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Biomems as a Tool to Decifer the Shortcomings of Pharmaceutical Analysis and Importance in Patient Self Care

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Abstract:- Over the years pharmaceutical analysis has been a field dominantly used in quantification, analysis, determination, separation as well as structure determination of pharmaceutical compounds. However it has largely been limited to laboratory structures, with limited influence in home-based care where it has left patients with a need to visit hospitals and pharmacies for disease monitoring. Drug monitoring remains an imperative part of healthcare systems, where a need to lessen the burden on the patients and medical practitioners is to be deemed a great necessity. This article reviews the interventions of BioMEMS in shifting the laboratory burden to an easier patient self-care system, which has thus made it a special part of pharmaceutical analysis that has proved to be reliable, time saving, patient friendly and has predominantly lessened the burden of patient monitoring in the medical field. Furthermore, there are recommendations for the future fabrication of biological micro-electro-mechanical system devices, even to nanotechnology to manage chronic pain, depression and psychiatric issues.

Keywords:- *BioMEMS, patient self-care, drug monitoring, home based care.*

I. INTRODUCTION

For years analytical chemistry reposed as a lab fixed tool for drug quantitation, qualitative analysis, compound identification and bio-assaying. This field of analysis has been an essential phenomenon integrating and underpinning the biomedical and the pharmaceutical analysis, research and development spheres. Through analytical chemistry and analysis, it has therefore been easy to identify ample quantities of drug, analyze biological samples. Hospitals have managed to monitor patients and to diagnose diseases employing biomedical tools. This convention therefore remains an extensively crucial part of analytical chemistry which continues to gain advancements1. However, as efficient as laboratory analysis of pharmaceuticals and biological compounds has been, several limitations surrounded this practice especially in medical personalized healthcare system. These entailed the restriction of bio-assaying and quantitation of drug substances to the biomedical centers and laboratories where experts in the fields would do all the work. This was a very strenuous and time consuming practice, which is still to a large extent existing even though efforts are being labored in order to eliminate or at least to reduce dependence on hospital monitoring, thus giving home-based care an advancement through technology. This system , especially the art of reliance on hospitals and biomedical centers for monitoring posed and still does perpetually reminds the patients of their medical conditions, consuming a lot of money perpetually as long as the patient lives for those with chronic diseases, further consuming the time which could be used for socio-economic development. Efforts had to me made to make sure there are means to normalize the lives of those living with diseases, or at least bring their lifestyles to a near-normal state.

Over time it was realized that there is a vast need to take pharmaceutical analysis to unlimited dimensions, where identification and quantitation does not have to be fixed to the laboratory setting. This revolved in many fields as the demand and realization for improvements became a mist in the world of science. This article hinges mainly on two areas of expertise, which are Bio-MEMS (which simply stands for Biomedical Micro-Electro-Mechanical systems) and Robotics laboratory, and their relative impact in taking analytical chemistry to patients' homes without the need for an expert in that specific field of biomedical sciences.2

BioMEMS embodies the detection and environmental changes through the use of sensors, actuators, transducers, as well as electrical devices. BioMEMS then incorporates this intelligence of micronized components in the medical field, or in simple terms, it is Micro-Electro-Mechanical systems finding applications or solving biomedical problems. Sensors enable the detection of environmental changes in the biological sample that is under evaluation. The transducers will then change the energy from one form to another in-order for the system to be able to give out an output. A physical output is then originated from the electrical signals through the work of the actuator. The birth of micro-fabrication as a technology in BioMEMS has allowed components of micro-size to be fabricate, whilst other techniques like lab-on-a-chip has also resulted in miniaturization of electrical devices. These technologies utilize glass and silicon, plastics and polymers, paper, as well as other biological materials for fabrication. However, Silicon has been the most used, though huge bio-compatibility issues are recognized and have to be overcome before fabrication occurs. By virtue of this systematic flow of energy and small electrical devices currently available in the world of science, Bio-MEMS has recognized a surge in use in diagnostics, therapeutics and other medical related fields like tissue engineering etc. these include :

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II. CURRENT ADVANCEMENTS IN BIOMEMS AND NANOTECHNOLOGIES

- Glucose monitoring device and diabetes therapeutics
- DNA testing
- Pregnancy tests
- Artificial capillaries
- Artificial kidney tissue
- Defibrillators and pacemakers
- Retinal prosthesis

One of the Bio-MEMS technologies of humongous interest in personalized healthcare has been the MiniMed Paradigm 522 insulin pump for the treatment of diabetes. This technology works by monitoring the patient's glucose levels, and administering the insulin as needed by the body. A sensor is placed beneath the skin to continuously monitor glucose levels in the interstitial fluid. This sensor has a wireless connection with a radio device which directs the readings to a mini-computer. The mini-computer will then determine the amount of insulin which is needed by the body at that specific time. 3,4,5,6

III. ADVANTAGES OF BIOMEMS TECHNOLOGY IN PATIENT SELF-CARE

- 100 percent adherence to medication is guaranteed as there is elimination of the need to personally check blood glucose levels, which may be difficult for the patient to do every time at their homes and workplaces.
- Elimination of the regular self injecting practice which is painful and results in uneven skin tone. This is one of the major disadvantages of the diabetes treatments which needed intervention and most probably one of the reasons why such technologies had to spring up.
- Reduces the burden of home based care to a lower level where only the machine would be checked once in a while to refill the medication and to review the blood glucose levels in order to assess medication success in management of diabetes.
- Invalidates the need to visit hospitals, pharmacies or any laboratories for blood glucose checkups.
- Highly convenient

IV. FURTHER RECOMMENDATIONS OF BIO-MEMS IN PATIENT SELF-CARE

Chronic diseases have always presented colossal challenges in the medical field especially in terms of monitoring and adherence. Such Chronic diseases include chronic pain management, kidney diseases, asthma, hypertension and many others. This entails that something can be done to ease the management of such diseases through bio-MEMS. This article would highly recommend that pain management be delved into. Managing pain for geriatrics, for example those with arthritis can be laborious. Devices could be fabricated, or through the lab-on-a-chip sensors be programmed for detection of prostaglandins, leukotrienes, histamines and other important pain mediators. These devices, just like the diabetes MiniMed, should be coupled with the respective medicines that can be automatically administered, depending on the types of dosage forms of the drugs. Parenteral dosage forms of the drugs could be the easiest forms for the biomedical fabrication of a device that can manage pain with concurrent drug administration. This parenteral administration of painkillers fabricated through MEMS could be made to mimic the insulin administrating MiniMed device.

More devices could be fabricated for the self-management of Depression. This should be devised with sensors for the neurotransmitters serotonin, norepinephrine and dopamine which are the depression chemistry neurotransmitters altered when depression presents. This device could be made targeting those patients with chronic depressive disorder. In fact, delving into psychiatric management could result in a bigger market for Bio-MEMS since these are conditions that even the patient may even fail to regulate and take their medication in time. These are also best contrived by nanotechnology, as Nano-sizing medication and any device involved in daily treatment management could reduce the psycho-social impact on the patient and those in the same living area.

V. CONCLUSION

Advances in Bio-MEMs and Nanotechnology have conscientiously gained market in treatment management for various diseases and found an imperative role in patient self-care in the home setup, reducing disease awareness by maximizing adherence in a subtle but tremendously scientific way. As a result the foresight is that more devices could be invented in a similar way for abounding diseases.

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