Personalised medicine: the future of Modern Medicine

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Abstract

Medical care is no longer a one-size-fits-all endeavour. There is a problem with the traditional or present systems of medical care because they were developed and tested on large groups of people. Consequently, the prescriptions prescribed are not suitable for every person. A certain number of medicines work very well for some people and some do not. Modern medicine relies on scientific evidence, including clinical trials, which is termed evidence-Based Medicine. It is expected that in the future, treatment will be based on algorithms that will take the patient's genetic, epigenetic, and lifestyle characteristics into account, resulting in personalized medication. The drugs that your doctor recommends for you will be determined by your genetics, lifestyle, and environment, along with your symptoms of illness. Modern medicine has enabled humans to live longer and healthier lives. Personalized medicine is the way of thinking about medicine in the modern era. We will examine how personalized medicine will change healthcare, how artificial intelligence and personalised medicine can be combined to improve healthcare, the role of personalized medicine in pharmaceuticals, its application, and its future trajectory.

Keywords: Personalised medicine, Genetics.

INTRODUCTION

The goal of personalized medicine is to tailor medical treatments to individuals based on their individual characteristics [1]. Our ability to develop personalized treatment programs that offer more tailored treat - ments. It will be based on our knowledge of the molecular biology and genetics of an individual. It will also depend on our ability to develop patient-specific molecular biology and genetic code that will enable us to provide better healthcare. It differs from the doctor's usual method of trial and error diagnosis: A doctor recognizes a possible health problem based on symptoms and develops a treatment plan based on details such as age and weight. They then adjust the plan until the treatment is effective. Personalized medicine offers an excellent chance to go beyond "one-size-fits-all" approaches to diagnosis, drug therapy and prevention. Although we are all the same, we are also all unique. An application of medication that ignores these differences cannot be any more valid. Genomic analysis allows us to predict disease risk with great precision. In personalized medicine, genomics plays a crucial role in selecting preventative plans suitable to the individual. Additionally, it can be helpful for choosing the right drug at the right time in some cases. With this medicine, we have experienced confusing dosages, side effects, and instructions which are hard to follow. In terms of time, resources, and health, this is extremely costly. We believe that healthcare has more to offer in today's data-driven, exponential era. There are many medications that do not work for everyone. Can we come up with new ideas to make taking medicine simpler? How about finding the doses and combinations that work best for you? The genomic revolution is enabling people to make personalized predictions about their disease risk by taking a closer look at them molecularly, so that they can choose a prevention plan that suits their lifestyles; genomics is a substantial part of the progress of personalized medicine [2].

In this paper, we have discussed the disruption brought by personalized medicine in the healthcare field.Even

though the biggest revolution in healthcare is still a long way off, maybe it isn't too far away.

History

Over the past sixty years, many studies have suggested that a significant portion of drug response variability is determined by genetics, along with diet, health status, exposure to the environment, and concurrent treatment [3]. Drug treatment must be tailored to individual needs with a relatively predictable outcome across a variety of geographically and ethnically diverse populations. Starting in the early 1950s, these findings of highly variable drug reactions led to a new scientific discipline called pharmacogenomics, which combines genetics, biochemistry, and pharmacology [4]. The field of pharmacogenomics was the result of molecular medicine advances, aiming to understand the molecular mechanisms behind drug response. Personalized medicine is the name given to this application of research. Personalized medicine has yet to be fully understood by the average patient, but it will eventually affect the entire health care system. Personalized medicine has come a long way since the human genome was mapped in 2003, especially in terms of discovery and product creation. Preventive, organized, and validated personalizedmedicine is a system for effective and efficient health care. In order to make the best care decisions possible, patients and doctors need access to a network of electronic health records that connects both clinical and molecular data. Personalized medicine compensates for genetic susceptibilities by integrating lifestyle choices and health maintenance

Personalized medicine transforms healthcare

The medical profession has been largely reactive throughout history. In many cases, treatments and cures are only attempted once an illness has manifested. As a result, our attempts to treat major diseases like cancer, Alzheimer's, and diabetes are often ineffective, inaccurate, or inconsistent owing to our incomplete understanding of the genetic and environmental influences that contribute to them. As personalized medicine is based on a patient's unique genetic profile, it is beginning to surpass the limitations of conventional medicine. Healthcare can be transformed from reactive to constructive by using personalized medicine. A doctor can better predict which medications will be effective for a particular condition, thereby benefiting the patient. A new clinical method and a change in understanding of medicine in the healthcare system is very important. Personalized medicine enhances drug selection and tailored treatments, minimizes adverse effects, increases patient compliance, shifts the focus of medicine from response to prevention, increases cost efficiency, and reinforces patient trust after the drug is approved [5]

Personalized Medicine in the pharmaceutical industry

A digital revolution has transformed manufacturing, creating smart factories and supply chains in the phar- maceutical industry 2.0. Manufacturing is gaining traction in high-value industries. We should consider what these technology-driven approaches can offer the biopharmaceutical industry, specifically gene and cell therapies [6].

