



PRECISION MEDICINE: - OPTIMIZATION, BENEFITS, CHALLENGES AND ITS APPLICATIONS

Shaikh Sameena*¹, Sameer Shafi¹, Dhumal P. B.¹ and Makne P. D.²

¹Shivlingeshwar College of Pharmacy, Almala Dist. Latur- 413520 Maharashtra (MH), India.

²Maharashtra College of Pharmacy, Nilanga, Dist. Latur-413521 Maharashtra (MH), India.

***Corresponding Author: Shaikh Sameena**

Shivlingeshwar College of Pharmacy, Almala Dist. Latur- 413520 Maharashtra (MH), India.

Article Received on 25/10/2022

Article Revised on 15/11/2022

Article Accepted on 05/12/2022

ABSTRACT

The “Precision Medicine” has become highly regarded over recent years, fuelled by scientific yet as political views. Despite its quality, its actual that means, and the way it's completely different from alternative common terms like “stratified medicine”, “targeted therapy” or “deep phenotyping” remains unclear. The ‘Precision Medicine (systems drugs)’ idea guarantees to realize a shift to future care systems with a lot of proactive and prognosticative approach to medicine, wherever the stress is on illness interference instead of the treatment of symptoms. PM seeks to maximize the standard of health care by individualizing the health-care method to the unambiguously evolving health standing of every patient. PM is formalized as a treatment regime that contains a sequence of call rules, one per call purpose, that map up-to-date patient info to a suggested action. The potential actions may be the choice of that drug to use, the choice of dose, the temporal order of administration, the advice of a particular diet or exercise, or alternative aspects of treatment or care. Specially, advances like cell sorting, epigenetics, proteomics, metabolomics, and a lot of are convergence with science and alternative technologies during a manner that's quickly increasing the scope of this field. This text can introduce key ideas and challenges of PM and a few of the approaches presently being enforced to beat these challenges. Future trends in PM are presumably in targeting genetic pathways in varied diseases with medications, cancer immunotherapies, DNA sequencing, and use of technology in acute interventions (e.g., automatic defibrillator).

KEY WORDS: - Precision Medicine (PM), Stratified, Epigenetics, Proteomics, Metabolomics, etc.

INTRODUCTION

In the past 5 years, speedy technology progress in collection, storing, analyzing, and connecting advanced medical knowledge has reshaped our world. Rather than the normal model of clinical development supported distinct, organized trials with comparatively little populations, these advances promise a replacement paradigm-whereby continuous learning is fed by present knowledge and period analysis. Though some hurdles still stay before this goal will be achieved, the expansion of knowledge has enabled a replacement, bolder vision of Precision Medicine (PM). During this new vision, a closed-loop system of continuous learning supported present knowledge permits every patient to learn from insights generated by the collective expertise of the whole medical profession.



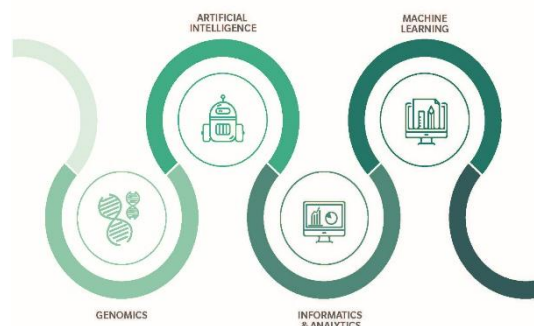
What is Precision Medicine (PM)?

The National analysis Council's toward exactness drugs adopted the definition of PM from the President's Council of Advisors on Science and Technology in 2008 as: “The craft of medical treatment to the individual characteristics of every patient...to classify people into subpopulations that take issue in their status to a selected malady or their response to a particular treatment. Preventative or therapeutic interventions will then be targeting those that can profit, scotch expense and aspect effects for those that cannot”. Because the definition suggests, the facility of Precision Medicine (PM) lies in

its ability to guide health care selections toward the foremost effective treatment for a given patient, and thus, improve care quality, whereas reducing the necessity for needless diagnostic testing and therapies.

