

Analyzing the Efficiency of New Staining Methods in the Diagnosis of Fungal Infections

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ABSTRACT

Due to the growth of at-risk populations and the adoption of therapeutic techniques that extend these patients' lives, fungal infections are becoming more common. Changes in the temperature, the expansion of human habitats, the ease of travel, and population shifts all contribute to the variations in endemic fungal diseases. Patients receiving immunosuppressive and chemotherapeutic drugs, those with HIV, premature babies, the elderly, and those undergoing major surgery are among the at-risk groups for opportunistic fungal infections or disseminated endemic fungal infections. As a result, there has been a change in the mycoses seen in the healthcare environment. Before the turn of the twenty-first century, *Aspergillus* species and endemic mycoses were the main culprits behind invasive lung infections. In contrast, *Candida* species were more commonly responsible for bloodstream infections. Fungi once thought to be nonpathogenic are often observed in immunocompromised individuals. These include mucoraceous species (formerly known as zygomycetes) and hyaline and dematiaceous moulds. Furthermore, a common issue that has significant therapy ramifications for these individuals is identifying infection as opposed to colonization with these fungi.

Keywords: Efficiency (EE), New Staining Methods (NSM), Diagnosis (DD), Fungal Infections (FI)

INTRODUCTION

Fungal infections have become the main concern these days. There are different types of Fungal Infections, such as athlete's foot, ringworm, jock itch, nail fungus, scalp ringworm, and others. Other types of Fungal Infections are related to the immune system, such as fungal infections related to HIV, Fungal infections related to organ transplants, fungal infections related to cancer, and others. There is a need for such staining methods to diagnose these fungal infections, which can provide swift results[1]. In this introduction, we are going to discuss what new staining methods are used for the diagnosis of a fungal infection at an early stage. In recent years, primitive staining methods such as Giemsa and PAS have been used to diagnose fungal infections. Giemsa is the old type of staining method used to recognise parasites, microorganisms, and cellular components. Although it is an old staining method, it is used for the diagnosis of malaria, bone marrow examination, microbial infection, tissue staining, and other purposes. However, there were some limitations in this staining method, such as the interference of background staining [2]. This method also needed expertise in microscopic examination. There was also variability in the staining method. The other primitive stain method is PAS, an abbreviation for periodic acid Schiff stain. This staining method was used to identify carbohydrates, lipoproteins, and glycolipids in tissue sections. Although it was used to diagnose diabetes, glycogen storage diseases, fungal infection Diseases, tuberculosis, and others. However, there were some limitations in this staining method, such as the need for high expertise in histology for using such a staining method[3]. Now, these old staining methods are not used, but better there are being developed old ones. The most important new staining methods are fluorescence in situ hybridization, which is abbreviated as FISH; immunofluorescence assays, which are abbreviated as IFA; confocal laser scanning microscopy abbreviated as CLSM, quantum dot-based staining; nano particle-based staining, and others. When we talk about fluorescence in situ hybridization, we may come to know important aspects related to it. It is a molecular technique used to diagnose and locate specific types of DNA using

fluorescent probes. The main principle of this staining method consists of three important steps[4]. The first step is the denaturation of target DNA and probe. The second step is the hybridization of the probe with the main targeted DNA. This hybridized probe is detected by fluorescence. This type of staining method is very important because it can be used for the diagnosis of genetic disorders such as downs syndrome, for the identification of abnormalities related to chromosomes, for analysis of gene expression, for microbial identification of bacteria, for staining fungal infections, for cancer diagnosis, and others[5]. This staining method is considered one of the best staining methods for the diagnosis of fungal infection. There are many advantages of this staining method, such as it has high sensitivity and specificity, it can provide results within a few hours, and it can detect fungal infections in very complex samples; this staining method is mostly non-culture-based. There are also a few limitations to this staining method, such as the need for specialized equipment to perform such a staining technique. The other limitation of this staining method is some challenges in probe design and optimization[6]. The other limitation is that it can also produce fluorescence in the background. The other important staining method for diagnosis of fungal infection is immunofluorescence assays. This staining method is used to identify specific antibodies or antigens in a given sample by using fluorescence. There are two major steps in the procedure of this staining method. The first step is labeling antibodies with some special fluorescent dyes, and the second step is using a microscope to detect the binding of antibodies [7]. This staining method is not only used for diagnosing fungal infection but is also useful for diagnosing other infectious diseases, such as malaria. It can also be used to diagnose autoimmune disorders. There are two types of IFA. One is direct IFA, which is mainly used to detect fungal antigens. The other type is indirect IFA, which is used to diagnose antibodies produced against fungal antigens. It can be used to diagnose invasive fungus. It can also be used to detect a fungal infection in blood, tissue, or any other body fluid[8]. The species of fungal infection can also be

