PERSONALIZED MEDICINE: AN OVERVIEW

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Abstract **- Personalized medicine (PM) is the concept of tailoring medical treatment to every patient's unusual characteristics. PM approach could even be a full extension of the traditional approach to increase our ability to predict which medical treatments are becoming safe and effective for individual patients and which ones will not be and cause toxicity and side effects, supported the patient's unique genetic profile. A humanized approach to personalized medicine will increase the possibility of employing process physiology and the use of P5 medicine, which includes personalized, predictive, participatory, precision, and preventive medicine. The predictive variables for disease progression should be investigated within communities to develop preventive measures for in-danger people, and healthcare is often customized and participative. Accurate illness diagnosis, monitoring, and treatment require advancements in biomarker discovery, the subsequent development of trustworthy signatures that suit complicated disease states, and medical methods that are constantly changed and adjusted for dose and drug selection. New technologies make it possible to clarify the causes of adverse side effects at the genetic level, prevent, reduce treatment costs and significantly enhance its security. Thus, the implementation of these approaches at the end of the day will contribute to significant savings. Many technologies are emerging to cause the paradigm shift from the traditional "one size fits all" to personalized medical. Personalized medicine may be a broad field, and it is often used to diagnose various diseases like cancers, Alzheimer's, Hepatitis, atrophic arthritis, Cardiac diseases, and others.**

Index Terms **- Personalized medicines, precision medicine, Targeted therapy, genome, 3D printing, Artificial intelligence, Diabetes, Lung Cancer, Future aspects.**

I.INTRODUCTION

Every being is unique. Each individual has a unique combination of genomic, demographic, development, occupational and environmental factors. This statement concludes that the treatment for each individual is different.

Traditional medicine is based on the appeal of protocols. If the therapy given to the group is successful in a randomized controlled trial (RCT), then traditional medicine treatment should work for all patients, although this assumption generally works. However, with recent scientific advancements, it has become clear that there are situations where the assumptions fail due to the following reasons.

First, traditional approaches fail to take into account the ethnic heterogeneity of patients. The possibilities for developing many diseases vary across the community[1]. In addition to variations in disease risk across races and ethnicities, there also are survival variations in different racial groups[2] (e.g., 5-year survival rates among those with breast cancer)[3].

Secondly, the one-protocol-to-heal-them-all approach does not necessarily account for confounding factors, like race, age, gender, body mass index, socioeconomic status, or even birth month.[4] [5] [6] [7] Protocols apply an "if-else" rule-based approach, which usually depends on observing laboratory tests and the patient's response to the treatment. The majority of clinical procedures are based on preliminary RCTs. For an RCT to be adequate, all possible confiders must be identified a priori before the randomization occurs. If a single confounder variable is absent during the randomization step, so the results of the RCT would not be generalized to these groups and so individuals can also be related to increased toxicity. This means that, a given treatment helps some people or subpopulations of the study; the treatment could also be harmful to a different subpopulation[8]. The challenges mentioned above with traditional approaches in medicine show an emerging need for developing more customizable treatments based on patient, which would be more fit to a given patient.

A.WHAT IS PERSONALIZED MEDICINE

Personalized medicine (also called personal genomics, genomic medicine, individual medicine, or accurate medicine) refers to the use of patient-specific profiles, including genetic and genetic data as well as clinical and environmental factors, individual risk assessment and integration of disease control strategies.

Reason for the emergence of personalized medicine
Many medicines work well for one person, but that might be less effective or cause serious side effects in another person. These differences are due to many important factors, like lifestyle, age, weight, and genetic makeup. Personalized medicine is that the tailoring of medical treatments to the individual, particularly to every patient.

Building on how a person's specific molecular biology and genetic code leads them to different diseases and developing personalized treatment programs that offer more precise treatments with the hope of better healthcare. This approach is different from the doctor's common practice of diagnoses of trial and error method: The doctor recognizes a possible health care situation based on symptoms, develops a prescription plan based on general data such as age and weight, and proceeds to adjust the treatment until it is successful.[9]

Personalized medicines have the excellent opportunity to make a "one-size-fits-all" approach to diagnosis, pharmacotherapy, and prevention and turn it into an individualized approach. We are all alike, but genetically we all are different.[10]

For as much as genomics gives us a window into our differences in an exact molecular way, it helps us to form individual predictions about disease risk, which can help someone select a prevention plan that's right for them; genomics is playing a significant role in the emergence of personalized medicine.

