Improving Diagnostics and Patient Outcomes in The USA Using Bioengineering Techniques

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Abstract- ***Medical diagnosis and personalized medicine in the United States have been greatly redefined due to the development of Bioengineering. The incorporation of Artificial intelligence, tissue engineering, biosensors have developed a better diagnostics process leading to early detection, precise diagnostics and personalized treatment processes. This research investigates the newest development in bioengineering and its benefits on patient outcome and the issues that are concerned with the implementation of these processes.***

I. INTRODUCTION

The rise of chronic diseases, increase in aging population and the high healthcare cost are some of the challenges of the health care sector in the United States of America. The application of Bioengineering which is concerned with integrating biological systems and engineering principles into medical sciences is essential in providing innovative solutions in the healthcare system. One of the forms in which bioengineering applies itself in solving the complex challenges in traditional medicine is through diagnostics which is essential in ensuring better treatment of patients. The need to fix the diagnostic world by introducing newer technologies is due to the realization that the traditional diagnostic methods lead to delay in results, inadequate sensitivity leading to questionable results and exorbitant costs. The increase in aging populations has led to an increase in chronic diseases as with humans old age comes with several ailments, this has reiterated the need for novel diagnostic solutions to help reduce the mortality rate. This is where bioengineering comes into play by developing newer technologies to improve the detection and treatment of diseases. The application of bioengineering to develop modern medicine has enabled the production of bio sensors, lab on a chip device, CRISPR based systems etc. These solutions have fostered accuracy in detection of diseases, reduced detection time frame and enabled better treatment of these diseases as early detection plays a huge role in the survival chances of a patient (McKinney et al., 2020). Biosensors have become critical in point of care testing which has helped quick detection of biomarkers in blood and saliva's of patients ((Clark & Lyons, 1962).

There has been great progress in the healthcare structure made by Artificial intelligence through its transformation of diagnostics techniques and its ability to detect patterns in large amounts of clinical data that will not necessarily have been observed by the traditional diagnostic processes. Artificial intelligence has proven to be a great tool in detecting chronic conditions like cancer, diabetic retinopathy, cardiovascular diseases and high blood sugar, it is more accurate at the detection of these conditions than traditional diagnostics, methods (Ardila et al., 2019; Gulshan et al., 2016).Bioengineering has brought about the creation of lab on a chip technology which has made the laboratory processes more better ensuring that complex tests now require very little resources and small sample volumes to be carried out (Whitesides, 2006). During the Covid 19 pandemic the importance of the changes made by bioengineering in the diagnostics sector was seen as essential to carry out quick but accurate tests to confirm patients' status. This played a huge role in saving the world and containing the spread of the virus. CRISPR-based technologies were also impactful as they were also a fast and accurate way of detecting SARS-CoV-2 virus (Kellner et al., 2019). While the detection of infectious diseases is one of the functions of these bioengineered diagnostic tools, they can also be used in the detection of genetic abnormalities and for monitoring the responsive and effectiveness of treatment given to patients diagnosed with chronic diseases. Bioengineering has transformed the healthcare eco

system for the better through its technological innovation and accessibility of its diagnostic tools, it's also cost effective when compared to traditional diagnostics methods. These diagnostic tools are mobile and easy to understand thereby enabling it to provide its services to the underserved population tackling the issues of disparities and access to adequate health care by people in the rural communities (Mahmud et al., 2018). Bioengineering processes has also played a vital role in personalized medicine enabling patients to receive tailored treatment plan depending on their genetics and individualistic traits this has led to better treatment plan for patients and reduce the level of side effects to medications.

II. ADVANCEMENTS IN BIOENGINEERING FOR DIAGNOSTICS

The production of biosensors has transformed the diagnostic world by providing a faster means of detecting diseases, a more accurate system. Biosensors work by detecting biomarkers which include proteins and nucleic acids from samples providing analysis in real time. An example of how this works is in the case of diabetes diagnosis, the glucose biosensors has aided patients' ability to conveniently manage their blood sugar levels as they can test for it conveniently from anywhere (Clark & Lyons, 1962). Wearable biosensors have also aided the monitoring of cardiovascular conditions and infectious diseases (Rao et al., 2021). Biosensors have experienced transformations and one of the most remarkable in the integration of nanotechnology into biosensors which has increased it sensitivity making it suitable for detecting low abundance biomarkers in cancer and neurodegenerative diseases (Park et al., 2020). These biosensors have been made accessible to rural and underserved communities through the incorporation of the smart phone technology into it. Artificial intelligence has been employed in bioengineering to analyze large data sets to detect the subtle indicative patterns of diseases

III. IMPACT ON PATIENT OUTCOMES

There has been an increase in the ability to detect diseases and an improvement in prognosis. This can be seen in the use of AI algorithms to enable diabetic retinopathy screening to improve diagnosis and prognosis accuracy (Gulshan et al., 2016). The diagnostics tools have been of immense benefits to patients, like the use of wearable biosensors to monitor heart rate and to detect arrhythmia, reducing the risk of having a cardiac arrest. Personalized medicine has received tremendous transformation because of the developments that Bioengineering have proffered. One of these benefits is pharmacogenomic test enables the prescription of specific for patients reducing the likelihood of them having an adverse reaction to the use of the drugs. All these benefits has enables better patient outcomes in the healthcare system and a decrease in mortality rate.

CONCLUSION

Patient care in the United States of America has greatly evolved due to the advancement of Bioengineering and the impact that it has had on healthcare diagnostics. The new diagnostics tools created because of Bioengineering have led to rapid detection of infections and diseases, the ability to create a sustainable treatment plan to attend to various individuals and has increased access of diagnosis facilities to people in underserved regions in the country. The diagnostics sector is still faced with challenges, but they can be solved through innovation and collaboration amongst several professionals in this industry and policy makers. A key player to ensuring that the impact of Bioengineering in the diagnostics sector is fully maximized is to tackle regulatory, ethical and mobility concerns of these diagnostics tools and methods across patients everywhere in the country.

RECOMMENDATIONS

Based on the reviewed study, the following is recommended;

- Investigate the ethical and legal challenges of using bioengineering innovations in personalized medicine and diagnostics.

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