identified by this staining method. This staining method can also be used to monitor the body's treatment response. Although there are many applications of this Staining method there are some limitations of this staining method. For example, this staining method may sometimes provide wrong positive and negative interpretations. The next important type of staining method used to diagnose Fungal infection is quantum dot-based staining. In quantum dot-based staining, nanoparticles are used are utilized to detect different types of biomolecules. The principle of this staining method consists of three main steps[9]. The first step is the absorption of light by quantum dots. The next step is the binding of quantum dots to the targeted molecule. The third and final step is the fluorescence microscopic examination for detection of quantum dot labelled target molecule. Different fungal targets for this staining method include candida albicans, aspergillus fumigatus, Histoplasma capsulatum, and others. There are many important applications of this staining method, such as its multicolor imaging capabilities, nontoxicity, and bio compatibility. It is resistant to photobleaching, and it is not photosensitive. However, there are some limitations to this staining method compared to previous staining methods. It requires highly specialized instruments and experts to perform its procedure. The other limitation is that it may sometimes not give accurate results because of background fluorescence [10]. Additionally, improvements in patient care (platelet transfusions, for example) and diagnostic radiography have made it possible to pursue certain diagnoses more easily by obtaining tissue biopsy specimens from body regions previously unsuitable for histopathologic analysis. Due to the minimal amount of tissue retrieved and the architectural distortion caused by these novel methods, the benefits of acquiring these specimens have presented a number of diagnostic issues. Furthermore, the diagnostic problems have been exacerbated by the treatment arsenal now in use and the fungi's medication resistance. Histopathology is still a quick and affordable way to get a preliminary or final diagnosis of an invasive fungal infection. Nevertheless, these problems cannot be resolved by using fungal silver impregnation stains (Grocott or Gomori methenamine silver [GMS]); instead, more advanced diagnostic methods would be needed. To achieve organism-specific diagnoses, microbiologists, pathologists, and clinicians must understand the drawbacks of morphological diagnosis, the tests that may be run with tissue and other materials, and the limitations of tissue diagnosis.

Research Objective

The main objective of this research is to understand the aspects of different new staining methods used for the diagnosis of Fungal Infections. This study describes the important applications and limitations of these staining methods. Studying the Effectiveness of Novel Staining Techniques in the Identification of Fungal Infections is the conclusion drawn from the research. There are five distinct sections in the study article. The purpose of the research is stated in the first section, which serves as an introduction. The literature review is presented in the second section. The process is explained in the third part. The results and their explanations are covered in the fourth part. The last section provides a summary of the whole body of research and a suggestion regarding the subject.

LITERATURE REVIEW

Researchers claim that staining techniques make diagnosing any fungal or parasitic infection possible. Clostridium is an infection-