An individualized approach can help in better understanding genetic factors for rare diseases. A rare disease is defined by the Food and Drug Administration (FDA) as a disease affecting fewer than 200,000 people within the United States (≥0.06%). The FDA has identified a total of 7,000 diseases meeting these rare disease criteria, many of which have no known treatment.[11]

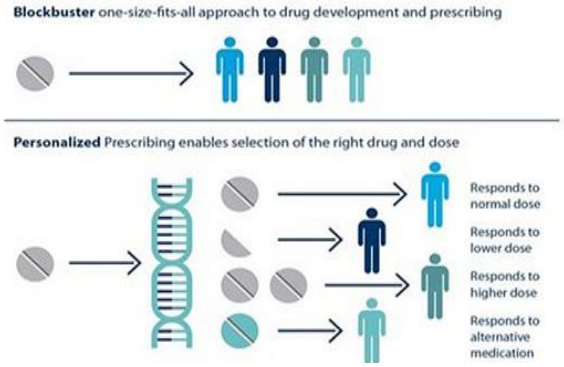

Fig 1: Principle of personalized medicine

B.BENEFITS OF PERSONALIZED MEDICINE

- It has the ability to do more :
  Traditional medicine's primary goal is to treat disease symptoms as soon as it starts. Precision medicine aims to predict, prevent, and treat disease.

- It is more precise :
  The average prescription medication may not be effective for everyone who takes it. Precision medicine can determine whether or not therapy will be effective for individuals, and if not, the doctor will not prescribe it. As a result, a precision medication is significantly more likely to succeed against a particular disease than a prescription drug.

- It reduces the chances of adverse effects:
  There are risks with each medication individual takes. The fact that tailored medicines operate directly on the illness improves precision medicine. They do not affect a complete individual body. Furthermore, because one is more likely to find the appropriate medication the first time, one will not need to take many medications. The fewer medications one takes, the less likely individual will experience adverse effects.[12]

II.P5 MODEL FOR PERSONALIZED MEDICINE

The personalized medicine approach is based on the P5 medicine model. There is a tremendous impact on the empowerment process: providing information

about the disease, participating in the clinical decision-making process, and initiate a constructive relationship with the health care providers. These are just a couple of the steps that improve patients' self-efficacy.

A medical approach that provides more attention to the patient as an individual considers their social and cultural context and recognizes the role of family and friends; fulfills the original mission of medicine: that medicine exists not only aimed to cure patients but also for safekeeping of them.[13]

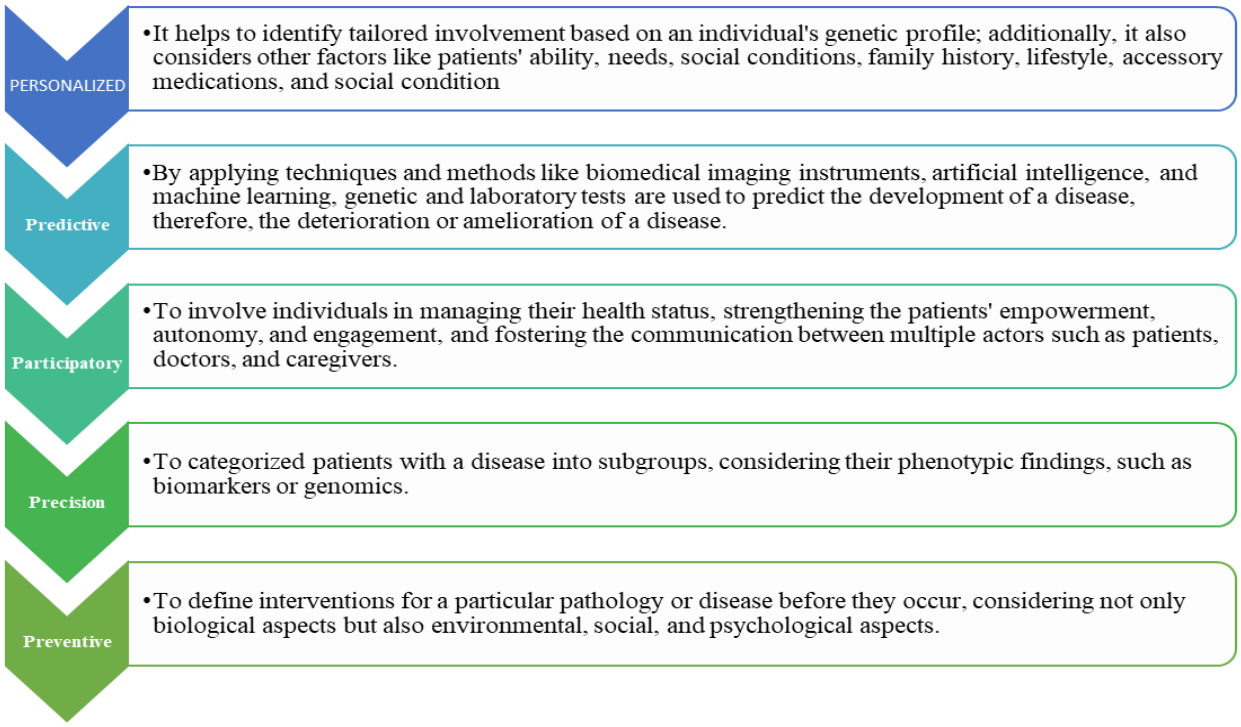

TABLE 1: P5 MEDICINE MODEL[14] [15] [16]

III.PERSONALIZED MEDICINE TIMELINE

The term personalized Medicine (PM) was coined within the late 1990s but was not introduced to the general US public until a few decades later, through Genomics and Personalized Medicine Act.

