to manage and provide effective health care. The utilization and selection of appropriate laboratory tests by the treating physician is not adequate to provide effective services and therefore, research is needed to improve these areas in clinical laboratories. In general, a clinical laboratory test is a service that can be provided by a laboratory owned and operated by a physician's office, or by a commercial or hospital-based laboratory. However, many tests are performed in-house and many tests are referred to other laboratories. Clinical laboratory testing is essential for the monitoring of high risk drugs, such as antibiotics, and has high sensitivity or is involved in the detection of diseases that have subtle symptoms or patterns of occurrence.

### **1.1. Definition and Function**

Medical Laboratories are facilities with equipments and instruments perform analyses and tests on specimens of human body fluids such as blood, urine, and tissues, in order to obtain scientific information about the health of a patient for diagnostic, preventive, or treatment purposes (Merrick et al., 2013). Laboratory medicine is a special study of tests that can be used to detect, treat, or prevent diseases in humans. Laboratory medicine has the purpose of providing a clinically reliable result to help the prognosis and treatment of the disease. Laboratory medicine has a function in detecting diseases including making an initial diagnosis of diseases, determining the severity of the disease, and checking the effectiveness of drug delivery or therapy. The main functions of medical laboratories in hospitals center on the primary tasks in a referral hospital. The laboratory at the health service level is intended as an effort to develop programs for the prevention of diseases on the basis of his ability to promote community attitudes so that health services are used optimally by community members. Since the cost of medical procedures is expensive, it is necessary to have a national health insurance program that caters to all the costs of maintenance and handling of diseases for the poor (Bashiru Okesina & Adelekan, 2018). In addition to handling diseases through professional medical personnel to improve services, especially clinics for diseases that are frequently affected by the nation that must be addressed over the people, also carry out socialization and health alertness to the public about the importance of health.

Key elements for care in a laboratory are as follows. The laboratory has the resources and infrastructure to perform the test and acquire results in a timely manner, i.e. providing appropriate testing at the right time. Clinical laboratory personnel have an adequate qualification, including advanced training, to perform a wide range of laboratory testing and ensure availability in different shifts or with on-call status. Samples collected in health facilities are forwarded to the laboratory according to standard protocols and required in a



certain time period in order to have a reliable overview of the situation. Transmission of laboratory test results from the laboratory to the ward should also be done on time, according to a well-defined system. Monitoring a laboratory is as important as monitoring a pharmaceutical management and monitoring health staff. These elements were well reflected in the projects supported by different U.N. organizations or other countries, including such activities as capacity building in laboratory diagnosis of tuberculosis and quality assessment of laboratory services, as an integral part of TB control.

## **2. Types of Medical Laboratories**

Healthcare is no longer limited to sick care. With the increasing awareness of various diseases, laboratory tests have become an important diagnostic tool in early detection of the disease. Medical laboratories play a vital role in maintaining the economy of a country. The financial growth of the laboratory depends on the proficiency of laboratory practices and the overall management. The ultimate diagnosis or message prescribed by the physicians depends on the analytical reports. There is an urgent necessity to maintain establishment and superiority of the laboratories.

According to objectives and responsibility, medical laboratories can be specialized in three ways that include private or personal medical laboratory, government or charitable hospital laboratory, and reference medical laboratory. Private medical laboratories are those run by one's own government or technical or educated personnel. Private laboratory management is much better than government or charitable hospital laboratories due to increased financial liability. But many times it can maintain the standard testing procedures in pathological investigations. Private laboratories also offer a reduction in routine diagnostic tests, but charges more for the biological and pathological experiments because it is costly to test the next level. A government or hospital laboratory also provides laboratory diagnostic services for pathological patients. Charges for health care and basic tests are much less than private ones (Merrick et al., 2013). Medical laboratories are now equipped with advanced instruments and timely training is also provided for research work. Many private investigators also use these laboratories to conduct research. In the case of private, the interest is only at an economic profit, because it has gone to the level of syphoning.