causing condition. Its presence in an affected patient is predicted by applying the blue stain technique to the patient's feces sample. specific toluidine blue stain is used for the staining purpose of clostridium[11]. Studies reveal that the majority of respiratory tract infections are caused by bacterial strains, but in some cases, fungi cause this infection. Among individuals with low immunity, the prevalence of fungal pneumonia is high. Adopting an effective diagnostic approach for fungal pneumonia treatment requires a lot of medical research on this type of pneumonia[12]. studies show that fungal diseases show nonspecific symptoms, and thus, diagnosing them is a bit difficult task. the approach of SSS proves helpful in predicting the fungal mode of action. the SSS revolution is related to the speed of spread of fungal infection, the simplicity or complexity of infection , and the sensitivity associated with fungus[13]. Studies predict that patients with less active immune systems are exposed to pathogens. These pathogenic strains could be caused by fungus or bacteria. in the case of CM, the Cryptococcus neoformans is the fungal strain responsible for this disorder. People with AIDS have a higher susceptibility to developing CM, and in most cases, such patients die at an early stage of the disease[14]. Scholars explain that skin infection, in medical terms, is regarded as a dermatophyte that is caused by a fungal attack. Despite of development of a lot of skin infection-related medication, the fungus causing skin cancer is growing rapidly around the globe. A huge number of people are affected by skin infections caused by fungus. however, dermatologists have adopted various strategies to provide general public guidelines for preventing skin infection[15]. Studies show that the sudden surge in IFIs is common among people already suffering from immune disorders. To prevent the fungal infection from worsening, accurate and timely diagnostic methods are used during the treatment process[16]. Studies suggest that AK and FK cause serious fungal infections. The main feature that makes the fungal studies on these infections common is that both of these infections belong to microbial keratitis. Inappropriate or delayed treatment provided to AK and FK patients can cause permanent blindness in them. The scanning technique that has been widely used for these fungal infections is the Vivo corneal scanning technique[17].also, IFD is another fungus type that greatly burdens the healthcare sector. The number of cases due to IFD is high, and proper treatment therapies are required for its treatment. Anti-fungal therapies are provided to patients for early diagnosis. The molecular diagnostic approach is the most preferable for IFD as it overcomes the limitations of traditional techniques[18]. Studies predict that AI is the best technology for optimizing research work on fungi to determine the mode of disease-causing action of all types of fungi. Moreover, AI is specialized to provide large amounts of data in a short period with high accuracy that improves the overall research outcomes[19]. Studies elaborate that FK is a severe eye infection caused by fungal strains that badly impact eyesight. The one major risk factor for FK is traumas. a person facing any trauma condition affected by FK fungal strains could become blind[20]. studies explain that histopathology is a diagnostic approach for identifying fungal infections. The diagnosis process during the histomolecular process is carried out on FTs using next-generation sequencing technology[21]. Studies suggest that fungal infection on various parts of the body, especially on the skin, is explained through a dermatology approach. The layers of skin get colonized due to fungus and cause skin related serious complications. Various methods are used to identify the dermatophytes, but the gold standard is the most acceptable method. PAS stains are also used to identify to identify the fungus on the skin[22]. Studies reveal That

most individuals in the world are immunocompromised which means their immune system is very weak. The weak immune system of a person makes him immunocompromised, and therefore, the chances of getting the fungal infection increases. The old methods of fungus detection were based on lung culture sampling, but with technological evolution, biosensors have been developed to detect the presence of the fungal gene in the samples [23]. Studies suggest that patients who are already affected with HIV could easily develop any fungal disease. various diagnostic methodologies have been developed by clinicians to find the reason behind high mortality rates due to invasive fungal infection[24]. Scholars show that adapting microfilaments fungi to various environmental conditions makes them easily spread among the population. The rapidly dividing activity of filamentous fungi allows them to make biofilm. This biofilm makes these fungi resistant to UV and other immune responses by the host. By assessing these biofilms, it becomes easy to predict disease diagnostic procedures. MTT methodology is used to identify these biofilms[25]. Studies predict that the classification process of images of fungal samples is a critical process. Many automated models have been developed to identify the stained images. An automated algorithmic model like CPN efficiently classifies stained fungal images[26]. Studies explain that if the risk associated with dermatomycosis increases,, then the possibility of a person's mortality increases. the high-death risk assessment provides more chances for accurately treating the disease. The old methods of treatment have been replaced with a new staining method that makes the process of the type of fungus detection an easy task[27]. Scholars' studies concluded that PCR and culture stains duties are among the two methods used for studying fungus histopathology. PCR is an amplification diagnostic test that improves the quality of diagnostic tests and provides reliable and authentic information[28] Moreover the PCR testing is a method that provides deep sequencing information about the fungal disease. the patients of FK undergo stable fungal testing to diagnose the disease condition at an early stage. After the diagnostic test, the patients provided with medical therapies for proper recovery from fungal infection. Also, developing preventive strategies helps prevent the spread of fungus in all parts of the body [29]. Researchers claim that WHO has regarded one fungal strain as highly pathogenic and infectious. this fungus is named as aspergilli and results in aspergilis. to detect the fungus morphology, many products testing and diagnostic testing are done on Aspergillus. also, the effective role of NGS in sequencing the information about aspergilli's species has been discovered through various research studies[30].