BACKGROUND OF PERSONALIZED MEDICINE: [17]

Year	Discovery
1950s	→Watson and Crick deduced the structure of DNA double-helix with anti-parallel nucleotide chains and specific base pairing.
1960s	→Researchers crack the genetic code.
1970s	→For the first time, DNA sequencing technology developed. →Researchers discovered the first enzyme, cytochrome P50, linked to individual variation in response to dosing.
1980s	→Polymerase chain reaction (PCR) was first developed, allowing for fast amplification of DNA sequences by Kary Mullis
1990s	→The human genome project launched →FDA approves first personalized medicine with a companion diagnostic for the treatment of HER2 metastatic breast cancer Trastuzumab.
2000s to present	→Human Genome Project completed. →First targeted therapies for carcinoma, leukemia, melanoma, cystic fibrosis, HIV, and plenty of other diseases. →42 percentage of the industry's pipeline has the potential to be personalized medicines. →Personalized immunotherapy was developed. →Digitalization and application of AI and 3d printing technologies. →EGFR TKI became an accepted therapeutic alternative in advanced non-small cell lung cancer. → Colorectal cancer (KARS M+) and non-small cell lung cancer have both been approved for targeted treatments. →Zelboraf, a prescription personalized medicine from Genentech, is formed available for people with skin cancer melanoma with a particular mutation in the BARF gene.

IV.BENEFITS OF PERSONALIZED MEDICINE

Personalized medicine stresses its potential to:

- Detection of the disease early and can be easier to treat effectively.
- Allow to select optimal therapy and reduce trial and error prescribing.
- Reduce the chance of toxicity and side effects in an individual.
- Helps in expanding patient compliance with the therapy.
- Improve the choice of targets for drug discovery.
- Decrease the cost, time, and failure rate of clinical trials.
- Avoid withdrawal of marketed drugs.
- Customized disease prevention strategies.
- Decrease overall cost of health care.
- Shift the attention in medicine from reaction to prevention.[18]
- Revive the drugs that failed clinical trials or were withdrawn from the market.
- Foretell susceptibility to disease, improve disease detection, and preempt disease progression.
- Helps to shift physician-patient engagement toward patient-centered care.
- Using cell-based or gene therapy to replace or circumvent molecular pathways associated with the disease
- Decreases high-risk invasive testing procedures.[19]
- There are new partnerships of scientists in a vast selection of specialties, and people from the patient advocacy community, universities, pharmaceutical companies, and others.
- A better understanding of the underlying mechanics by which various diseases occur.
- Better integration of electronic health records (EHRs) inpatient care allows doctors and researchers to access medical data more efficiently.
- Personalized medicine applications have extended beyond cancer to improve treatments in cardiovascular disease, infectious diseases, psychiatric disorders, and transplantation medicine.[20]

V.HOW DOES PERSONALISED MEDICINE WORK?

Genetic testing is completed then the genetic material of the patient is employed to seek out a treatment for the sickness. Personalized medicine has existed for many years, but it has not been as popular today. The knowledge of gene variations has increased through generations, and it has become easier to depict a medicine for a selected illness.

For drug metabolism, the one dose fits all medicine might work for one individual but not for an additional because of the difference within the genes. It is an incontrovertible fact that most drugs prescribed only work for an hour of the patients, whereas personalized medicine will have a better percentage. To have the correct medication for the correct patient. A sample of the patient's DNA is collected, which is later wont to identify the medication that most accurately fits that patient. After collecting DNA, the DNA is then analyzed and later accustomed to minimize the side effects and make a technique for a more successful outcome from the medical treatment. Personalized medicine is employed for genetic testing for abnormalities and providing treatment. The Human Genome Project found that there are around about 25,000 genes in humans. The project also determined the sort of genes that exist and their role in a healthy human.

Furthermore, the gene of a healthy human is often compared to the gene of a patient to seek out the abnormalities. Gene testing is merely done when symptoms start to seem. Through the utilization of personalized medicine, it has been assumed that the drug is best fitted to its genes. This sort of drug aids in reducing the amount of time the patient is on medication. This is because the personalized is more precise, and it relates to the ordering of the patient. Through the name of personalized medicine, it is often stated that words like personalized proves that this sort of medication is merely for private use. Personalized medicine is described as safe when it involves the quantity of dosage needed for a particular individual. Every individual has different and unique genes; counting on the genes, the quantity of needed dosage can also be found through the sample of DNA. Personalized medicine also will aim to supply the tools and knowledge to fight chronic diseases and treat them more effectively. With the utilization of personalized medicine, diseases like cancer, diabetes, Alzheimer's, and other heart conditions may often be cured. Personalized medicine is preventive, coordinated, and

evidence-based. It also helps keep patients healthy with a particular treatment.

