

Microbial Forensics: An Integral Part of Forensic Study

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ABSTRACT

Microbes liable for instigating infectious pathological disorders have been established to be accountable for nearly 15 million deaths globally per annum. However, foremost investigations and developments have equipped the mankind to combat such microbes. Regrettably, such discoveries that aid the mankind to combat such microbes can also be exploited to create and produce modern distressing biologic weapons that can be used notoriously in acts of bioterrorism. In order to trace them, for the purpose of a felonious investigation relating to the act of bioterrorism, microbial forensics has arisen as the most recent branch of forensic science. Microbial forensics is a comparatively fresh emergent division which unites the section of microbiology with medical forensic science, where microbial agents act as a part of the staunch legal evidence in civil and criminal cases. The core purpose of the review is to focus of microbial forensics and explain the enormous potential associated with the branch.

KEYWORDS: Bioterrorism; Forensics; Microbiology

INTRODUCTION

The human body is a household to trillions of microorganisms, living both extrinsically as well as intrinsically. Such microorganisms are immensely diverse and range from bacteria, virus, fungi, to protozoa. The viroids are also considered to be a part of it, while some scientists consider them as non-living.¹ The momentary extrinsic group of microbes is obtained from the external environment, while the intrinsic microbes are present in the human body for a longer phase of time. The study in relation to such microorganisms is referred to as microbiology.

Forensic science is a branch of medicine which is an implied field of science associated with civil and criminal lawsuits. A very integral part of such forensic science is the microbial forensics that has been designated as a technical discipline linking microbiology and forensic medicine committed to the examination of bioterrorism and bio-crime. The branch embraces an enormous opportunity of forensic science bludgeoned with microbiology, which comprises scrutiny of microorganisms or their toxins as well as the constituents used to formulate, stockpile and distribute the pathogenic microbe. The mammoth prominence of this novel branch is vital for the contemporary domain owing to the fact the knowledge and expertise possessed by the felonious terrorist could be calamitous to the mankind. The influence and bearing of such an attack have been perceived manifold stretches in history. Nonetheless, it was earnestly reflected when the United States observed a threat of an anthrax attack in the United States in the year 2001. Sensing the potential of such science, there was a

new branch formulated in forensics, referred to "Microbial Forensics".²

However, the primary ideology to utilize forensic science for the purpose of the criminal investigation initiated in the year 1995. It was apparently beneficial to use forensic medicine in contrast to the routine investigation owing to the view that investigations with the aid of forensic science could be effortlessly performed without the obtainability of witnesses, timely reportage, archives accessible for assessment, and unforeseen evidence. Back then it was perceived that one day a minor number of expert beings would thrive in such an action, by having acquaintance with microbial forensics, employing safe keeping, and using elusive resources throughout diffusion of an organic agent.³

FORENSIC SCIENCES

Forensic science denotes the usage of scientific discipline to explore and institute proofs in the court of law. It is a comprehensive undertaking that encompasses variegated branches of toxicology, processor exploration, fingerprint scrutiny, DNA expertise and other essentials. The branch emphasizes on the microbial aspect of the victims of the crime along with the entities who executed the misconduct.⁴ It denotes to the revealing of dependably checked molecular variations amid linked strains and utilizes the information to spot the derivation of a precise forensic sample.⁵ Nevertheless, efforts must be made to form margins and restrictions that would restrict and construct confines towards the guidelines of engagement of the applied field. The field of microbial forensics has

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taken derivation and aid from numerous fields, some of which includes microbiology, genomics, processing and much more.⁶ The amalgamation of such branches into microbial forensics provides a conceivable alternative for swift and dependable inference to maintain law and order in the society.

PRECEDING & EXISTING ISSUES OF BIOWEAPONS

Even though the concept of biological weapons and bioterrorism is equitably novel, a proportionate amount of documentation with regard to it has been found in the literature. The primogenial reference can be perceived in Bible where God send about ten lethal pestilences to free Israelites from Pharaoh. A peculiar instance of the use of bioweapon was observed in the United States of America where a gastroenterologist was sentenced for inoculating his prior partner with blood-derives gained from an HIV-1 infested patient.⁷ In Europe, bio-terrorism has been observed with the use of ricin, similarly in Texas where a person deliberately injected his co-workers with Shigella. The infamous attack with anthrax spores in New York in the year 2001 was also an act of bioterrorism.⁸ Thus to prevent such attacks and to restrict the creation of bioweapons, a Biological and Toxin Weapons Convention was recognized and by around 170 states.