Methodology

The research study determines that Analyzing the Efficiency of New Staining Methods in the Diagnosis of Fungal Infections. The research was based on primary data analysis to determine that the research used questions related to the new staining methods and diagnosis of fungal infections. For measuring, the research, used Smart PLS software and it describe descriptive statistic and correlation coefficient analysis between them. The staining method has been used for many years to diagnose and detect different substances related to some kind of infection. When we study the characteristics of fungi, we know that they can grow in harsh environments as well. These fungi can cause disease in different ways on and in the human body. So, there is a dire need to use such diagnostic methods that can provide swift analysis of fungal infection. For this purpose, there are a variety of new staining methods that are useful for the diagnosis of fungal

infection. The following are the important implications of analyzing the efficiency of new staining methods in diagnosing fungal infections.

Rapid and Efficient Detection of Invasive Fungal Infection, Enhanced Detection of Fungal Antigens by Using Samples, and Diagnosis of New and Rare Fungal Infections

There are a variety of clinical implications for using these new staining methods to diagnose fungal infection. There are various staining methods, such as fluorescence in situ hybridization, immunofluorescence assays, quantum dot-based staining, and others. All these staining methods are not based on simple physical reactions for identifying fungal infections. These methods use probes that can detect the specific genetic material of fungi by different methods, such as fluorescence. As we know, the cases of Fungal infections have been increasing across the whole world, so there is a need for swift and timely diagnosis of these Infections. Using these staining methods, we can detect fungal infections in a Better and more accurate way. The other important implication of using new staining methods for diagnosing fungal infection is diagnosing fungi's antigens. As we know when fungus enters into body, the fungus has specific antigens on it. As a response to these antigens, antibodies are produced in the body. So, these staining methods focus on identifying these particular antigens in the body. There are some direct methods of staining which identify the antigens of fungi in the human body. At the same time, there are some indirect staining methods, such as indirect IFA, which identifies the presence of fungi in our body by detecting specific antibodies in the body which are produced in response to fungal infections in the body. So, it is the important implication of new staining methods that help identify the accurate antigens of fungal infection. This aspect will help treat fungal infections with better medication. The other important implication of using new staining methods for diagnosing fungal infection is the discovery of New and rare fungal infections as we know, a polluted environment gives rise to many types of pathogens, including fungi. So, when we use these new staining methods, they will help us discover new and rare types of fungal infections. As these staining methods are based on genetic analysis of fungi, they will also help identify species of these fungi. These genetic analyses will also help develop vaccines against these fungal infections. In this way, we can say that these new staining methods are important because of their variety of applications.

Evaluation of Staining Efficiency, Investigating the Causes of Pathogenicity of Fungi, and Development of Multiplex Staining Methods

As we have described, there are a variety of staining methods that can be used to diagnose fungal infection. However, every staining method has a few applications along with a few limitations. So, it is necessary to evaluate the efficiency of each staining method. There were also some previous and old staining methods that had few limitations, so new staining methods replaced them. So, for evaluation of staining efficiency, we can analyze these new staining methods. Sometimes, there are causes that make it difficult to diagnose fungal infections. In such cases, that staining method must be used with high efficiency. The other important implication of using new staining methods for the diagnosis of fungal infection is investigating the cause of the pathogenicity of the fungus. As we know, the main cause of the pathogenicity of any pathogen lies in its genetic material. By using these new staining methods for the diagnosis of fungal infection, an analysis of the genetic material of the fungus can be performed, which

can provide us with information about the cause of the pathogenicity of the fungus. The other important implication of using these new staining methods for the diagnosis of fungal infection is the development of multiplex Staining Techniques. The multiplex Staining method is a type of staining method that can detect more than one targeted molecule at a single time. This staining method will be helpful in this way that it will save time and cost and can provide accurate information about more than one targeted molecule by a single procedure. Because of these implications, new staining methods have gained much importance in the diagnostic sector of the healthcare aspect.