VI.ROLE OF PERSONALIZED MEDICINE

The influence of Personalized Medicine in six different areas is summarized, which covers the main activities of medical R&D and clinical practice. In many pre-clinical and clinical development steps, Personalized Medicine methods will be applied.[21] [22]

1.In Basic Research

- Personalized medicine identifies biochemical pathways and related biomarkers that identify the genetic variations in diseases, help diagnose and target candidate pathways for particular therapeutic interventions.
- Personalized Medicine also considers drug metabolism and response to new therapeutic interventions.

2. In Drug Discovery and Development

- Personalized Medicine gives a more excellent mechanistic approach, the use of predictive information, for growing more secure and more excellent powerful drug remedies for treating specific sub-populace groups.
- Personalized Medicine is being utilized to predict how new drugs will work in cells.

3.In Pre-Clinical Testing

- Personalized Medicine gives a method to pre-clinical testing that may pro-actively tell drug development paths. Through a theory known as Phase 0 trials, little or micro-level dosages will be given to individuals to investigate the biology or pharmacology of the potential drug candidate, as is done in Phase I trials. Along with advanced tools, such as microscopy or imaging, pre-clinical testing will be tackled to identify which drug candidate has the most favorable receptor binding, kinetics, metabolism, or even proof-of-mechanism studies

4.In Clinical Research

- Personalized Medicine can be used to elect participants based on their genetic predispositions to respond to certain types of therapies, resulting in more efficient, safer, less costly, and more rapid clinical studies.
- A novel approach to "adaptive clinical trials" is being advanced, where patient outcomes from early phases of the trial are used to reconcile the trial's allotment of future patients in subsequent stages.
- Personalized Medicine offers an avenue for rescuing or reintroducing drugs that were impotent during previous clinical trials or had adverse drug reactions with a particular sub-group.

5.In Clinical Adoption

- Personalized Medicine will offer physicians a further targeted drug therapy approach for treating their patients, mainly through combination diagnostic-drug treatments.
- Advances in diagnostic technologies and the ability to demonstrate clinical utility will be vital for moving Personalized Medicine forward.

6. In Health Care

Personalized Medicine offers a powerful new approach for improving public health:

- Identify individuals with a predisposition for the development of a specific disease.
- Early detection of disease, resulting in improved outcome of treatment.
- Determine which patients will benefit from a specified medication.
- Recognize patients likely to be at increased risk for adverse drug reactions.
- Monitor reaction to treatment for the motive of adjusting treatment.
- Addressing cost-effectiveness of drug treatments.

VII.CLINICAL APPLICATIONS OF PERSONALIZED MEDICINES

Personalized medicine can give medical practitioners with a new biological foundation for categorizing some disorders. This will have an impact on genomic-based advances in screening, diagnosis, and prognosis. It will also enable better optimization of preventive and therapeutic services. Personalized medicine can help with illness prediction, prevention, and treatment methods by doing the following:

- Determining if a person is at a higher risk of developing a problem, as well as promoting and assisting with adherence to available preventative methods;

- Diagnosis of the condition during the development stage by the use of ideal surveillance, allowing for more effective treatments or treatment choices;
- Improving healing efficacy by ensuring that the most appropriate medicine is utilized and that the dosage schedule takes into account any genetic polymorphisms that may modify drug metabolism.
- Avoiding unnecessary medication-related difficulties and adverse effects as a result of generic "one-size-fits-all" prescription prescribing.
- Medical practitioners will offer more targeted preventive and treatment plans to their patients, resulting in better patient outcomes, fewer adverse events, and more cost-effective utilisation of health care resources.[23] [24]

Classification of Personalized Medicine:

As shown below, the use of personalized medicine is divided into two categories: predictive medicine and treatment optimization.

A.Predictive medicine: Genetic information allows for a more accurate evaluation of a patient's risk of getting the disease, disease progression, and symptom severity. These records may be utilized to prevent and treat that individual, as well as to make informed decisions regarding lifestyle, hormonal difficulties, screening, and preventative therapy.

TABLE 2: CLINICAL UTILITY OF PREDICTIVE MEDICINE[24]