The technology behind this development has been primarily influenced by technological breakthroughs: First, computer chips, sensors, and transmitters have become more affordable, which has paved the way for more of them to be integrated into machines and products. Secondly, the Internet has become accessible to almost everyone through wireless networking, blurring the line between the physical and digital worlds and allowing machines and products to interact directly and autonomously [6].

As a result of these technologies, self-organizing systems can be developed that collect and share data on a mass scale and make decisions on their own. The pharmaceutical industry can benefit from other technological advancements such as cloud computing, big data analytics, which lets huge amounts of data be handled and analyzed in real-time, and artificial intelligence, which lets computers learn and adapt.

Genomic analysis may be used by doctors to determine a person's DNA form and treat them appropri- ately. Companies will use this information to develop improved drugs and expand the amount of marketable compounds, by predicting new compound concepts based on genetic data for each individual patient. Phar- maceutical companies can take less time to develop new drugs if they have higher profit margins. As a result of newer platforms for gene mapping, productivity has increased. In 1998, the community produced 200 Mb of DNA per month, but by January 2003, the DOE Joint Genome Institute sequenced 1.5 billion bases in a month [7].

The world is finally getting its hands on personalized medicine more than a decade after governments began anticipating it. A Precision Medicine Initiative was announced by the US president in 2015.

Pharmaceutical industry leaders from across the world, think of precision medicine as an opportunity. Despite internal and external obstacles, few companies have been able to capitalize on the potential of precision medicine. In spite of the promise of pharmacogenomics technologies to enhance fundamental advances in the biological sciences such as the discovery of disease-causing genes and new therapeutic targets, it is also possible to raise

industry concerns with products designed with pharmacogenomics guidance for specific patient populations[8].

Drug manufacturing is primarily driven by fixed costs associated with research, development, and testing. As a result, the market is fragmented as targeted treatments favor a smaller population. Due to this, their future revenue sources are smaller, and thus their fixed costs are more evenly distributed. Nevertheless, an improvement in the sustainability of these targeted therapies, which would mean longer market availability for personalized drugs instead of blockbuster drugs, could theoretically compensate for these low potential revenues and sales [9].

A personalized medicine approach using artificial intelligence

The use of artificial intelligence in personalizing medicine is a revolutionary new approach to improving the quality of life for all. Personalized medicine involves providing healthcare tailored to the lifestyle, genes, and environment of a particular individual. In the modern world, genetics, artificial intelligence, and growing access to health data present an opportunity to make precise personalized patient care a clinical reality.

Healthcare is a very personal industry, so no two illnesses are the same, so each person's treatment is unique and different. The advantage of AI is that it can measure the transcription in real-time of all the genetic profile of the individual within the organism. Doctors are faced with enormous amounts of data. Finding and analyzing a combination of genes whose expression levels distinguish the groups of patients is a difficult task for a human, but for artificial intelligence, it is relatively straightforward[10].

Computers, artificial intelligence, and smart healthcare monitoring devices in the modern world make it very easy for us to collect and store this information. Is there any possibility for your labs to move from your center lab to your smartphone, your home, or even inside of your body to measure drug levels or other kinds of data? Our modern era is centered around genomics. Your genomic profile can help you understand whether you need a low dose, a high dose, or perhaps another combination of drugs.

As an example, imagine your doctor or your pharmacist was able to integrate this information into their workflow database, augmented with artificial intelligence, so that they would be able to understand which of the 22,000 approved drugs to use and in what dose.

Artificial intelligence in healthcare plays a vital role in personalizing care. Artificial intelligence has already become an essential element of IT services. In the near future, it brings together advances in biomedical data sciences, imaging, and genomics, mobile technologies, environmental sciences, social engagement, networking, and communication in order to make therapies, diagnostics, and proactive, more individualized, predictive, and precise therapies.

However, machine learning and big data are already used in the pharmaceutical R&D field in broad ways to discover and develop new drugs. This big data will probably originate from improved and more refined monitoring health devices, which will be used to gather information to build prediction models for the improvement of more accurate predictions.

In the future, personalized medicine is likely to reduce drug-development costs, treatment costs, and time, which will lead to improved health outcomes. For personalised medicine to be a breakthrough in the med- ical healthcare system, everyone has to play an important role from patient to regulatory authorities and researchers to leaders by developing new creative ideas, experimental diagnostics, and personalized care protocols [11,12].

