International Journal of Engineering Management and Life Sciences (IJEMLS)
Volume: 01 Issue: 04 | September-2016 **ISSN: 2456-2580** **www.ijemls.com**

Pharmacogenomics: Gateway to Personalized Medicines

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Abstract

Pharmacogenomics have been vastly accepted as basic steps toward personalized medicine. They deal with genetically determined descriptors in individuals response to medicines, and pose the potential to revolutionize drug therapy by adapting it according to individual genome. Significant developments in pharmacogenomics research have been made since inherited differences in response to drugs. The clinical utility and applications of pharmacogenomics are at present particularly evident in some therapeutic areas.

***Key Words*: Disease, Drug, Genomics, Gene, Pharmacogenomics, Personalized Medicines**

INTRODUCTION

Developments in genomics are changing the way we define disease, develop medicines, and prescribe treatments. Equipped with a better understanding of disease biology, it has become evident that a patient's response to treatment with respect to both efficacy and safety is greatly dependent upon his or her molecular profile. The promise of personalized medicine is to get the correct treatment to the right patient at the correct dose the first time through the use of molecular biomarker tests and targeted treatments.

All drugs (and other substances) that we ingest or are absorbed by our bodies, are metabolized by enzymes so that our bodies can use the substances (as in food or drugs) or excrete the substance. Minute changes in the genes that make the enzymes can cause minute changes in the structures of those enzymes—and those changes may have a significant effect on how the metabolism proceeds.

The theory of personalized medicine is an attractive for the future of medical care. It forecasts the use of molecular data to classify disease, to assist the development and validation of new targeted therapies, to treat patients with more specificity and efficacy but fewer adverse drug reactions, and to more accurately predict disease predisposition. This theory is driven by the results of the Human Genome Project [1-2].

Pharmacogenomics and pharmacogenomics are the studies of the way each of us responds to medicines based on our genes. Some of us metabolize the active ingredient or active metabolite of a drug with higher rate, which means that the body needs a higher dosage of the medicines to have the desired effect. In the opposite case, if we metabolize with lower rate a drug, a "normal" dose may accumulate and cause adverse drug reactions [3].

Pharmacogenomics is the study of affects of an individual's genetic inheritance on body's response to medicines. The term comes from the words pharmacology and genomics and is thus the intersection of pharmaceuticals and genetics.

Personalized medicine is empowering because of our personal genetic and other predictive information allows us to take action that is specific for individuals rather than the theory of one drug fits to all.

Pharmacogenomics combines traditional pharmaceutical sciences such as biochemistry with annotated knowledge of genes, proteins, and single nucleotide polymorphisms. It holds the promise that drugs might one day be tailor-made for individuals and adapted to each person's own genetic makeup. Environment, diet, age, lifestyle, and state of health all can influence a person's response to medicines, but understanding an individual's genetic makeup is thought to be the key to creating personalized drugs with greater efficacy and safety [4].

EXPECTED BENEFITS OF PHARMACOGENOMICS

Personalized medicines

Such approaches promise the advent of "personalized medicine"; in which drugs and drug combinations are optimized for each individual's unique genetic makeup.

More Accurate Methods of Determining Appropriate Drug Dosages

Current methods of basing dosages on weight and age will be replaced with dosages based on a person's genetics --how well the body processes the medicine and the time it takes to metabolize it. This will maximize the therapy's value and decrease the likelihood of overdose [5].

Advanced Screening for Disease

Knowing one's genetic code will allow a person to make adequate lifestyle and environmental changes at an early age so as to avoid or lessen the severity of a genetic disease. Likewise, advance knowledge of particular disease susceptibility will allow careful monitoring, and treatments can be introduced at the most appropriate stage to maximize their therapy.

More Powerful Medicines

Pharmaceutical companies will be able to create drugs based on the proteins, enzymes, and RNA molecules associated with genes and diseases. This will facilitate drug discovery and allow drug makers to produce a therapy more targeted to specific diseases. This accuracy not only will maximize therapeutic effects but also decrease damage to nearby healthy cells [6].

Better, Safer Drugs the First Time

Instead of the standard trial-and-error method of matching patients with the right drugs, doctors will be able to analyze a patient's genetic profile and prescribe the best available drug therapy from the beginning. Not only will this take the guesswork out of finding the right drug, it will speed recovery time and increase safety as the likelihood of adverse reactions is eliminated. Pharmacogenomics has the potential to dramatically reduce the estimated 100,000 deaths and 2 million hospitalizations that occur each year in the United States as the result of adverse drug response [7].

Better Vaccines

Vaccines made of genetic material, either DNA or RNA, promise all the benefits of existing vaccines without all the risks. They will activate the immune system but will be unable to cause infections. They will be inexpensive, stable, easy to store, and capable of being engineered to carry several strains of a pathogen at once.

Improvements in the Drug Discovery and Approval Process

Pharmaceutical companies will be able to discover potential therapies more easily using genome targets. Previously failed drug candidates may be revived as they are matched with the niche population they serve. The drug approval process should be facilitated as trials are targeted for specific genetic population groups --providing greater degrees of success. The cost and risk of clinical trials will be reduced by targeting only those persons capable of responding to a drug [8].

Decrease in the Overall Cost of Health Care

Decreases in the number of adverse drug reactions, the number of failed drug trials, the time it takes to get a drug approved, the length of time patients are on medication, the number of medications patients must take to find an effective therapy, the effects of a disease on the body (through early detection), and an increase in the range of possible drug targets will promote a net decrease in the cost of health care.

3. CONCLUSIONS

The aim of personalized medicine is to enhance the likelihood of medicinal efficacy and to minimize the risk of drug adverse effects for an individual patient. Pharmacogenomics is among the major contributors in this concept. Marked inter individual genetic variation contributes significantly to both susceptibility to diseases, and drug response. Even though pharmacogenomics is not a new science, the translation of pharmacogenomics into clinical practice has not taken place at the same pace as science is

delivering new results. It is felt that a large number of recent pharmacogenomics findings allow bold steps to be taken toward personalized medicine.

CONFLICT OF INTEREST: None

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ISSN 2456-2580