Disease	What the test detects	Reason for Testing	Comments	Clinical utility
Somatic cell genetics – single genes				
Acute leukemia	Minimal Residual Disease	Patients often relapse after an apparent cure	Has become standard treatment for acute promyelocytic leukaemia, chronic myeloid leukaemia, and acute lymphoblastic leukaemia with the Philadelphia chromosome (Ph').	(*)Allows for a more accurate prognosis and to identify further treatment needs.
Germ cell genetics – single genes				
Lynch Syndrome	Mutations in the MLH1, MSH2, MSH6, and PMS2 genes	Mutations in these genes increase the risk of developing: Lynch syndrome; penetrance is not 100%	In families with Lynch Syndrome, MLH1 and MSH2 account for approximately 90% of detected mutations,MSH6 for approximately 7%-10% and PMS2 for Fewer than 5%.	(*)Detection of mutations allow for surveillance which includes colonoscopy with removal of precancerous polyps every one to two years starting at age 25.
Huntington disease (HD)	Presence of HD mutation	Mutation confers 100% penetrance and HD is presently Incurable	Though presently incurable, preventative therapies are being investigated. HD testing can relieve anxiety for unaffected individuals, and allow affected individuals to make informed life choices	(#)Allows for planning for life and long term health decisions, including family planning. May, in the future, allow for protective.
Germ cell genetics – complex diseases				
Alzheimer disease	Type E4 of ApoE gene	Identifying an increased risk allows early intervention and planning.	The testing has been used at population level to detect population level risk. The test is not accurate enough to predict individual risk	(^) Most cases occur sporadically and do not involve these mutations.

Notes: (*) Used in clinical practice but not formally evaluated (#) clinically useful (^) Limited clinical utility

B. Treatment optimization

Many adverse drug interactions are caused by individuals being prescribed the incorrect dosage of medication. In addition to well-understood variables such as age, sex, weight, and body fat, genetic differences can result in differing responses to a given drug. This is because many enzymes involved in drug response have genetic variants associated with an increase or decrease in drug metabolism.[24]

Pharmacogenetics/pharmacogenomics is a term used to describe treatment optimization. The goal of pharmacogenomics is to match the best available medication or dosage to a person's genetic profile.

TABLE 3: CLINICAL UTILITY OF TREATMENT OPTIMIZATIN[24]

Disease and Drug Test	Drug/test Purpose	Reason for Testing	Clinical Utility
Somatic Cell Genetics			
Breast cancer Herceptin® (trastuzumab)	Herceptin® is used to treat tumors that overexpress the HER2 protein. HER2 positive breast cancers can be targeted more Effectively	Herceptin has significant side effects, and in tumors, not over-expressing in HER2, the risks outweigh the potential benefits	(^)Herceptin®, a costly drug, can now be targeted to those most likely to respond and so as well as cost savings, it reduces the risks of complications in those unlikely to respond to it.
Complex Interactions in Somatic Cell Genetics (Pharmacogenomics Type Test)			
Breast cancer MammaPrint®	Measures the expression profile of 70 genes implicated in endocrine responsive breast cancer. Stratifies patients into high and low-risk groups for relapse and metastasis	This can inform treatment decisions as high-risk groups may need further chemotherapy treatment while low-risk groups may only require hormone therapy and monitoring.	(**)Clinical utility is to be confirmed. Clinical use may be justified while ongoing studies confirm the role of MammaPrint® in clinical practice. This would assist in decision-making, particularly for treated early-stage breast cancer when it is difficult to predict what type (if any) adjuvant therapy is needed
Germ Cell Genetics- Single Genes:			
Inflammatory bowel disease, transplantation, some forms of leukemia Thiopurines	The thiopurine methyltransferase (TMPT) gene is essential in the metabolism of thiopurines.	Some subtypes rapidly metabolize thiopurines (requiring higher doses), while others metabolize slowly. (more likely to develop side effects).	(**)The ability to personalize dosages can reduce the risk of complications while ensuring effectiveness. This is quite likely to be clinically beneficial.

Notes: (^) Clinically Useful (**) Under Evaluation

VIII.TECHNOLOGIES USED FOR PERSONALIZED MEDICINE:

With a growing number of publicly available patient data, there is an emerging have to be compelled to implement novel techniques for data analysis. With the latest developments in machine learning, deep learning has become widely utilized in biomedical sciences.[25] Another technique that has become more popularly enforced in bioinformatics is biclustering.[26] This data processing technique is often used to identify subgroups of patients with specific characteristics.[27] [28] With the ongoing progress within the field and the development of sophisticated and accurate methods which will extract informative patterns, a step was made toward finding the solution for diseases.[29] [30]

AI technology in personalized medicine:

The role of AI in promoting personalized medicine is going to be significant. There is more acceptance of AI-based health products, but such products can be developed and utilized emerging computer capabilities such as quantum computing to gain greater speed and handle larger and larger data sets. [31] [32]. These very broad data sets are likely to come from better and more sophisticated health monitoring devices, which can be used to collect data to generate data and output to improve reliable forecasts.[33]

In addition to harnessing more incredible speed and computational efficiency, AI-based health products and devices are likely to incorporate a greater understanding of biology into their formulation in the future. Thus, the invention of easy input/output relationships between data points, which has been the focus of an excellent deal of AI, machine learning and statistical analysis research, can be pursued with constraints that govern events of relevance. are known to do (for example, barriers to the production of metabolites during known biophysical biochemical pathways, first principles to try and do with Watson–Crick base pairing, and others).[34] [35]

The greater use of AI in the development of personalized medicine is focused on the treatment of individuals with apparent disease: identifying the underlying pathology, determining which interventions make the most sense to provide what is known about that pathology, and thus the mechanism of action of the intervention, and testing to find out whether the intervention works. As a result, most AI-based products and technologies are used to advance customized medicine with a focus on personalized diagnosis, prognosis and therapy. This is understandable because given the cost of current treatments, especially in the context of cancer, there is an excellent need for progress and efficiency gains in treating patients.

