JOURNAL OF
PRECISION MEDICINE AND PUBLIC HEALTH

EDITORIAL ARTICLE
PUBLISHED: 15 May 2017

Precision Medicine: Blending Genes with Medicine

M Muzafar Beigh

Senior Research Fellow, Indian Agriculture Research Institute, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India.

***Correspondence:** **M Muzafar Beigh**, *biobeigh@gmail.com*

EDITORIAL

A visionary approach to predict, prevent and treat various diseases were unveiled by many world leaders in the form of population based genome sequencing programs to make Precision Medicine (PM), a part of future public healthcare system. The term precision medicine is quite new, but the concept has been practised since many years in the form of HLA antigen matching, blood group typing etc. Precision medicine can simply be defined as "an emerging discipline for disease prevention and treatment that takes into account individual variability in genes, environment and lifestyle for each person" (www.ghr.nlm.nih.gov). The potential of precision medicine have prompted many countries including USA, UK, Saudi Arabia, Qatar, Australia etc., to initiate their respective human genome sequencing programs to identify genetic, epigenetic and other risk factors associated with human health and diseases. Under Precision Medicine Initiative (PMI), US National Institute of Health (NIH), have planned to sequence the genomes of approximately 1 million research cohorts to detect various genetic, epigenetic, microbial, social and other environmental risk factors associated with disease and health in US population. Therefore, multiple genome sequencing programs are going to become a guiding platform for implementing precision medicine into many areas of public healthcare, a medical model commonly referred to as public precision medicine (PPM). The PM approach is basically a medical prototype that will be helpful in customizing healthcare as well as decision making in providing therapies by taking into account patient's lifestyle, environment and genetic constitution. It will also empower clinicians and patients with the information regarding disease susceptibilities, their pathogenesis as well as therapeutic outcomes. Under precision medicine program, all records regarding patient's healthcare will be linked with his/her biological data together compiled into electronic health records (EHRs) and will be maintained in national health database/s, accessible to both patients and clinicians as a part of medical informatics programs.

The practicability of precision medicine in public healthcare has grown stronger in recent years and has largely been attributed by steeply decreasing cost of sequencing technologies, surging computational powers as well as greater advances in multiple fields of biotechnology. The increasing storage capacity for large-scale biological databases including genomic, proteomic, metabolomic data-sets etc., improved algorithms for data analysis, user-friendly medical informatics tools (EHRs), availability of cheaper personal gadgets like smartphones etc., is hopefully going to spur precision medicine in future healthcare. Since PM requires cutting-edge high-end computer applications including programming, algorithm analysis, statistics along with wide array of molecular biology experiments, therefore healthcare policy makers should frame standardized protocols for integrating omics based technologies with present-day clinical practices to ensure swift implementation of PM in public healthcare domain. The initial impetus to the PM should be led by consortia, where leader from academia, healthcare, computer scientists, healthcare policy makers etc., conglomerate to draw up strategies for efficacious implementation of personalized and/or public precision medicine in advanced clinics.

One of the mainstays of precision medicine is clinical-grade genome sequencing technologies and is mostly spurred by Whole-Genome Sequencing (WGS) as well as Whole-Exome Sequencing (WES) methodologies. Among the genome sequencing technologies, accessibility to low cost exome sequencing technology especially sequencing of gene panel analysis consisting of 10 to 100 genes and/or sequencing of coding region of all genes (exomes), will pave the fast forward path for genetic and/or genome based test/s into clinical applications. Scientists in recent years have meticulously been working to bring down the cost of human genome scanning to approximately $1000/genome in order to make it accessible to a common man. Genome and/or gene based tests will be helpful in making personalized treatment a public trend especially for patients which are prone to genetic diseases due to their pedigree. Comprehensive categorization of diseases in future will be based on intrinsic disease biology, molecular mechanisms etc., besides using traditional approach of signs and symptoms. Precision medicine will not only contribute in transforming clinics from traditional physiology-pathology driven approach to a more inclusive molecular mechanism based clinical practice but will also be helpful in articulating novel ways of understanding disease mechanism, development as well as progression. Therefore the latest trend will led to the