Education and Training of Healthcare Professionals, Awareness and Monitoring Programs for Public Welfare

As we know, these staining methods are performed by healthcare professionals, so proper training and education of healthcare

Descriptive Statistic Analysis

Table 1: Result of Descriptive Statistic Analysis

Name	No.	Mean	Median	Scale Min	Scale Max	Standard Deviation	Excess Kurtosis	Skewness	Cramér-Von Mises P Value
EE	1	1.900	2.000	1.000	4.000	0.755	-0.252	0.460	0.000
NSM1	2	1.460	1.000	1.000	3.000	0.607	0.017	0.988	0.000
NSM2	3	1.840	2.000	1.000	3.000	0.674	-0.782	0.209	0.000
NSM3	4	1.620	2.000	1.000	4.000	0.690	1.408	1.060	0.000
DD1	5	1.520	1.000	1.000	3.000	0.574	-0.610	0.573	0.000
DD2	6	1.580	2.000	1.000	3.000	0.603	-0.574	0.528	0.000
DD3	7	1.560	1.000	1.000	3.000	0.637	-0.442	0.723	0.000
FI1	8	1.460	1.000	1.000	3.000	0.607	0.017	0.988	0.000
FI2	9	1.700	2.000	1.000	4.000	0.700	0.927	0.866	0.000

The previously mentioned outcome in table 1 indicates how the findings of a descriptive statistical study explain the probability value of each variable by describing mean values, median rates, standard deviation rates, and skewness values. The EE indicates that 1.900 is the mean value. There is a 75% standard deviation rate. 0.000 is the total probability value. It demonstrates their 100% significant rate of agreement. The mediator means values for NSM1, NSM2, and NSM3 are 1.460, 1.840, and 1.620,

professionals is mandatory so that they can perform these staining methods Better and more accurately. So, proper study and analysis of new staining methods for the diagnosing fungal infections will help provide better education and training to healthcare professionals.

The other important implication of using these staining methods for diagnosing fungal infection can be described well in the relevance of monitoring and awareness programs for public health. The knowledge that we get from the analysis of these new staining methods can be delivered to the public through awareness campaigns in different areas, including rural and urban areas. The monitoring programs can be carried out in a better way, which can help us understand the early symptoms of fungal infection even before the time. In this way, we can say that analysis of new staining methods for the diagnosis of fungal infection will help us in the aspect of public awareness as well.

respectively. Each variable's standard deviation rate is 60%, 67%, and 69% of the mean. The mean values of 1.520, 1.580, and less than 1.560 positive average rates are shown by the DD1, 2, and 3. There is a 57%, 52%, and 72% standard deviation from the mean values. The outcome indicates that FI1,2 stand for 1.460 and 1.700, respectively, being the mean values. 60% is the standard deviation, meaning that 70% of the data deviates from the mean (Figure 1).

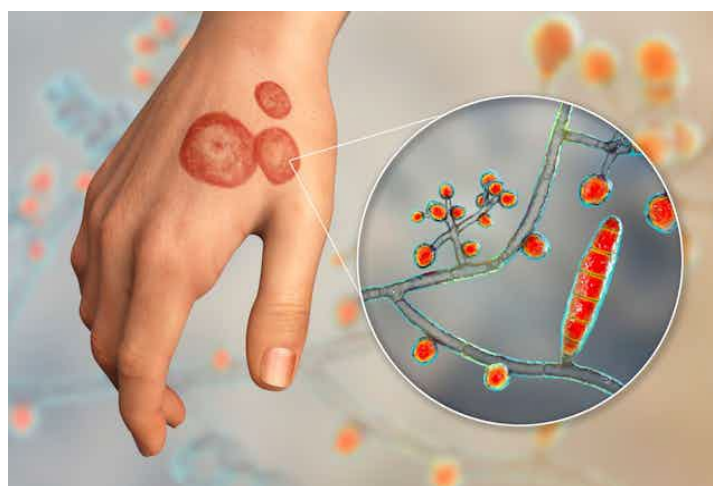


Figure 1: Fungal Infections

Molecular Diagnostics

Nothing is developing more quickly in the field of clinical mycology than the use of contemporary molecular technologies for fungal identification. The fast collection of protein and DNA sequence data, which never stops and gets faster with every new technological

development, as well as the increasing requirement to identify a wider variety of fungus, have been major factors in this field's progress. Crucially, as molecular techniques do not rely on traditional phenotyping techniques, they directly address the diminishing number of clinical mycologists in the field of fungal diagnosis and identification. Similarly, a growing number of fungi that cause illness

in both people and animals may be identified using molecular approaches.