On the other hand, the use of AI for disease prevention is gaining a lot of interest and attraction. For example, AI and machine learning techniques have been shown to be helpful in the development of 'polygenic risk scores', which will be used to identify individuals at high genetic risk for a disease, who will be monitored more closely.[36] [37] [38]

Additionally, uniting insights into genetic predisposition to disease with constant monitoring to spot initially signs of disease could certainly stop diseases in their tracks before arduous treatments are needed for fulminate sorts of the disease manifest.[39] [40] Such inspection might be significantly intensify by applying AI techniques to novel sensors.[41] [42]

Finally, the excitement for using AI methods is unlikely to wane anytime soon. AI will almost certainly influence nearly every business, from manufacturing to sales and marketing, finance, and transportation. These businesses can be improved, with AI playing a crucial part in the necessary advancements. The healthcare business is no less likely to profit from artificial intelligence.

Research in both AI and precision medicine reveals a future in which medical professionals' and consumers' health-related duties are supplemented by highly customized medical diagnostic and treatment information. The synergy between any of these two forces and their impact on the healthcare system aligns with the ultimate goal of disease prevention and early detection in individuals, which could ultimately reduce the burden of diseases for the public at large and, as a result, the cost of preventable health care for all.

3D printing technology in Personalized medicine:

Particularly essential applications of 3D printing in the pharmaceutical industry is the capacity to personalize dose formation to people. This can be achieved by making appropriate dosage forms, modifying the dosages, amalgamating them, or altering the dosage forms' release profiles according to the patients' needs.

Dose Personalization

3D printing has the potential to enable dose adjustability based on the needs of the patient. One large population group that needs dosage resilience is the pediatric population, in which the therapeutic dose changes in accordance with the child's age and body weight. Using 3D printers, the various dosage forms may be appropriately adjusted to administer the optimal patient dose. This is easily accomplished in orodispersible formulations (ODFS) by adjusting the liquid API sprayed on the film. ODFs can also be altered in form and extent to personalize treatments.[43] Similarly, dose capacity in various dosage forms, such as pills or patches, can be adjusted to meet patients' needs. For example, by changing the printing scale, utilized fused deposition modeling and hot-melt extrusion to print theophylline tablets with doses ranging from 60 to 300 mg. [44]

In recent years, the pill has been split by hand or by splitter to achieve dosage flexibility. This has been unsuccessful because the different characterization parameters of the subdivided tablets do not always meet the pharmacological standards. One study compared split tablets to 3D printed subdivided tablets. 3D-printed segmented tablets were determined to be more accurate, secure and customizable.[44] Personalized 3D printed pellets or mini-print tablets were produced. They can also be used to combine two different drugs.[45] Mini-printlets can also be combined and encapsulated in the desired dose for the personalization.[46]

The fast progress of 3D printing technology can shift pharmaceutical production from mass production to on-demand personalized dosage forms, providing patients with safer and more effective medications. Its ability to change traditional pharmacy practice might be critical to the healthcare system.

Aside from therapeutic applications, this technique may be used in industry to create dosage forms with complicated geometries and release characteristics.

The FDA's confirmation of Spritam is a significant landmark in the realm of 3D printing, and exciting research has been abundant since then. The most significant benefits of adopting 3D printing in the pharmaceutical industry are rapid manufacturing rate, cost-effectiveness, and formulation flexibility.

Moreover, various platforms' advantages and disadvantages fundamentally be considered to create a 3D printer suitable for a hospital setting.

In spite of its benefits and significant development, the application of this technology to manufacture pharmaceutical goods is still in its early stages. This is owing to the numerous obstacles encountered, primarily technological, quality control, and regulatory issues.[47]

IX.PERSONALISED MEDICINE FOR LUNG CANCER:

Systemic treatment for lung carcinoma is minimal; Targeted disease treatment is all too common these days. Authorization of many additional drugs and syntheses like tyrosine kinase inhibitors (TKIs) such as monoclonal antibodies (mAbs). They are resistant to the epidermal growth factor receptor (EGFR) and produce over 70% of responses.[48]

In accord with additional research, targeted medicines aggravate the disease more than cytotoxic treatments, which are more expensive than conventional drugs.[49] Non-small cell lung cancer (NSCLS) is the most common kind of cancer, and these cells exhibit uncontrolled cell proliferation.