Applications of Personalised Medicine

Personalized medicine will result in a treatment plan tailored to an individual's genome and individualized to their needs. Personalised medicine may allow for a better diagnosis, earlier intervention, and the development of more efficient drugs and more targeted treatments [13].

Diagnosis and intervention

A more accurate diagnosis and more specific treatment plan can be determined by assessing a patient on an individual basis. The process of genotyping involves using biological tests to determine an individual's DNA sequence.

The genetic code of an individual can be compared with a reference genome, like that of the Human Genome Project, to assess the occurrence of existing genetic variations that may contribute to disease [14].

It is then possible to apply this information to effectively diagnose and treat an individual. It is also important to know one's genetic make-up in order to determine how well they respond to a particular treatment. Therefore, knowing their genetic content can change the type of treatment they receive. Pharmacogenomics is one aspect of this, which makes use of an individual's genome to provide more customized and informed drug prescriptions

[15].

Diagnostic tests can guide therapy as part of a theranostic platform in personalized medicine. Diagnostic tests can involve medical imaging, such as MRI contrast agents,fluorescent markers, and nuclear imaging agents (PET radiotracers or SPECT agents)[16], as well as in vitro lab tests, with DNA sequencing of certain samples[17], along with deep learning algorithms that weigh the results of tests for several different biomarkers[18].

In order to test the effectiveness and safety of a drug, it is now possible to run companion diagnostic tests specific to a patient group or sub-group. In this case, it refers to a technology developed to enhance the therapeutic treatment available to each individual based on the results of an assay that is developed during or after a drug has been released into the market[19]. These companion diagnostics have incorporated pharmacogenomic information into the prescription label of the drugs in order to assist the prescriber in making the most informed and efficient treatment decision for the patient[19].

Drug development

Genomic information about an individual can be of considerable importance to the process of developing drugs while they await FDA approval for public use. When determining whether a patient should be included or excluded in the final stages of a clinical trial, a detailed understanding of a patient's genetic make-up is invaluable
[13] Identifying patients who will benefit most from a clinical trial will increase patient safety and endanger adverse effects from the testing product, and smaller and faster trials will entail lower costs [19]. Furthermore, drugs that are ineffective for a larger portion of the population can gain approval by the FDA depending on the personal genomes used to evaluate the effectiveness and necessity of the specific medicine, even though the majority may not require it.

Aspects of theranostics

In theranostics, diagnostics and therapeutics, similar molecules for cancer diagnosis and treatment. It is now most commonly applied to the field of nuclear medicine where radioactive molecules are attached to gamma or positron emitters for SPECT or PET imaging, and to beta, alpha or Auger electrons for therapy. For example, radioactive iodine was once used to treat thyroid cancer patients. Other examples include radiolabelled anti-CD20 antibodies (e.g. Bexxar) to treat lymphoma, Radium-223 for bone metastases, Lutetium-177 DOTATATE for neuroendocrine tumours, and Lutetium-177 PSMA to treat prostate cancer. Fluorodeoxyglucose is the most common reagent used, which uses the isotope fluorine-18[20].

Radiotheranostics

Radiotheranostics, or radiotherapy, is a subspecialty of theranostics that uses similar pharmaceuticals for both imaging and radiation therapy. In both therapeutic radiopharmaceuticals and diagnostic radiopharma- ceuticals, the radionuclide is interchangeable, with the diagnostic radiopharmaceutical often being a gamma or PET emitter, and the therapeutic radiopharmaceutical often being a beta or alpha emitter[21].

Molecular cancer genomics

There are many types of cancer that appear the same in traditional pathology and we are also becoming aware of tumour heterogeneity, or genetic diversity within a single cancer. This discovery poses the possibility of discovering that drugs that do not work in general populations of cases might be effective in cases with particular genetic profiles.

Oncogenomics, or "Personalized Onco-genomics", is the application of personalized medicine to Cancer Ge- nomics. To better understand disease pathology and improve drug development, high-throughput sequencing methods are used to characterize genes associated with cancer. Among the areas of genomics with the great- est potential are oncogenomics, particularly for drug therapy.

Examples of this include:

A monoclonal antibody drug called trastuzumab (trade name Herclon, Herceptin) targets the HER2/neu receptor. It is used primarily in the treatment of breast cancer. Patients are prescribed this drug only if their cancer contains an overexpression of the HER2/neu receptor[22].

Patients are screened for potential benefit from Herceptin treatment based on two tissue-typing tests. Several tissue tests are performed, including immunohistochemistry (IHC) and Fluorescence In Situ Hybridization (FISH). Patients with Her2+ status will receive Herceptin therapy (trastuzumab)[23].