creation of "Novel Taxonomy of Diseases" and will greatly be helpful in re-defining diseases with high-resolution as well as precision. Medical professionals should ready themselves to adopt to a more comprehensive or wholesome approach encompassing both traditional as well as data- intensive panomics procedures including genomics, transcriptomics, proteomics, metabolomics, lipidomics etc. helpful in disease diagnosis, prognosis and therapeutics. Another rapidly growing area of precision medicine is precision genetics and/or genomics using newly discovered CRISPR/Cas systems. Genetic/genomics based diseases are known to require high level of gene correction/s and CRISPR/Cas based technology is hopefully going to form the basis for precision genetics biology in future medicine. Therefore CRISPR/Cas system along with other genome editing tools are going to form a backbone for genome engineering biology which will be useful for treating hereditary based diseases requiring gene therapies.

The main aim of precision medicine is to ensure that each patients should receive right treatment, at right time and of right dose with marginal side effects and with highest effectiveness. The precision medicine employs "one-size-doesn't-fit-all" approach and takes much more precise patient centric and/or population-powered path to devise future strategies for improving human health and its outcomes. Since precision medicine is a novel approach and is still in its infancy, its feasibility in public healthcare can be arbitrated first by commencing the pilot project/s on diseases like cancers and at the same time public response to its methodologies can be adjudicated so that future course of action can be considered. Precision medicine, oncology will basically be helpful in customizing treatment/s based on molecular genetic profiles of individual patients, since similar type of malignant tumors in different patients are known to be genetically and physiologically heterogeneous in nature and hence will require explicitly different therapeutic approaches.

Since traditional methodology of one-size-fit-all norm currently being used in cancer chemotherapy have not yielded any desired results leading to adverse side-effects e.g., cytotoxic chemotherapies are known to even cause life threatening side-effects in cancer patients. Therefore PM is prophesied to have a broad impact on medical sciences including improved decision making for clinical therapies, predicting drug responses by patients, identification of harmful mutations requiring gene corrections, diet adjustment, exercises, prophylactic surgeries for preventing the on-set of predisposed diseases e.g., *BRCA 1* and *2* genetic variants are known to cause breast, ovarian cancers sometimes requiring surgeries. Besides oncology, neonatology can also be added as early harvest project/s, since the number of genetic tests for new-borns have been in use from long time e.g., New Born Screening (NBS). Besides genetics, epigenetics factors are known to play a major role in genome organization, function and its modifications during the lifetime of an individual affecting health as well as disease susceptibilities. Hence public precision medicine will be helpful in determining diet, lifestyle, occupations and healthcare choices for people based on their genetic and epigenetic biases. Hence public healthcare experts as well as clinicians will start advising people based on the information present in their electronic healthcare records (EHRs) on maintaining healthful lifestyles, hence promoting healthy aging. Besides devising strategies for treating diseases, preventive measures will therefore be helpful in deterring the on-set of future disease manifestations as a part of preventive precision medicine approach. Hence, genomic guidance through PM will become crucial tool in the hands of clinicians for translating novel genomic discoveries into clinical applications in future medicine.

The implementation of PM as a medical model will no doubt be bereft with plenty of challenges especially in understanding the multi-parametric data generated by panomics technologies. The clinicians and medical specialists at present are not acquainted with latest omics approaches and hence may probably oppose its implementation in current medical arena. The most frequently encountered problem will be bioinformatics and informatics components including elucidation of multi-omics data, EHRs and their interpretation.

Therefore it will become mandatory for medical professionals to abreast themselves with panomics methodologies and consequently may face additional demands while acquiring the specializations in same. Hence healthcare policy makers and medical boards worldwide should consequently introduce basic and advanced courses on multi-omics approaches in future medical curriculum in order to apprise the students as well as clinicians with precision medicine biology. Most of the technologies used in precision medicine are still in their initial phases of development and hence need to mature fully before being applied in clinical practices e.g., CRISPR/Cas system. Although many other challenges may lay ahead for successful implementation of precision medicine, including high test cost, incidental findings, unpredictable variations, privacy and other ethical issues etc. Nevertheless medical professionals including clinicians and healthcare experts should be ready to tackle any future challenges in order to provide improved and intensive clinical care to patients as well as general public. This biomedical researchers and medical professionals should work in unison to make precision medicine a benchmark for future public healthcare policy and develop it into medical enterprise in healthcare system in years to come.