Positron emission tomography (PET) and radioactively tagged medicines are two approaches to personalized medicine for cancer treatment. The concentration of metabolite and pharmacokinetics was determined by regular assessment of blood sample urine and others.[50] The PET has the advantage of targeting the diseased site by using radiolabeled drugs, which can further help develop targeted drugs for the treatment as PET is a sort of imaging technology that produces three-dimensional (3D) pictures using gamma rays as a personalized medication.[51]

The pharmacokinetics (PK) of targeted medicines have been investigated, and novel treatments are frequently developed, and so can the binding of radiolabeled drugs with tumors is predicted. Immuno-PET is a kind of imaging technology that is utilized chiefly for antigen therapy. MAbs have been studied as an agent in Immuno-PET, and mAbs are tagged with a radionucleotide, such as 89Zr.[52] For the reason of slow PK, dynamic scanning was not feasible, just in the case of radiolabeled mAbs. Static image utilizes the tumor-to-blood, standardized uptake value (SUV), and tumor-to reference tissue ratios. Following mAb binding, target cells internalize the mAbs.

Some radio nucleotides get degraded and washed out from the cell, such as 124I, 76Br, and others.[53] The TKI-PET is additionally a tool for imaging damaged cells, and it mainly targets the EGFR. TKI are small molecules with fast pharmacokinetic profiles that block the activity of kinase proliferating pathways. TKI competes with ATP for binding with target tyrosine kinase; for example, erlotinib targeted the EGFR kinase domain after competing with adenosine triphosphate (ATP).[54] TKIs are often labeled with 18F or 11C. Due to their short half-life activity, they get a better fit with biological half-life. After injecting radiolabeled TKIs, they immediately attach to target cells and are often cleared by the biliary and renal systems.

In this instance, dynamic scanning is typically utilized to evaluate PK modeling and quantitative tracing uptake. The benefit of using short live nucleotides is that it is easily a decade, and the patient can receive this therapy a second time immediately after the first.[55]

TABLE 4: The table shows the available personalized medications on the market.[56]

Trade name of the drug	Class of drug	Generic name of the drug	Target site
Tarceva Iressa Tagrisso	Tyrosine kinase inhibitor	Erlotinib Gefitinib Osimertinib	Epidermal growth factor receptor
Potrazza Avastin Cyramza	Monoclonal antibody	Necitumumab Bevacizumab Ramucirumab	Vascular endothelial growth factor receptor
Keytruda		Pembrolizumab	Progressive disease

X.PERSONALIZED MEDICINE FOR DIABETES:

Personalized medicine for diabetes (PMFD) is defined as the use of data about a person's genetic composition

to adapt strategies for preventing, diagnosing, treating, or monitoring their diabetes.

PMFD practice consists of four main phases:

- First is identifying genes and biomarkers for diabetes and obesity, the most significant risk factor for type 2 diabetes.
- Second, once these diabetes predictors have been established, resources must be allocated to prevent or diagnose diabetes and obesity phenotypes in high-risk patients whose risk is determined by their genotype.
- The third is a selection of individualized therapies for affected individuals. The selection procedure includes selecting which drug to prescribe, what dose to administer, and which diet to recommend. The method also considers which drugs are least likely to cause adverse effects or toxicity.
- The fourth step is to detect circulating diabetes biomarkers in order to evaluate the response of preventive or therapy.[57]

Benefits of personalized medicine in diabetes:

The potential advantage of a personalized medicine approach to diabetes is the ability to collect relevant information to prevent or treat diabetes through screening genetic testing.

- Patients at high risk for chronic diseases, such as diabetes generally have a long asymptomatic phase before the condition manifests itself. Patients who are found to be at high risk for diabetes by genetic testing might be guided toward preventative treatments such as lifestyle modifications or medicines to postpone or prevent the illness.
- Genetic testing and biomarkers can be used to predict diabetes diagnosis and track its progression.[58]
- Greater drug development efficiency is achievable if genetically[59] or nutritionally[60] determined drug targets are discovered in subpopulations of diabetic patients.
- Polymorphisms in receptors, transporters, and metabolizing enzymes that are genetically determined lead to varied drug reactions. Individualized medicine enables personalized drug prescribing with less trial and error and less time lost on ineffective responses or adverse effects.[61]

Diabetes will benefit significantly from personalized medication. This method becomes widely used only when the identification of risk factors by genetics or biomarkers is complemented by effective medication. Personalized medicine will be used to treat diabetes patients using particular techniques that may be beneficial for one patient but may not be effective for another with identical height, weight, and glucose levels. Diabetes will also be prevented with personalized medication before it develops. Diabetic personalized medical treatment will become an increasingly essential element of diabetes treatment.

XI.FUTURE ASPECTS OF PERSONALIZED MEDICINE

Personalized medicine (PM) holds great promise for disease treatment and prevention. It provides a great potential to enhance the future of individualized healthcare for all citizens (citizens herein referring to individuals in society, reflecting the inclusive and equitable nature of PM methods) and promise illness treatment and prevention.

There are great hopes for the future, but will PM and its associated tools and techniques revolutionize healthcare and extensively benefit society and its residents by 2030? Will scientists, inventors, healthcare professionals, and others give the most appropriate drug, at the correct amount, at the right time, and at a fair cost?

