Advancements in Precision Medicine

Dr. S. Sreeremya
External Faculty of Pharmacology
Department of Pharmacology
Crescent College OF Nursing, Palakkad, Kerala, India
Email: *sreeremyasasi@gmail.com*

ABSTRACT

Precision medicine is an emerging technique, in the decades to come will have its own significance. The disease identification and understanding the minute details of the disease will be easier by keeping the molecular data. Many pharma players have started the step of bioaccumulation of genomes.

KEYWORDS: *- bioaccumulation, genomes, Precision medicine, pharma players, disease*

INTRODUCTION

According to the Precision Medicine the Initiative, precision medicine is "an emerging approach for the disease treatment and prevention that takes into account individual variability in genes, environment, and also lifestyle for each person." This approach will allow doctors and researchers to predict more accurately which treatment and the prevention strategies for a particular disease will work in which the groups of people. It is in contrast to a one-size-fits-all approach, in which disease treatment and the prevention strategies are developed for the average person, with much less consideration for the differences between individuals (Ding et al.,2019). Although the term "precision medicine" is relatively novel, the concept has been a part of the healthcare for many years. For example, a person who needs a blood transfusion is not given blood from a randomly selected donor; instead, very precisely the donor’s blood type is matched to the recipient to very much reduce the risk of complications. Although examples can be found in several areas of medicines, the role of precision medicine in day-to-day healthcare is relatively limited. Researchers hope that this approach will mainly expand to many areas of health and healthcare in coming years (Marı et al.,2019).

PROGRESSIVE FIELD

The Precision Medicine Initiative is a much long-term research endeavour, involving the National Institutes of Health (NIH) and also multiple other research centers, which aims to understand how a person's genetics, environment, and the lifestyle can help determine the best approach to prevent or treat disease. The Precision Medicine Initiative has both the short-term and long-term goals. The short term goals involve mainly expanding precision medicine in the area of the cancer research (Dwivedi et al,2017). Researchers at the National Cancer Institute (NCI) hope to use an elevated knowledge of the genetics and biology of cancer to find new, more effective treatments and strategies for various forms of this disease. The long-term goals of the Precision Medicine Initiative focus on mainly bringing precision medicine to all areas of health and healthcare on the large scale. To this end, the NIH has launched a study, known as the All of Us Research Program, which precisely involves a group (cohort) of at least 1 million volunteers from around the country of United States. Participants are providing genetic data, the biological samples, and other information about their health. To encourage open data sharing, the participants can access their health information, as well as research that uses their data, during the study. Researchers can use these data to study a large range of diseases, with the goals of better predicting disease risks, understanding how diseases occur, and also finding improved diagnosis and treatment strategies (Hrdlickova et al.,2017).

COMPARISON BETWEEN PRECISION AND ALSO TRADITIONAL MEDICINE

Traditional medicine is a process that depends on the therapies, the experiences and beliefs along with highlighting the ability of skills, knowledge and the practices to treat the disease. Lack of specification can create disadvantages for the traditional medicine such as the risk of over dosage. Another risk factor of the traditional medicine is the quick contamination of drugs that can harm the patients' health (Chen et al. 2019). The oral dosage approach of traditional medicine is not accepted by all the patients who can be considered as the major disadvantage of traditional medicine. Accessibility and the availability of traditional medicine are not easy which obstructed the way of health improvement. After the consumptions of traditional medicine side effects can very much negatively impact the patient’s health which can be a negative consequence of traditional medicines. The potential problem of traditional medicine is the lack of the scientific data that can verify the efficacy and reliability of traditional medicine considering the patients’ health safety (Flanagan,2015). The wastage of

resources due to the negative impact of the traditional medicine has disrupted environmental sustainability. In traditional medicine delay in the detection of the disease has affected the patients' health which can pave to dangerous results of disease out comes. On the contrary, precision medicine offers more advanced and the effective treatment that helps to develop the healthcare system. Presumption of the precision medicine the strength of the effectiveness of the treatment has worked better to mainly cure a disease rather than the application of an average prescription (Knight et al., 2017).The Precision medicine also has lower chances of side effects that ensure efficient health treatment for the people. Medical decision-making in favour of the health improvement of a patient has been driven by the precision medicine. Optimisation of the treatment choice and implementation of disease prevention strategies has been offered by the precision medicine that ensures quick remedy for treatment. Large data sets and implications of the artificial intelligence have impacted the health system considering precision medicine (Jacob et al., 2019). The Early detection of rare diseases and also measuring the severity of the disease in the precision medicine has been helped to strategise plans for further treatment of the diseases. Therefore, considering the digital era, precision medicine is far better than the traditional medicine and highly accepted by the health system for the further development of the treatments allied with rare and chronic diseases.