Non-Culture-Based Molecular Diagnostic Methods

A subgroup of diagnostic techniques known as molecular identification techniques don't always require living fungal cells to be effective. Pure cultures are usually the greatest source for accurate results when using molecular approaches for fungus identification. However, as many molecular identification techniques rely on the polymerase chain reaction (PCR), molecular identification can still function without active cells if patient materials, such as fixed tissue, include template nucleic acid. PCR is an essential part of many molecular procedures, either as the main diagnostic strategy or as one of the initial steps of the test. As a result, diagnostic PCR uses a range of methods. The most basic method is conventional PCR, which amplifies fungal DNA from clinical specimens using primers unique to the species, which were designed based on available sequence or data. The readout usually comprises of whether a band exists or not, and the size of the band is sometimes used as an additional identifier. This type of PCR is simple, inexpensive, and not FDA-approved, yet it is very variable within and across laboratories. Furthermore, there must have been some prior uncertainty about the identity of the isolate,

which the PCR result will confirm. However, it is still in use in research laboratories that occasionally may need to do diagnostic tests on certain species, and if the thermocycler has a consistent power source, it could be suitable for labs with modest equipment. PCR products are resolved on a gel and visualised as the last step of the experiment. Restrictions enzymes can be employed to further boost the discriminating power of typical PCR procedures by breaking down the PCR products. Based on the different sizes and presence/absence of the particles, an identification may then be determined. This method was very useful in early fungal taxonomy. Unfortunately, because of its high variability and confirmatory nature—which might provide positive or negative results depending on the suspected pathogen—PCR is not widely used in clinical laboratories. Importantly, conventional PCR serves as a confirmation test; a positive outcome just confirms the presumed fungus' identity. The confirming nature of the test stems from the need to design primers that anneal to specific target sequences already discovered from a known organism. If the product is going to be sequenced, that might significantly increase the number of fungi that can be amplified. To achieve this, certain strategies are used in the design of primers and the identification of targets. Nevertheless, this identification can be expanded to genus or higher taxonomic levels using degenerate primers (Figure 2).

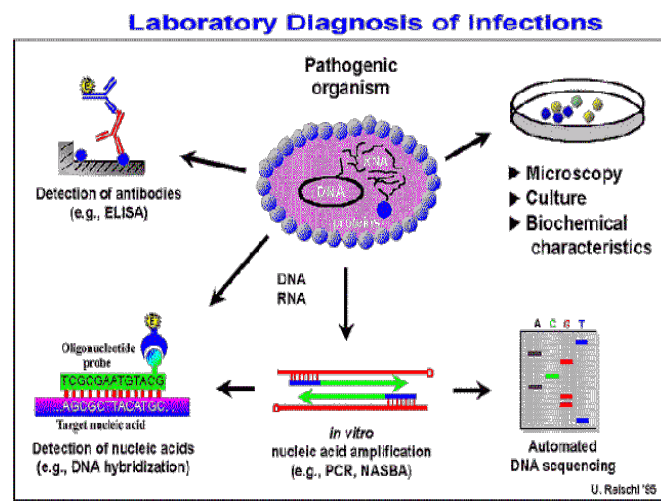


FIGURE 2: New Staining Methods of Infections

Correlation Coefficient Analysis

Table 2: Result of Correlation coefficient Analysis

	EE	NSM1	NSM2	NSM3	DD1	DD2	DD3	FI1	FI2
EE	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NSM1	0.362	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NSM2	-0.267	-0.358	1.000	0.000	0.000	0.000	0.000	0.000	0.000
NSM3	0.157	0.274	-0.088	1.000	0.000	0.000	0.000	0.000	0.000
DD1	-0.157	0.060	0.008	-0.309	1.000	0.000	0.000	0.000	0.000
DD2	0.127	0.036	-0.018	0.386	-0.293	1.000	0.000	0.000	0.000
DD3	-0.008	0.006	-0.350	0.029	-0.140	-0.169	1.000	0.000	0.000
FI1	0.275	0.240	-0.162	-0.012	0.002	0.091	-0.149	1.000	0.000
FI2	-0.246	-0.099	-0.144	-0.112	0.189	-0.014	0.421	-0.005	1.000

The results above shown in table 2 show that there are some positive and some negative correlations between them according to the correlation coefficient analysis. Fluorescent dyes, such as SYBR green, are used in real-time PCR to improve specificity.