The most disturbing consideration of bioterrorism is that the potential use of microorganisms as weapons requires low capital and less sophisticated laboratory as compared to other weapons.⁹ There are numerous approaches to release such microorganisms in the community. However, most of the biological weapons formulate the microorganisms in the most pathogenic form and then subsequently release it. Moreover, with the recent advances in genetic engineering, an ecological commensal may too be armed with an operational contaminant fabricating gene. With such modifications, the biological weapon becomes tremendously stable and extremely potent. Such modification of biological weapons makes it challenging to identify the DNA sequence of the altered microbes.

MICROBIAL FORENSICS TO CONFRONT BIOTERRORISM

The foremost objectives of microbial forensics are to recognize the probable biological attacks, to ascertain the susceptible population, and to generate an information record. The field focuses on evolving etiquettes for credentials which inculcates the determination of inimitable genomic signs, protein signatures and thereby ripening packages for safeguarding the legitimacy of results.¹⁰ The most commonly faced problem is that the involved group of microbes may not be a known pathogen to humans, or could simply be an herbal pathogen that can perpetrate heavy financial mutilation.¹¹ The conception of an information catalog through the branch of microbial forensics would aid in guiding towards the outcomes and will help in the timely

diagnosis of the involved microbe. The database must encompass inputs from numerous conventional turfs comprehensive of microbiology and forensic science.¹²

SOIL MICROORGANISMS AS FORENSIC POINTERS

In order to connect a case to a local environment, soil microbes act as one of the staunchest forensic indicators. Customarily, numerous agencies perform analysis on the soil to define the chemical constitution, but it is generally unorganized due to lack of comparable databases. It was extremely arduous to culture certain species in the lab, but now with developments in molecular techniques, there is no such hurdle.¹³ The current studies focus on utilizing RNA gene sequencing which is comparatively cheaper and uses the ALH-PCR sequence.

VALIDATION PROCEDURES OBLIGATORY IN MICROBIAL FORENSICS

A complete validation procedure is always unique to each condition. However, few basic steps need to be followed irrespective of the nature of the condition. The steps are: A) Assortment and safeguarding: The accomplishment of an exploratory investigation hinges on the suitable assortment and safeguarding of microbial forensic substantiation. Appropriate assortment and safeguarding would ensure the reliability of the proof and uphold the peak level of attributing acknowledgment. Even though each evidence extract is exclusive, it is still fitting to ripen and cultivate typical methodologies.¹⁴ Variegated procedures and tactics may indicate to diverse results. Hence there is a necessity for a typical process to safeguard the collected evidence.

B) Removal of the microbial part: The removal of the microbial part from an assorted sample may or may not be vital depending on the state of affairs. It is necessary when the assortment is made using a swap or a filter, in which the microbe needs to be separated from the homogenous media. However, it may not be necessary when microbes are collected by replicating organisms from an agar plate.

C) Analytical constituent: In order to carry out the specific analysis for microbial forensics, multiple accounts of validation actions exist in the literature. Most of the validation actions lack the consistency essential for operational clarification, but some of them have been fairly valid for the uncovering of nucleic acid targets.¹⁵ Also, judicious and well-timed sampling is of enormous worth due to its swift destruction.¹⁶ Moreover, every trial should be measured hypothetically perilous and handled only in an equipped laboratory.

CONCLUSION

Microbial forensics is a budding impending branch that is being employed for emphasizing the vital role of

microbes in the forensic study. With astonishing advances in science including molecular biological assay, microbial forensics is turning out to be an integral fragment of forensic science. Nonetheless, heaps of investigation is vital in this arena along with a domestic and international alliance to counteract the menace of bioterrorism.

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