PERSONALISATION OF THE MEDICINE CONSIDERING PRECISION PUBLIC HEALTH

Precision medicine has an effective characteristic that mainly indicates the personalisation of the treatment according tothe consistency of a disease of a patient. The Precision public health is associated with precision medicine that mainly ensures the further betterment of the health care system (Kozomaraet al. 2019). PPH helps to develop the precision medicine utilising new technologies with the effective big data and a big part of the public health population. Precision public health encompasses precision medicine along with involving disease prevention and the health promotion activities. This approach indulges the individual initiatives of the public regarding their own health which also aids to develop public health. Precision public health helps to optimise the treatment process of the precision medicine focusing on the family health history (Chadwick et al.,2015).

Individualized impact In the original concept of the precision medicine, insight generation

centered around univariate analysis: that is, understand what mutation paves to what disease through the retrospective research, and use that algorithm to prospectively identify mutations in a new population (Shapiro,2009). This has become aggrandizingly powerful in oncology, through integration of genomics, EHRs, and the advanced analytics. However, across therapeutic areas, we are seeing an explosion in the availability of the data over multiple dimensions, which in turn pave us to a much broader set of questions to solve. The advent of new technologies and the mobile medical apps has allowed us to actively track a patient's physiology in real time. Whereas previously researchers collected descriptive statistics of discrete populations, researchers can now take this multidimensional data and create predictive algorithms, which use the collective learnings to specifically predict outcomes for an individual. This approach implies a cyclical, the dynamic feedback loop whereby processes and the underlying capabilities are constantly modified based on the inputs from patients (Duarte et al.,2016). To continue to push the potential of the precision medicine, healthcare stakeholders are actively trying to build the capabilities along three dimensions: data acquisition, data analysis, and the analytics-based decision-making. As the number of data inputs increases and the level of the analysis becomes more and more sophisticated, we are seeing both start-ups and the established technology players with core competencies in advanced analytics also trying to mainly enter the healthcare space(Mele et al.,2015)(Fig-1).

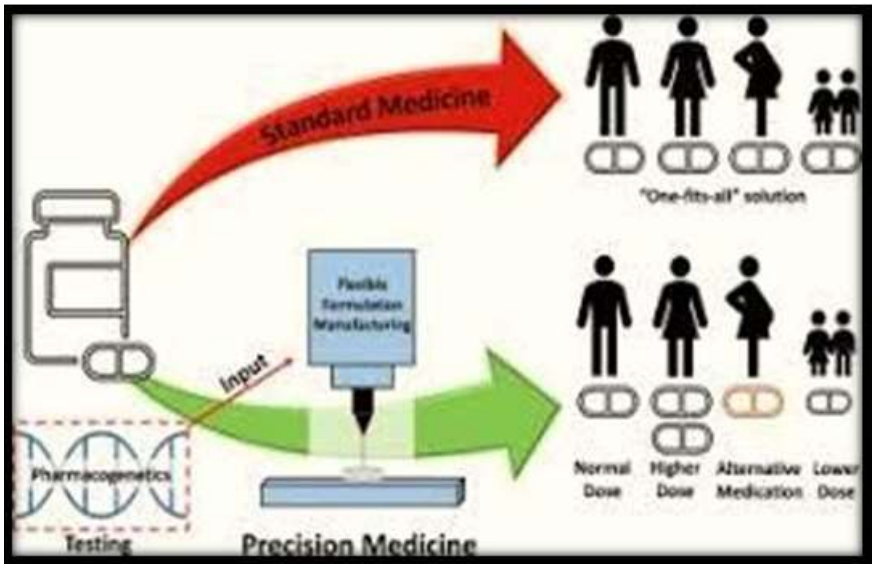

Figure: 1

One recent example is Tempus, which delineates itself as a "technology company that has built the world's largest library of the clinical and molecular data and an operating system to