### **2.1. Clinical Laboratories**

One of the major impacts of modern medical laboratories is ensuring disease diagnosis through advanced technologies. These technologies include a wide range of tests and procedures conducted on clinical specimens, which go beyond the standard hematological and blood biochemistry tests. Molecular-based testing and high-level serological analysis are also extensively performed. Other than that, pathological tests of biopsies, fresh tissues, and



body fluid specimens are done to ensure a more precise, sensitive, and accurate disease diagnosis using advanced light and electron microscopy technologies.

Since ancient times of the Chinese and Babylonian civilization, the importance of medical laboratories was noticed by traditional physicians and healers. The oldest history of clinical laboratory testing derives from the ancient Egyptians in 3000–2000 BC. In 1674, Leeuwenhoek discovered the blood circulation using the simple microscope he made. In 1831, Purkinje demonstrated the absorption spectrum of the V-m shape of the haemoglobin molecule under a microscope. These early research findings and contributions drove the later advancements in the establishment of modern medical laboratories. Currently, clinical laboratories offering a wide range of clinical pathology tests are an integral part of disease diagnosis by physicians worldwide. Medical laboratories now play a pivotal role in disease diagnosis and monitoring therapy responses by employing advanced technologies (Tomo et al., 2020). The Laboratory Formulary is a major part of a Clinical Laboratory Improvement Amendment. The majority of medical laboratories developed such a laboratory formulary or test menu containing a list of commonly performed and available tests. Clinical laboratories also provide an interpretation service of the laboratory results. In addition, they are also related to the multi-disciplinary team (MDT) meeting and tumor board regarding interpretation of pathological findings and laboratory data in connection with the symptoms of patients, clinical analysis, prevention and risk prediction (B. Freedman, 2015).

### **3. Laboratory Tests and Techniques**

Laboratory tests are widely used in medical practice to aid diagnosis, management, and treatment. Although clinical examination remains the cornerstone of patient assessment, it is often necessary to investigate further before a definitive or probable diagnosis can be made. Patients who do not have a definitive diagnosis after clinical examination and (if needed) routine investigations usually need “special” investigations, i.e. laboratory tests or imaging techniques that provide detailed information. There are now many simple tests and techniques that are available to help in the diagnosis and management of a wide range of diseases, from common infections and tumors to rare inherited genetic disorders. Although some samples can be tested in the clinic (such as urine dipstick tests and pin-prick blood glucose measurements), many laboratory tests and investigations are conducted in a hospital laboratory using dedicated equipment and skilled staff.

There are many different tests used in laboratory medicine covering everything from blood sugar to genetic markers. There are hundreds of tests that are done in various settings from the relatively simple glucose meter to more complex DNA analysis of a person's genotype. However, a small number of common tests make up a core set of investigations that are used more widely, despite the fact that each is often performed using kits manufactured by



different companies. This is an important issue because the same test performed in the same patient on the same day may give different results that can lead to confusion and further unnecessary testing (Ransom Fairfax & Salimnia, 2013). Moreover, these tests are used so widely that most laboratories are likely to have experience in their use, both in terms of the technical and clinical aspects and in what to look out for when interpreting the results. This text is concerned with these "core" laboratory tests and techniques.

### **3.1. Common Tests and Techniques**

Clinical laboratories analyze body fluids, tissues and other samples to help diagnose a vast array of diseases. Blood, urine and stool samples are the most commonly tested specimens requested. The importance and scope of clinical testing, along with its various facets, will be the focus of this series. Common tests and techniques used by medical laboratories will be reviewed as well as their technical and scientific underpinnings (Basu & Shetty, 2021). In addition, pre-analytical and post-analytical variables will be addressed. Awareness of the reliability and limitations of clinical testing can facilitate informed decisions when interpreting results and whether to pursue more testing.