WHY PRECISION MEDICINE?

The Convergence of people, process and technologies is creating opportunities for extreme advances for the human race



Precision Medicine (PM) has catalyzed sturdy discussion over the deserves and realities of an additional customized approach to aid. In one camp square measure the philosophic, UN agency believe that the utopia of medication will exist in an exceedingly world wherever patients' genomes, and -omits connected data like exposomics and metabolomics, will guide period, personalized hindrance and medicine for improved outcomes to any or all. Within the different camp square measure those that tell a cautionary tale, citing current inability to reconcile the dream with the truth. Above all, there's concern concerning the connectedness and impact of personalized Precision Medicine (PM) approaches for public health, wherever populations square measure the normal focus for intervention and selections that aid initiatives to fund should be rationalized among finite budgets.

It's outdated the term "Personalized Medicine" that was outlined synonymously, then again discharged with the argument that physicians have continuously treated patients on a personalized level. Indeed, the non-public approach that's an inherent a part of the doctor-patient relationship could be a central facet of exactness drugs, however isn't a replacement invention. However, new medicine data may add substantial data on the far side signs and symptoms that were antecedently discernible, and also the term PM implies the novelty of this idea, that is that the incorporation of a good array of individual knowledge, together with clinical, lifestyle, genetic and more biomarker data. With the convergence of humanity, ethics, economy, social science and different data parts, exactness drugs aims to reduce induced harm and expense and reach an optimum therapeutic result. Innovative ways in which to observe drugs can result in redesigning the manner within which we have a tendency to teach drugs. Medical education ought to shift the main target from pure content to the event of integrative skills and competences. relating to however exactness drugs may well be educated to medical students, we have a

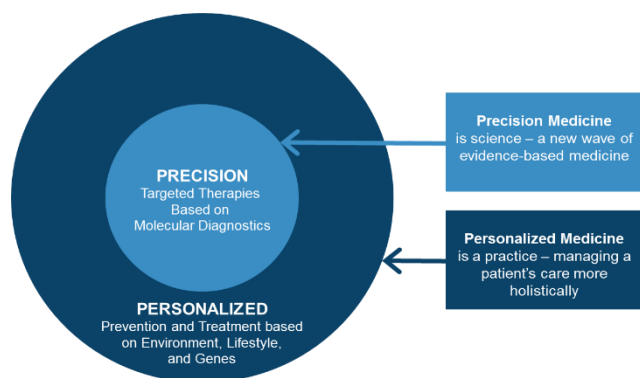
tendency to believe that 2 main changes ought to be created to this medical curriculum: First, learning of basic science subjects, specializing in however this information will directly impact clinical observe, ought to be emphasized; Second, it's of nice importance to push discussion panels on the evolution of medication, conveyance in specialists within the groundbreaking fields that square measure dynamical aid and, thus, stimulating students to pursue a career on these areas.

According to the Precision Medicine Initiative (PMI), Precision Medicine (PM) is "a rising approach for malady treatment and hindrance that takes into account individual variability in genes, setting, and modus vivendi for each person." This approach will modify doctors and researchers to predict extra accurately that treatment and hindrance strategies for a specific malady will add that groups of people. It's in distinction to a one-size-fits-all approach, among that malady treatment and hindrance strategies area unit developed for the everyday person, with less thought for the variations between folks.

Although the term "Precision Medicine" is relatively new, the thought has been a neighborhood of aid for many years. As an example, a private UN agency needs a transfusion is not given blood from an each that means chosen donor; instead, the donor's people are matched to the recipient to chop back the possibility of complications. although examples are found in several areas of medication, the role of PM in a day aid is relatively restricted. Researchers hope that this approach will expand too many areas of health and aid in returning years.

What is the Difference between Precision Medicine (PM) and Personalized Medicine?

