



Relevance of Bioinformatics in Medical Laboratory Science

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Abstract

Bioinformatics in medical laboratory science is a branch of diagnostic medicine that uses computer system in the analysis of body fluids and tissues for effective disease diagnosis and treatment. Here, this article explains the specific and roles bioinformatics has played for effective disease diagnosis. It touches each specialties found in medical laboratory science which includes microbiology/immunology, chemical pathology, hematology and histopathology.

Keywords: Relevance, Bioinformatics, Medical Laboratory Science

INTRODUCTION

Bioinformatics is the collection, manipulation and analysis of biological information or materials with the aid of a computation system. It can be defined as “the application of computational tools to organize, analyze, understand, visualize and store information associated with biological macromolecules [1]

The steady demands for analysis and interpretation of discoveries lead to the evolution of the science bioinformation. It uses the mechanism of computation and analysis in interpreting biological data. In some countries bioinformatics is referred to as computational biology while others have different school of thought towards it [2].

Being a combination of multidisciplinary fields, bioinformatics derives its branches from computer science, statistics, mathematics and medicine. The objective of bioinformatics is to develop methods and procedure of studying large volume of biological data for effective analysis and interpretation of those data.

These biological data relates to the field of genomics, proteomics and other metabolomics. It uses algorithms and practical problems arising from biological data [3]

Bioinformatics has reduced the trial and error process of drug discovery to a rational and structure based drug design. This has given opportunity to drug target identification based on patient molecular modelling and stimulation. It has improved pharmaceutical research and drug or vaccine development and discoveries.

Indeed, Bioinformatics is of great relevance in Medical Laboratory Science. Medical laboratory science is a branch of health science or medicine known for disease diagnosis. It involves using body fluid, tissues and products to examine the nature of the body system[4].

Bioinformatics in medical laboratory sciences uses computation in the analysis of body fluids; tissues etc..., for effective diagnosis and treatment of diseases.

Bioinformatics has created great impact on the different discipline in medical laboratory science such as microbiology and immunology, chemical pathology, haematology and histopathology [5].

Microbiology and immunology

The ambiguity of micro-organisms makes human environment unsafe. This also causes inversion a day to day experience. Bioinformatics through the genetic studies reveals the DNA structure of micro-organisms for example; there has been crucial fight against the SARS- Cov-2 virus that causes Covid-19. Computer analysis has made it possible to reveal the identity and molecular structure of virus proteins in a way that allows easy development of vaccines. Such identification is made with aim of understanding the genetic properties of the disease, causative agent, and computation of differences between already existing members of their family [6].

Immunologically, bioinformatics are used to study differential protein interaction mechanism across the entire immune cell lineages. This helps for easy identification of antigen- antibody reaction.

Chemical Pathology

Bioinformatics has shown to be useful in the diagnosis of cancer cells, diabetes-related diseases and other non-malignant tumors through the presence of some disease biomarkers. To develop such screening, tests to identify the disease early stage, researcher uses bioinformatics tools or data to identify possible disease biomarkers.

Numerous makers in DNA, RNA and protein level can be as prognostic biomarkers in cancer and guide the effect of treatment either independently or in addition with present prognosis system. This method is used to evaluate the relationship between biomarkers and effects or survival of patients with cancer [7].

Bioinformatics does not only reveal genes and gene clusters responsible for diabetes but also enables scientists to pinpoint genetic variations or SNPs(Single Nuclear Polymorphism) associated with type 2 diabetes.

Hematology

Hematology studies blood, its components and blood related diseases. Hematological diseases refer to diseases that originate in the hematopoietic system, or affect the hematopoietic system with abnormal blood changes and characterized by anaemia, bleeding and fever. Using bioinformatics methods aids in the diagnosis and treatment of blood related diseases. Also, through the analysis of molecular targets and biomarkers, new targets for drug resistance related to haematological disease have been discovered [8].

Bioinformatics supports in the diagnosis of the following areas in haematology

- Meta-analysis: by integrating phenotypes and environmental or genetic factors, mining factors related to the occurrence of haematological diseases.
- Genome-wide association analysis: mining genetic factors related to the occurrence of haematological diseases.
- Omics data analysis: research on the pathogenesis of haematological diseases.
- Biomarkers and target discovery: identify disease makers and biomarkers used to measure drug efficacy and mechanism of action.
- Genotype analysis: SNP genotype analysis and DNA sequence are used to dictate new SPNs related to disease or drug response.

Histopathology

Pathologists often stain tissue seeking for specific proteins known to be useful biomarkers of disease for example; Congo Red Staining technique use to demonstrate Amyloids. Bioinformatics opens the doors to the discovery of those biomarkers.

The emergence of field of bioinformatics enables the pathologist to actively contribute to better understanding of cancer pathologies through histogenesis which is simply the interpretation between morphology and genomics. It adds more meaning to the data provided.

Histological evaluation of tissues is the basis of anatomical pathology practice yet is famous for its inter and intra-observer variation.

The subjective evaluation of histologic specimens as currently practiced cannot possibly capture the detailed wealth of information in many disease tissues, including cancer.

This limitation triggered the concept of objectivity quantifying morphological properties in histopathological images to aid chemical decision making.

Bioinformatics algorithms have given improvement on image analysis by providing qualitative image features [9].

CONCLUSION

From this work, it can be said that bioinformatics has a touch on every aspect of medical laboratory, though diagnostic medicine is an independent body. But it creates a beautiful picture when it works with bioinformatics.

Bioinformatics builds its bond with medical laboratory science through the following;

- Gene sequencing: it aids in the present polymerase chain reaction (PCR), viral genetic reaction and mutation.
- Biomarkers: here, biomarkers are dictation which aids in personalized medicine. A health care that treats each patient based on individual genetic make-up.
- Antibiotics and Antiviral drugs production: Bioinformatics pays attention to the reason behind drug resistance through proper analysis in pharmacodynamics, and pharmacokinetics.
- Provides quality visualization of histopathological images.

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