Many pathogens are possible drivers of infections. The array of bodily sites and clinical manifestations that microbes can inhabit, and cause, is vast, which necessitates medical laboratories with a broad analytical scope (K. Krishna & M. Cunnion, 2012). Cancer is a significant cause of mortality; it is responsible for 8.2 million deaths annually. The diagnosis of cancer relies heavily on lab testing, including anatomy and molecular diagnostics. Tests are performed for myriad reasons, including monitoring disease progression and treatment effectiveness and risk assessment. Regulatory bodies, as well as the laboratory accreditor CAP, must be satisfied that the equipment and techniques employed are robust and meet international standards. Techniques that report a quantifiable output are often subjected to internationally recognized peer-review schemes. This scrutinizes factors such as theoretical underpinnings, analytical range, error sampling and reporting, and, for kits and reagent sets, commutability. Experimental artifacts need to be disambiguated from analyte-derived signals, which alternatively necessitate diagnostic prediction and intervention. Standardized lab routines, providing a stable basis of comparison, are paramount in this regard.

### **4. Importance of Accurate Diagnosis**

Medical laboratories with their new direct measurement procedures play an important role in improving patient healthcare. The performance characteristics of these laboratory tests are measured in the analytical phase. Therefore, the analytical quality of a test, e.g., accuracy, precision, and the relationship of these characteristics with medical decision quality, can be achieved. Vitros 5.1 FS is a laboratory/home portable hardware for the detection of cholesterol using the Clinical Chemistry software Virtual Test Panel. In addition, a newly



designed water filter for the hardware was tested that modifies reagent water to pure water. For the cholesterol in plasma samples, the method was evaluated using a reference analyzer compared to the standardized IFCC two-step enzymatic method. In combination, the quality of the direct-assay procedure in terms of accuracy and precision were evaluated for 24 months in routine operation in a medical laboratory by analyzing Vitros Direct Test 191 Systems cholesterol in human serum.

Laboratory diagnostics is a separate medical/scientific discipline, along with surgery, internal medicine, pediatrics, etc., and plays an important part in the overall patient management. For the diagnostic process, meaningful, accurate, and precise routine measurements are essential. For most diseases, about 70% of all therapeutic decisions, as well as the follow-up of their success, depend on routine medical laboratory analysis. In critical care, the contribution reaches 90%. The contribution of the diagnostic laboratory in the overall diagnostic process is in the range of 40–60%, depending very much on the kind of the disease status investigated (M. Müller, 2010). Thus, diagnosis, risk assessment, treatment, and follow-up of the patients all strongly rely on the results of in-vitro analyses. In many diseases, clinical symptoms do not allow exact prognosis. On the other hand, after treatment, it is often not clear whether the patient is fully cured, has improved, or has relapsed. Here, the diagnostic laboratory has to provide unambiguous data justifying therapeutical consequences.

#### **4.1. Impact on Treatment Decisions**

There is a considerable investment in disease prevention, diagnosis, and treatment, and as laboratory tests drive up to 70% of clinical decisions, they are of high economic value. As new diagnostic tests are emerging at an unprecedented rate, their utilization management is becoming increasingly crucial. Despite its demonstrated positive effects, there are various challenges impeding it, which include insufficient clinical and laboratory interaction, problematic test ordering and performance, as well as market access issues (Bogavac-Stanojevic & Jelic-Ivanovic, 2017). There is a wealth of literature exploring these challenges, examining possible solutions, and demonstrating examples in a wide range of clinical contexts. However, there is a significant lack of harmonized proposals, guidelines, policies, or legislation for overcoming such challenges, especially when it comes to emerging high medical value diagnostic tests. The current article critically assesses such implemented or proposed initiatives worldwide, or within Europe or individual countries, tackling market access challenges and promoting the utilization of new diagnostic tests through harmonization. Evaluating diagnostic tests requires evidence on their technical accuracy, as well as – increasingly – on their impact on patient outcomes and cost-effectiveness. The development of ‘cost evaluation’ and of an ‘assessment of value’ in health care is rich, but scattered, and compelling challenges persist. This encompasses the history and



methodologies which have been key in determining cost-effectiveness thresholds, including issues of overarching concern.