There is lots of overlap between the terms "Precision Medicine (PM)" and "personalized medicine" keep with the National Analysis Council, "Personalized medicine" is an older term therewith suggests that identical as "Precision Medicine." However, there was concern that the word "personalized" could be misinterpreted to imply that treatments and preventions are unit being developed unambiguously for each individual; in PM, the most target is on characteristic that approaches are effective that patients supported genetic, environmental, and means factors. The Council thus most well liked the term "Precision medicine" to "Personalized Medicine." However, some people still use the two terms interchangeably.

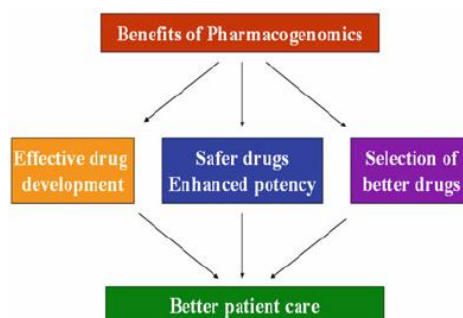


What concerning Pharmacogenomics?

It is a vicinity of PM. Pharmacogenomics is that the study of but genes have an impact on a person's response to specific medication. This relatively new field combines medication (the science of drugs) and biological science (the study of genes and their functions) to develop effective, safe medications and doses that are unit tailored to variations in a every person's genes.

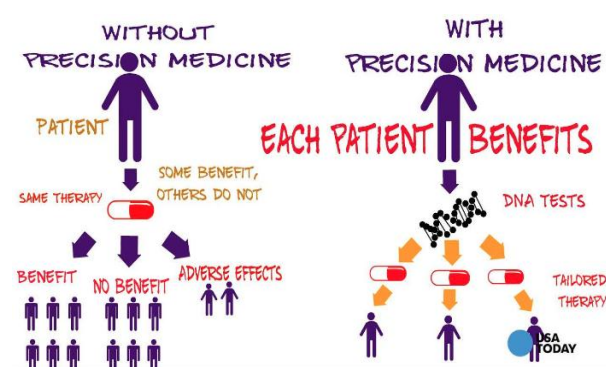
What is the Precision Medicine Initiative (PMI)?

The Precision Medicine Initiative could also be a semi-permanent analysis endeavor, involving the National Institutes of Health (NIH) and multiple totally different analysis centers that aims to know but a personality's biological science, atmosphere, and life-style can facilitate verify the foremost effective approach to forestall or treat malady. The Precision Medicine Initiative (PMI) has every short and semi-permanent goals. The short goals involve increasing PM among the area of cancer analysis. Researchers at the National Cancer Institute (NCI) hope to use associate exaggerated info of the biological science and biology of cancer to look out new, additional sensible treatments for varied sorts of this malady. The semi-permanent goals of the (PMI) target delivery PM or any areas of health and health care on an oversized scale. To the current end, the bureau has launched a study, known as the all folk's analysis Program that involves a bunch (cohort) of a minimum of 1 million volunteers from around the U. S. Participants are providing genetic info, biological samples, and totally different knowledge regarding their health. To encourage open info sharing, participants can access their health knowledge, furthermore as analysis that uses their info, throughout the study. Researchers can use this info to envision an oversized vary of diseases, with the goals of upper predicting malady risk, understanding but diseases occur, and finding improved identification and treatment ways that.



What unit of measurement some potential edges of Precision Medicine (PM) and additionally the Precision Medicine Initiative (PMI)?

Precision Medicine holds promise for up many aspects of health and tending. variety of those benefits are planning to be apparent presently, as a result of the all folk's analysis Program continues and new tools and approaches for managing info unit of measurement developed. different benefits may result from semi-permanent analysis in PM and may not be completed for years.