make that data accessible and also useful, starting with cancer." Recently valued at $2 billion, the company has established data partnerships with the large cancer centers across the United States, encompassing Vanderbilt-Ingram Cancer Center and ASCO (Zeggini et al.,2019). It garners a proprietary platform to ingest unstructured data (clinical notes, pathology images) and the structured data (next-generation sequencing) to deliver actionable, personalized insights. More established players in this space encompass IBM and Google. Google's Deep Mind recently published impressive results analyzing the 3D optical images, outperforming experts in making referral recommendations for a range of the retinal diseases, while IBM's Watson has continued to precisely improve its ability to tailor treatment options to a patient's genomic profile. While still a work in-progress, both the level of the commitment and investment by the major technology companies to advance AI in medicine is a harbinger of things to come.10, 11 in 2017 and 2018, few researchers also saw approvals of two truly individualized therapies, Yescarta and Kymriah, for the serious disease called leukemia and lymphoma. These CAR-T therapies are a type of immunotherapy where a patient's own immune cells are genetically modified to fight the cancer cells. Other gene therapy techniques, most notably CRISPR, are in bioactive development, and we expect more and more individual therapies to be approved in the next 5-10 years of time (Crick,1970).

Implications for the pharmaceutical companies - As multiomics become increasingly important in the understanding and treatment of the disease, there will be profound changes in drug development, from target identification to biomarker development to clinical testing and further analysis. Many of these implications are important for genomics, but going beyond to multi-omics will also require specific nuances fitted to each avenue. We see three moves that pharmaceutical players can perform to prepare themselves for the future: „ Biobanking of the patient samples. From a research perspective, understanding how the dynamics of each -genome is involved in or associated with disease progression will be critical in biomarker discovery and the patient stratification. The foundation for such research is access tothe patient biological specimens at different time points of disease progression. Many pharmaceutical companies are already collaborating with the independent biobanks. Pioneering players are also developing their own patient database for genomic analysis, like the Regeneron-led consortium created earlier this year to sequence 500,000 UK patient samples (Hasin et al.,2017). A no-regret move for all the pharma players is to biobank patient samples from clinical trials and establish the relationships with independent biobanks (Miller

et al.,2015). It will also be important and crucial to consider the sample handling requirements and increase diversity of samples that novel technologies will require. Longitudinal analysis will also multiply the total volume of the samples. With new analytical techniques being developed, the pharmaceutical companies will need to carefully choose and hedge what to biobank for the future analysis. Develop multi-omics abilities through selective partnerships. Generating the data in a reliable manner will require new tools which are specific and techniques to be developed for each molecular profiling technique. While these methods likely already exist in academia, pharmaceutical companies will need to adapt them to enable studying multi-omics in a high throughput manner, at a larger scale, and often with greater reliability(Collins et al.,2015).Modern day pharmacology(Dr. S. Sreeremya,2024a) ,biotechnology(Dr. S. Sreeremya,2024b) and categories like paediatric pharmacology (Dr. S. Sreeremya,2019c) and geriatric pharmacology has to be deeply assessed for the use of precision medicine in that age groups(Dr. S. Sreeremya,2019b).Bach flower is another important therapy(Dr. S. Sreeremya,2025a) like plasma treatment and ozone therapy (Dr. S. Sreeremya,2025a)which has the ability to remediate illness(Dr.S. Sreeremya,2024).Precise and valid genomic understanding is crucial (Dr.S.Sreeremya,2025b)

CONCLUSION

The long term perseverance of pharmaceutical companies to collect the molecular data helps them to navigate easily and can also identify the uniqueness of the precision medicine. The moniker bio accumulation of data is a perfect term used for the collection of various individuals' genomic data. In order to justify precision medicine, a deep analysis of person's genetics, environment, and the lifestyle can help determine the best approach to prevent or treat disease

REFERNCES

1. Collins FS, Varmus H. A new initiative on precision medicine. NEngl J Med. 2015;372:793e795
2. Miller NA, Farrow EG, Gibson M, et al. A 26-hour system of highly sensitive whole genome sequencing for emergency management of genetic diseases. Genome Med. 2015;7:100.
3. Hasin Y, Seldin M, Lusis A. Multi-omics approaches to disease. Genome Biol. 2017;18(1):1e5.5.