With more than 500 million primary care visits per year in the US, diagnostic tests influence an estimated 60% to 70% of critical clinical decisions affecting patient care. Despite recent trends in restraint, accountability for healthcare spending continues to escalate. Approximately 23 million times a year, primary care physicians order tests with no clear understanding of why the tests are ordered or how the results will influence their clinical treatment (B. Freedman, 2015). Meanwhile, there is widespread acknowledgment of the economic strain poor test utilization contributes to the system. Attention must be given to the roles that can, and should, be fulfilled by those who laboratory medicine before diagnostic tests. From a patient safety perspective, inadequate education in laboratory testing must be seen as a critical issue. For consideration are some of the varied interventions designed to promote the effective use of laboratory tests. Practice guidelines offer evidence-based, peer-designed expert opinions. The majority of time, clinical guidelines overlook one of the most effective tools available for immediate use – the clinical laboratory formulary. Supplying a catalyst to dispel one of the most significant contributors to overutilization generates savings in an area of healthcare where expenditures have continued to spiral out of control in an otherwise highly successful trend toward cost containment. A laboratory formulary is an up-to-date, detailed list of diagnostic tests and testing strategies. It outlines what tests a clinician may order or what tests are permitted to be sent to outside laboratories. A laboratory formulary is established and maintained for a single facility or within a consortium of office practices. By these means, maximum control is wielded towards cost savings without giving precedence to non-clinical considerations.

## **5. Quality Assurance in Medical Laboratories**

The method of controlling products and services will improve a standard of customer's confidence. The quality control of products or services is required. Clinical laboratories are the necessary parts of health care systems. Evaluation of the effectiveness of disease treatment and detection of some health problems are goals of medical laboratories. In current medicine, up to 70% of medical decisions are based on laboratory results. Incorrect laboratory results can lead to restriction in treatment selection, increased hospitalization period, extra diagnostic tests and costs, and increased inpatient mortality. There were 13,000 laboratory error-related deaths in hospitals. In laboratories, other than test selection, there are extra factors affecting the test performance. High-quality results from clinical laboratories are important decisions based on it.

Molecular diagnostic methods have a critical role in clinical laboratories. Therefore, standardization is an evolutionary process for a laboratory that needs to be upgraded. A poor



laboratory shall never enhance its work. Besides, the definition of a poor laboratory needs to know about laboratory activities. The poorly equipped laboratory cannot be defined as a poor laboratory. In developing countries, some of the laboratories have equipment without necessary personnel or a potential laboratory in an equilibrium with lack of expert personnel.

## **5.1. Regulatory Standards**

Laboratory medicine is both a science and an art. Laboratories are staffed by clinical scientists trained in pathology's multiple disciplines: chemical scientists may be supervised by pathologists with qualifications in clinical chemistry, hematology, microbiology, transfusion medicine, virology, immunology, genetics, or cytology (B. Freedman, 2015). The quality of the outcome of analytical processes in the laboratory affects the reliability and validity of the diagnosis. Despite its paramount importance, the process and outcome of analytical diagnosis in direct terms is indirect from the safety point of view for the patients. Modern medicine depends on complex medical diagnostics. To ensure fair comparisons among different laboratories, tests and diseases, the report about the test results must adhere to preset norms regarding what to report, and how to report it. Quality standards are those indispensable conditions that must attend all processes of the medical laboratory to ensure pre-defined and desired quality of the laboratory work or its service (Kleymann-Hilmes et al., 2022). Guidelines for Test Ordering are produced by the professional organizations of clinical and laboratory medicine and their main aim is to rationalize the test use thus avoiding inappropriate testing, with benefits for the overall quality of care. It is necessary to contact physicians in order to update Guidelines for Laboratory Test Utilization. Moreover, low-cost initiatives may be implemented aimed at improving physicians' understanding of laboratory tests methodology, standard units of measurement, test duration, proper sample collection and transportation. Common guidelines of laboratory tests are included in the guidelines produced by scientific societies and policies. However, institutions may produce their own Guidelines for Laboratory Test Utilization, following the flow-chart of definitions suggested by the Professional Affairs Committee. To increase the impact of these guidelines on the clinical practice, frequent contact with GPs is recommended. Finally, it is important to emphasize that, in order to increase the perceived transparency of these recommendations, a panel of clinicians and clinical pathologist should be responsible for defining and subsequently updating these Guidelines.