Gleevec (imatinib) is a tyrosine kinase inhibitor developed to treat chronic myeloid leukemia (CML), in which the BCR-ABL gene (a result of a reciprocal translocation between chromosomes 9 and 22) is present in over 95% of

cases and produces hyperactivation of abl-driven protein signaling. Based on scientific knowledge of disease pathophysiology, these drugs inhibit the Ableson tyrosine kinase (ABL) protein specifically[24].

Genes identified in tumor biopsies assist in recommending specific drugs associated with immunotherapy response, and specific mutation patterns are linked with previous exposure to cytotoxic cancer drugs [25].

While lung cancer has limited systemic treatment options, targeted treatments are becoming more common. Many new drugs and compounds, such as monoclonal antibodies (mAbs) and tyrosine kinase inhibitors, are being developed and approved. More than 70% of these drugs work against epidermal growth factor receptors (EGFRs) [26]. We investigated the pharmacokinetics of targeted drugs, which enabled us to develop new medicines and predict radiolabelled drug binding to tumours. Immuno-PET is primarily used to detect antigens. Immuno-PET has been studied with MAbs, and mAbs have been labelled with radionucleoids such as 89Zr [26].

Melanoma survival rate is just 15-20 percent when it is spread to other parts of the body. About 50 percent of melanomas contained a mutation in the BRAF gene which plays an important role in the overproduction and spread of cancer cells[27]. Based on this information three immunotherapy anticancer drugs are developed which function by inhibiting proteins that prevent the immune system from destroying cancer cells [28].

A new wave of molecularly targeted therapies has transformed chronic myeloid leukemia (CML) from a highly lethal disease into a disease in which patients can live normal, healthy lives. Drug imatinib targets the abnormal proteins that signal cancer cells to divide. Imatinib works by stopping these signals. CML patients now live lives that are similar to the average as a result of the availability of more drugs in this class [29].

Personalized Medicine in Cystic Fibrosis

A genetic disease called cystic fibrosis results from mutations in the gene that codes for a protein called CFTR, which regulates the body's ability to absorb and secrete salts and water[30]. The drug is designed to target one of several faulty CFTR proteins in patients, resulting in meaningful and long-term improvements in lung function [31].

Personalized medicine in the COVID-19

In the ongoing global pandemic of Corona virus, personalized medicine is currently being utilized to aid in the prevention of its spread. Scientists are now utilizing artificial intelligence and the automated patient model to identify COVID-19 high-risk genes.

Several studies are studying whether Corona virus can be treated with drugs designed for other diseases. COVID- 19 patients who suffer complications such as sepsis might benefit from these drugs as they can be used to develop new clinical strategies to improve their survival rates. In patients with serious COVID-19 reactions, data-driven observations aid in the identification and characterization of underlying and related disorders, as well as problems related to such conditions. *Perspectives for the future*

In the future, physicians will be able to provide more personalized treatments to patients based on their genomic profiles. As this new approach to patient care and personalized medicine continues, a large amount of genomic data on patients will be available. The research can be used to guide best practices across a wide range of indications and create patient success stories [3].

In the future, medicine will become an information science. Information processing is an essential component of health-care, which extends beyond simply converting medical and genomic data to digital formats. Over the next 10 years, we may have an enormous amount of data on each individual. It is IT (Information Technology) hardware or software that can turn that into real hypotheses about each patient [32].

The use of Personalized Medicines will result in more affordable and effective healthcare, access to novel biomedical methods, and a better grasp of one's own health and genomic information by individuals as well as economic growth in the healthcare sector [33].

Many prescription medicines are ineffective for many people. In 2015, the top 10 grossing pharmaceutical products in the US only benefited 23 to 1 in 4 people. The worst thing about this drug is that sometimes drugs may not work, but may still cause side effects.

In the pipeline, 45% of new medicines can be personalized. Seventy-five percent of cancer drugs could be customized. The expected increase in personalised medicine investment over the next 5 years is 35 percent.

Conclusion

There is still much to learn about personalizing medicine. In the present era of healthcare, it is possible to select medication based on a patient's genetic makeup, which reduces adverse side effects and ensures better health. In

the future, personalized medications could have a positive impact on the healthcare system by providing each person's full genomic profile details on the day of their birth to put into an individual health- care record. Clinicians and doctors will be able to adopt more reliable and efficient healthcare approaches using genomic data based on patient exposure to multiple diseases. In the future, only firms that invest in pharmacogenomics and personalized medicine will be able to survive in the pharmaceutical industry. Genetic profiles will be linked to large knowledge bases in order to offer custom-designed diagnosis and treatment to individual patients. In the future, different diagnostic tools will be used to identify and evaluate diseases at various stages. Furthermore, this will also be an opportunity for new players to enter the Pharmaceutical market by bringing innovative ideas to the market. In the future, the pharmaceutical market will shift from a mass market to one that offers specialized products.

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