The dyes are either nonspecific DNA-binding dyes or they are specific fluorescently labelled probes that are aimed at a target

sequence located inside the amplicon. This is not the case with traditional PCR, where the ultimate readout is ethidium bromide-stained PCR products electrophoresed on a gel.

For probe labelling and fluorescence detection, a variety of thermocycler systems (such as Light Cycler, GeneAmp) and chemistries (such as Taqman, Molecular Beacons) are available, and

their combinations can offer different throughput levels. Fluorescent probes have been added to PCR, making it appropriate for use in

clinical laboratories. Nanoscale implementations of this technique allow for the identification of many species utilising various matrices.

Smart PLS Algorithm Model

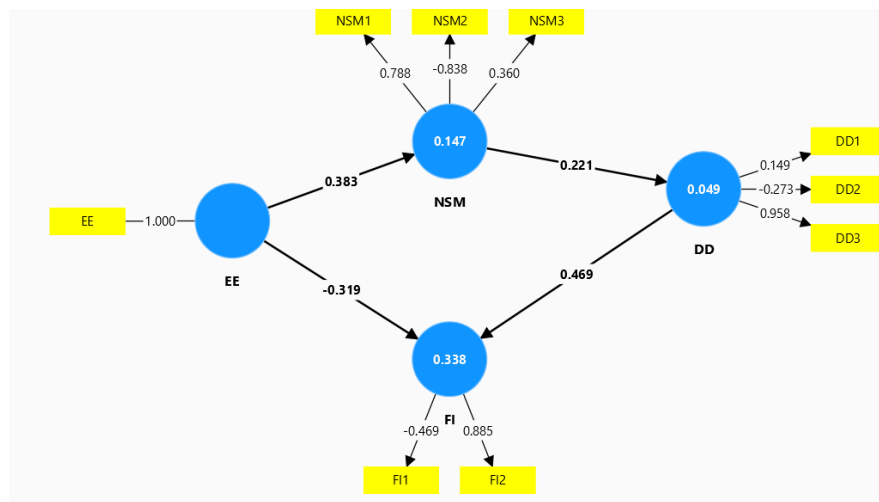


Figure 3: Smart PLS Algorithm Model

The above model of result of figure 3 called smart PLS Algorithm model result describe that EE present negative link with FI its rate is -0.319 the FI shows that 46% positive and significant link with DD. The result also describes that 14%, 27%, and 95% positive relation with them. the NSM describe that 14% and 38% positive also significant link with EE respectively.

Conclusion

After an overview of these aspects of the implications of utilizing these new staining methods for the diagnosis of fungal infection, we may conclude that there are many advancements in staining techniques that can be proved effective for healthcare sectors. To satisfy the various needs of various fungal diseases and the testing resources available, many diagnostic platforms are probably going to be required. An optimal test would identify infection at an early stage of the illness, maybe even prior to the onset of symptoms. Antifungals might be administered at the most probable period for therapy to be

effective an early diagnosis would allow for this. For instance, if medication is postponed by more than twelve, the death rate from invasive candidiasis increases by 20%. The discovery of cryptococcal polysaccharide in the sera of patients starting antiretroviral treatment without cryptococcal meningitis symptoms is an example of a diagnostic test that can indicate subacute infection. Second, treating patients at high risk for IFD would benefit greatly from a test with a significant negative predictive value. The research study determine that efficiency related to the new staining methods in the diagnosis of fungal infection.

The overall research concluded that direct and significant link of new staining methods in the diagnosis of fungal infections. The empirical treatment of neutropenic patients with unexplained fever who do not respond to broad-spectrum antibiotics frequently involves the use of antifungal drugs. Patients who shouldn't get antifungal medication might be identified by a test with a strong negative predictive value. Both the expense of patient treatment and the emergence of antibiotic resistance would decline as a result.

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