## **6. Emerging Technologies in Laboratory Diagnostics**

A 95-MEMBER AGGREGATION OF COLLECTIVELY 900 years of experience convened by the journal Diagnostics concluded that a significant oversight in prior lists of urgent research needed for infectious diseases and particularly for the next or current, emerging pandemic infectious disease, is the need for member states of the WHO to tell the truth about any infectious disease outbreaks (K. Krishna & M. Cunnion, 2012). This includes the WHO



immediately sending teams to assess conflicting claims. The labs of virtually all countries, not just those with better technology and training, can employ timely genetic tests to detect true infections for diseases suspected to be spreading internationally. A good way to model endemic diseases about this is essential for preparing. Laboratory diagnostics to examine infections need to be employed carefully and properly. Direct, or purely genetic, tests for pathogens show that infection is present, whereas other tests show either that infections are non-viable or are about symptoms or antibodies instead. False negatives and false positives are special risks for poor understanding or for indifferent design of tests. The possibility of showing frank disease not despite a positive test ('symptomatic latency') and of transferring symptoms between people without symptom overlap ('symptomatic transmissibility') should be publicized by health authorities, or people can easily conclude an outbreak must be psychosomatic. Including to a traditional but informal enumeration; a failure rate for any widespread and strict policy depends on a claimed symptom list being unambiguously scored by one test, which with only non-genetic tests for most claims is virtually impossible. There are few data on direct tests for pertinent diseases, and the literature advice on symptom-based clinical testing could not catch infection. The counterpart broad advice would be dangerously wasteful, and if countries did repeat one against modeled outbreak in reports to the WHO, it might then be obvious that test and disease propagation rates were both greatly underestimated. The WHO and other organizations who publish detailed documents on tests, symptoms, or policy in such matters may offer financial bounties for the labor-saving exposure of good false claims; sufficient attention should also be drawn to doctors and virologists in order for them to notice for themselves and implement such an exceedingly important task (A. Pence & Liesman, 2020). Printed advice will hasten international attention.

## **6.1. Advancements in Automation**

Total automation in diagnostic medicine has over the years resulted in a rapid advancement of the hardware and the software of the clinical laboratory analyzers. Modern clinical analyzers offer results on tests considered 40 years ago as rapidly, and more frequently, than could have been done by any of the methods then available. They are a welcome addition to laboratories that need to process a high volume of blood samples which the current low technology world infrastructure of clinical laboratories cannot manage. Nonetheless, while a considerable body of medical literature has come to focus on tying the industry to test volume and to particular laboratory practices, much of this literature includes analyzers from the 'second generation' placed in medical laboratories since the early 70s. This hampers an understanding of the relationship between medical outcomes and 'third generation' analyzers, which have been more widely available in hospital settings starting in the mid-80s.



The last forty years saw the clinical analyzers evolving quickly from simple analytical devices to complex whole-blood analyzers that automatically perform a variety of often highly complex procedures on the sample: harvesting the serum fraction; pipetting the sample into a variety of cuvettes, tubes, or multiple reagent wells; and bar-coding the patient information for tracking. These procedures are performed by a series of complex robotic procedures which are controlled by a central microprocessor (Donald Moshen, 2010). After the reactions have progressed, they are both filtered and quantitated by one or more detectors. Labs now estimate that 75% of all work by Medical Laboratory Technicians will become obsolete in the next 20 years through total automation. In fact, the first biochemistry analyzer was installed in 1960s, and the first haematology analyzer in the 1970s (Avivar, 2012). All of these models have been replaced by more advanced analyzers in Europe and almost 80% of all tests are now analyzed with the new models. Minimum stock requirements together with rapidly changing technology have made procurement of sophisticated equipment extremely difficult.