These are problems that demand immediate attention and concerted effort to accomplish the objective of complete PM implementation by 2030. The International Consortium for Personalized Medicine[62] argues that progress in biological, social, and economic disciplines and technology development is the driving force behind the PM. Substantial investment in research and innovation is thus required for its successful implementation. By 2030, the Vision is that PM will have led to the next generation of healthcare.

Through five significant viewpoints, PM as a medical practice centered on the individual's characteristics has enhanced diagnostic, therapeutic, and preventative efficacy, additional economic value, and equal access for all citizens.

ICPerMed views healthcare in the following five fundamental perspectives, as to be realized by 2030[63]:

Perspective 1: Informed, empowered, engaged, and responsible citizens
• The citizen has control over health-related data, including input, monitoring, and access.
• There are easily accessible, reliable, and understandable sources of medical information.

Perspective 2: Health care providers who are well-informed, empowered, engaged, and responsible
• In clinical settings, the safe, responsible, and optimum utilization of health information and research results is necessary for PM in a routine clinical setting.
• Clinical decisions necessitate multidisciplinary teams that incorporate novel health-related professions.
• Clinical decisions necessitate multidisciplinary teams that incorporate novel health-related professions.
• Interdisciplinary aspects of PM have been incorporated into healthcare professional education.
• Clinicians and researchers collaborate closely to support the rapid development and implementation of PM solutions.

Perspective 3: Patients can benefit from personalized, optimal health promotion and sickness prevention, diagnosis, and treatment due to healthcare systems.
• All citizens now have equal access to PM services.
• The efficacy and equity of PM services are optimized
• Resource allocation within healthcare systems is compatible with social ideals.
• There is a secure flow of health data from individuals and healthcare systems to regulatory agencies and research.

Perspective 4: Health-related information that is readily available for improved treatment, care, prevention, and research
• Personal data in electronic health records (EHRs) is utilized for more efficient PM by healthcare professionals and researchers.
• Health-data management employs standardized methods to assure data privacy, safety, and security.
• Personalized treatment and prevention benefits citizens while reducing prices and risk.

Perspective 5: Creating economic value through developing the next generation of medicine
• For PM, a suitable balance of investment, profit, and shared benefit for citizens is a reality.
• PM has appropriate business principles and models in place.
• Telemedicine and mobile solutions both enhance PM and have a monetary value.
• New employment is created in healthcare systems.

The ICPerMed 2030 goal is consistent with the Agenda for Sustainable Development, which outlines a vision for excellent health and well-being through encouraging healthy lifestyles, preventative measures, and modern, efficient healthcare for everyone. Four pillars reflecting transversal issues are crucial for the effective implementation of PM (Fig.) to support these aims and preserve the five views of the ICPerMed Vision.

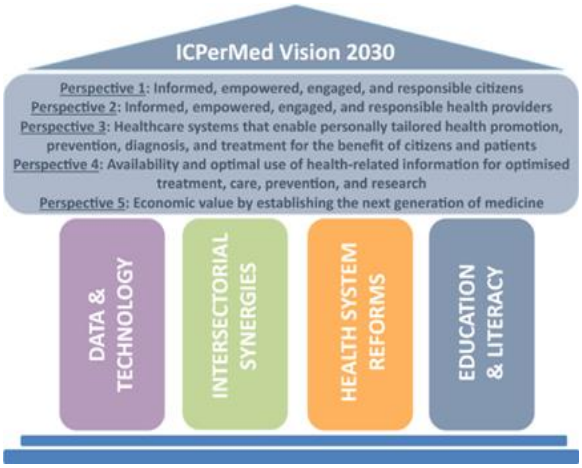

FIG 2: VISION FOR PERSONALIZED MEDICINE

XII.CONCLUSION

Precision medicine is getting attention for its potential and uniqueness with its upcoming new opportunities. Personalized medicine is based on the discovery of individual genes, which cause disease. Pharmacogenomics is a promising field, but it is the best method to create new targeted therapy for any disease. Because of this approach, we will get accuracy in the treatment, and also the chances of side effects will also be reduced. This could be a better way to reduce the cost and time required to develop new medicine. This initiative is not reaching all parts, but slowly this will help developing countries also. This sophisticated approach could be a hope for developing

potent novel biologics or bio-markers for disease management. The FDA has already approved so many medicines, and in the future also it will approve based on their novelty. This therapy combines clinical and family history, which offers an exciting and novel tool for drug development. As it is a challenging field, this could be tough to overcome all the problems because of its expensiveness, insufficient information, less awareness to the people and others. The development of therapies could be a tough job for all because they need more time to develop and need sophisticated commercial assay techniques, but on another side, it might be beneficial for developing counties. So, personalized medicine can be a better approach for early detection and cure disease, but these people or future physicians should be responsible and active towards efficiently facing the challenges and making this approach feasible.

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