4. Crick F. Central dogma of molecular biology. Nature.1970;227(5258):561e563.
5. Zeggini E, Gloyn AL, Barton AC, Wain LV. Translational genomics and precision medicine: moving from the lab to the clinic. Science. 2019;365(6460):1409e1413.
6. Mele M, Ferreira PG, Reverter F, et al. The human transcriptome across tissues and individuals. Science.2015;348(6235):660e665.
7. Duarte TT, Spencer CT. Personalized proteomics: the future of precision medicine. Proteomes. 2016;4(4):29.
8. Shapiro JA. Revisiting the central dogma in the 21st century. Ann N Y Acad Sci. 2009;1178(1):6e28.
9. Chadwick LH, Sawa A, Yang IV, et al. New insights and updated guidelines for epigenome-wide association studies. Neuroepigenetics. 2015;1:14e19.
10. Kozomara A, Birgaoanu M, Griffiths-Jones S. miRBase: from microRNA sequences to function. Nucleic Acids Res.2019;47(D1):D155eD162.
11. Jacob M, Lopata AL, Dasouki M, Abdel Rahman AM. Metabolomics is the integrative readout of both genetic andenvironmental impacts Metabolomics toward personalized medicine. Mass Spectrom Rev. 2019;38(3):221e238.
12. Knight R, Callewaert C, Marotz C, et al. The microbiome and human biology.Annu Rev Genom Hum Genet.2017;18(1):65e86.
13. Flanagan JM. Epigenome-wide association studies (EWAS): past, present, and future. Methods Mol Biol. 2015;1238:51e63.
14. Hrdlickova R, Toloue M, Tian B. RNA-Seq methods for transcriptome analysis. Wiley Interdiscip Rev RNA. 2017;8(1).https://doi.org/10.1002/wrna.1364.
15. Dwivedi S, Purohit P, Misra R, et al. Diseases and moleculardiagnostics: a step closer to precision medicine. Indian J ClinBiochem. 2017;32(4):374e398.
16. Marın de Evsikova C, Raplee ID, Lockhart J, Jaimes G, EvsikovAV. The transcriptomic toolbox: resources for interpreting large gene expression data within a precision medicine context for metabolic disease atherosclerosis. J Personalized Med. 2019;9(2):21.
17. Ding C, Qin Z, Li Y, et al. Proteomics and precision medicine. Small Methods. 2019;3(7):1900075.
18. Dr. S. Sreeremya, Journal of Pharmacology, Toxicology and Therapeutics, History of Pharmacology-Review, Vol 6(2),pp-40-47.2024a.
19. Dr. S. Sreeremya ,Journal of Research in Forensic Medicine and Biotechnology,

History of Biotechnology – Overview, 2024b.Vol6(2):48-54.

20. Dr. S. Sreeremya ,Journal of Child Health Care and Pediatric Nursing, Pediatric Pharmacology, Vol 1(2),pp-1-11.2019a.
21. Dr. S. Sreeremya, Journal of Pharmacology, Toxicology and Therapeutics, Geriatric Pharmacology, Vol 1(2),pp-1-11.2019b.
22. Dr. S. Sreeremya, International Journal of Ayurveda and Alternative Medicinal research, Bach flower Therapy-Review, Vol 44(1), pp-1-10. 2025a.
23. Dr. S. Sreeremya, Journal of Bio-Medical and Instrumentation Engineering, Plasma Therapy, Vol 9(2),pp-38-43.2024.
24. Dr. Sreeremya. S, Book title- Bionanotechnology and Genomics, 2025, pp-200, paperback. ISBN-978-93-49942-33-2.
25. Dr. S. Sreeremya, Journal of Pharmacy Practice and Clinical Research, Ozone Therapy and Healing-Review, Vol 7(2),pp-70-78.2025a