## 7. Challenges and Limitations

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### 7.1. Sample Contamination

#### 7.1.1. What is contamination?

Laboratory contamination can be defined as the inadvertent addition of analytes to test samples during sample collection, transport or analysis, which may result in a false positive result (De Lappe et al., 2009). Cross contamination can lead not only to compromised patient care, misdiagnosis and inappropriate treatment, but also to costly and time consuming investigations of pseudo-outbreaks. Several sources of microbial laboratory contamination have been described. Among these, the following table will address the most commonly reported sources: culture of deliberate positive control strains, culture of recent isolates, handling by laboratory or hospital personnel, airborne exogenously acquired material.

Table 7.1. Sources of microbial laboratory contamination

#### 7.1.2. Introduction

Quality assurance ought to be aiming to further the art of medicine in regard to disease diagnosis. It is indeed necessary that the diagnostic laboratory is as contaminant free as possible to assure valid test results, and in an attempt to ascertain this, there are written guidelines for sterility. However, most of those guidelines seem to be common sense, and as such may be forgotten or overlooked since they cover a well known topic. It was decided to compile written guidelines that subspecialties of a diagnostic medical laboratory may find useful as a check-list. These guidelines would naturally be changed, abolished, or introduced



as current techniques and knowledge in diagnostic laboratories advance (Marit Andersen, 2018).

Sample contamination refers to unwanted contamination of the sample material, e.g. sticks, dead insects or cleaning solvents that have dripped into the sample container (or been sprayed there). Less easily observed are contamination of water samples and importantly, contamination of biological samples with materials containing potential PCR inhibitors. Many physical, chemical and biological substances are considered to inhibit PCR amplification, and small amounts of the contaminants may have an extremely reduced effect on amplification efficiency. The handling procedures below deal with source separation and attempt to avoid contamination of clean samples. However, samples may also exhibit contamination problems due to the strictly improper handling at the sampling site or be deliberately contaminated at arrival to the laboratory. In both cases the laboratory should be informed and an agreement should be reached on how to proceed in an attempt obtain valid data.

## **8. Future Trends in Laboratory Medicine**

What does the future hold for clinical microbiology? (Raoult et al., 2004). The possibility of automated methods for the rapid detection of biological warfare agents highlights the potential for screening of hospital-attended disease for pathogens that have never been seen in the clinical microbiology laboratory. As for the changes in established practice, remote consultation will inevitably lead to the remote handling of real specimens and the development of rapid and robust techniques for identification and susceptibility testing.

On a different front, emphasize the need for microbiologists to look out for new and unforeseen infections. In conjunction with improved electronic reporting of notifiable diseases, the use of machine performance monitors in microbiology laboratories could provide an early warning system for increased incidence. In a perhaps less newsworthy context, developments in both the analytical sensitivity and the specificity of nucleic acid amplification tests endow these techniques with an expanding and diversifying range of applications.

In particular, an increasing number of tests have appeared that can distinguish between alive and viable but nonculturable organisms. This will permit far more effective monitoring of the clinical effectiveness of antimicrobials as they are rolled out by community-based physicians. Other soon to be reduced to routine commercial kits will distribute essential testing infrastructure for the local surveillance of molecular epidemiological trends. Amplification methods are being adapted for antimicrobial susceptibility testing and, in the very near future, various tests will be licensed for the rapid screening of parasitemias in the context of hospitals casualty units and community-based physician surgeries. The development of



cheap, ruggedized kits for field use will allow large-scale, intensive and highly-targeted eradication campaigns.

### **8.1. Personalized Medicine**

The role of Henry Festing Jones on the treatment of syphilis was portrayed in a recent publication. This will be critically examined, and some important aspects of syphilis as seen by the founder of the disease will be surveyed. With the possible exception of gonorrhea and perhaps leprosy, syphilis is probably the only venereal disease that had nomenclature attached to it before the 19th century. It has generated many myths and folk beliefs throughout its history, in ancient Greece and Rome, in India, and in the Western world from 1495 onwards, when the malady is best known. In the course of this process, many remedies and nostrums were promoted and advertised. None of these, of course, had any medical validity, nor were they better or worse than many medicines of the 19th century or the present time. There are a number of publications that have considered venereal diseases in the past hundred years, in particular of syphilis and gonorrhea, and a number of recent volumes review social and medical aspects of these diseases up to the 19th century. Included in his treatise on Theriaka, glass vials with the sign of the bow and arrow found among the Pompeian mummies in the Temple of the Three Doctors should certainly be allocated to venereal complaints. Similarly a preserved medicine chest. Varro gave details of a number of venereal remedies in his *de Re Rustica*, presumably of a veterinary nature.

### **9. Conclusion**

Clinical laboratories play a fundamental role in monitoring parameters and analyzing the etiopathogenesis of many prevalent diseases today. In addition to their role in patient satisfaction since the issue of knowing the cause of health-related complaints or detecting a possible risk at an early stage is at least as satisfying as treatment, testing and diagnosis also has a practical aspect in terms of curing curable diseases and caring for chronic diseases. On the other hand, it is seen as a cost factor rather than a saving factor since it fills up the part of the budget allocated from the health budget. However, despite this perception, the medical laboratory is an element that starts in the foreground from the production process to the end of the chain from the existence of public and private health institutions. Although one of the reasons for this perception can be identified as the chaos created by the private laboratory structure, the other factor is the adoption of the belief that only test results are important as a result of the evaluation of physicians based on the perception that they provide results at a higher level.

In order to maintain their structure and to perform their functions correctly and effectively, health services should use control and supervision services efficiently both for human resources and physical infrastructure. In line with all these outcomes, laws and regulations



that will cover the health sector as a whole have been published. According to the legislation in force, the main principles that health services should act on regarding medical laboratories are clearly outlined: individuals and establishments that work in the field of health services must have a certificate of authorization given by the relevant administration; these individuals and institutions must comply with the hygiene and technical rules determined by the administration; periodic examinations of equipment, laboratory and materials should be made. In the last legal regulations taken from 2019 until today, efforts have been made to eliminate problems often encountered in sampling, transportation, test error and accreditation for assurance purposes in general.

## References:

1. K. Krishna, N. & M. Cunnion, K. (2012). Role of Molecular Diagnostics in the Management of Infectious Disease Emergencies. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
2. Tomo, S., Karli, S., Dharmalingam, K., Yadav, D., & Sharma, P. (2020). The Clinical Laboratory: A Key Player in Diagnosis and Management of COVID-19. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
3. Merrick, R., H. Hinrichs, S., & Meigs, M. (2013). Public Health Laboratories. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
4. Bashiru Okesina, A. & Adelekan, A. (2018). The Role of Laboratory Medicine in Addressing Migrant Health Problems. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
5. B. Freedman, D. (2015). Towards Better Test Utilization – Strategies to Improve Physician Ordering and Their Impact on Patient Outcomes. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
6. Ransom Fairfax, M. & Salimnia, H. (2013). Diagnostic Molecular Microbiology: A 2013 Snapshot. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
7. Basu, S. & Shetty, A. (2021). Laboratory Diagnosis of Tropical Infections. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
8. M. Müller, M. (2010). Quality and diagnostic perspectives in laboratory diagnostics. [\[PDF\]](#)
9. Bogavac-Stanojevic, N. & Jelic-Ivanovic, Z. (2017). The Cost-effective Laboratory: Implementation of Economic Evaluation of Laboratory Testing. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
10. Kleymann-Hilmes, J., Brünschwitz, S., & Müller, M. (2022). Qualitätssicherung in medizinischen Laboratorien – Eine Unentbehrlichkeit mit Nutzen und Risiken. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
11. A. Pence, M. & Liesman, R. (2020). Clinical microbiology. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
11. Donald Moshen, T. (2010). Cost challenges for laboratory medicine automation in Africa. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
12. Avivar, C. (2012). Strategies for the Successful Implementation of Viral Laboratory Automation. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)



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13. De Lappe, N., O Connor, J., Doran, G., Devane, G., & Cormican, M. (2009). Role of subtyping in detecting Salmonella cross contamination in the laboratory. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
14. Marit Andersen, B. (2018). Laboratories. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)
15. Raoult, D., Edouard Fournier, P., & Drancourt, M. (2004). What does the future hold for clinical microbiology?. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)