Potential benefits of the Precision Medicine Initiative (PMI)

- New approaches for shielding analysis participants, considerably patients' privacy and additionally the confidentiality of their info.
- Design of recent tools for building, analyzing, and sharing huge sets of medical info.
- Improvement of workplace oversight of tests, drugs, and different technologies to support innovation whereas making sure that these merchandise unit of measurement safe and effective.
- New partnerships of scientists in an extremely wide range of specialties, likewise as people from the patient support community, universities, pharmaceutical corporations, and others. Opportunity for 10,00,000 people to contribute to the advancement of analysis.

Potential semi-permanent benefits of research in Precision Medicine (PM)

- Wider ability of doctors to use patients' genetic and different molecular data as a section of routine treatment.

- Improved ability to predict that treatments will work best for specific patients.
- Better understanding of the underlying mechanisms by that varied diseases occur.
- Improved approaches to preventing, diagnosing, and treating an honest vary of diseases.
- Better integration of electronic health records (EHRs) in patient care, which might modify doctors and researchers to access medical info extra merely.

What are variety of the challenges facing Precision Medicine (PM) and so the Precision Medicine Initiative (PMI)?

Precision medicine might be a growing field. many of the technologies that are needed to meet the goals of the Precision Medicine Initiative have alone recently been developed. As an example, researchers needed to standardize the gathering of clinic and hospital information from quite a meg volunteers around the country. They put together needed knowledgebase to store huge amounts of patient knowledge with efficiency. The PM Initiative put together raises ethical, social, and legal issues. It's necessary to protect participants' privacy and so the confidentiality of their personal and health knowledge. Participants need to understand the risks and benefits of collaborating in analysis, which means researchers ought to have a rigorous technique of consent. value is to boot a drag with PM. The PMI itself will price many varied used in federal funding, and so this initiative would need Congress to approve funding over multiple years. Technologies like sequencing large amounts of polymer square measure pricey to carry out (although the value of sequencing is decreasing). To boot, drugs that square measure developed to treat conditions supported molecular or genetic variations using potential to be pricey. Compensation from third-party payers (such as personal insurance companies) for these targeted drugs is to boot potential to become a drag. If PM approaches using to become a district of routine care, doctors and totally different care suppliers will need to apprehend loads of regarding biological science and chemical science. They're reaching to more and more need to interpret the results of genetic tests, understand but that knowledge has connexion to treatment or interference approaches, and convey this knowledge to patients.

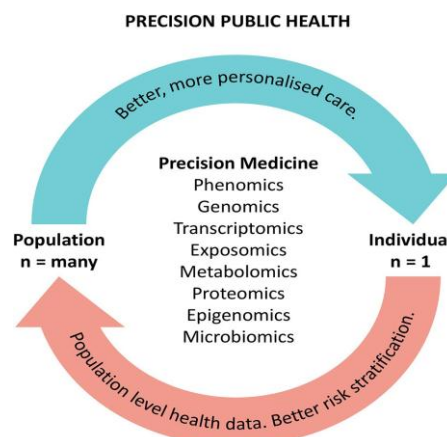
Progress and Challenges in Precision Medicine



Evolution of Precision medicine (PM)

In the past, making clinical choices was solely done on the premise of clinical experience and

pathophysiological clarification. this case acknowledged as "Evidence Based Medicine" may be a heap of experience based and entails thought-about use of current best proof in making choices regarding the care of individual patients. Evidence Based Medicine (EBM) is grounded on three basic principles, the hierarchy of proof supported study design: systematic reviews to avoid selection bias, and patient's values and preferences. many researchers have criticized EBM for that focus on groups of patients rather than on the individual. Specifically, once proof is reportable for treatment powerfulness once trials, the results unit of measurement sometimes supported the everyday treatment impact and do not apply to any or all patients.



The emergence of Precision medicine (PM)

The observe of medicine is presently undergoing a paradigm shift from the primarily 'reactive medicine' of the past to and loads of 'proactive predictive medicine' intermeshed toward illness hindrance. rather than treating an illness, there is a shift towards the treatment of individual patients, supported a customized data-driven approach. This transformation is being driven by the convergence of the huge data and omits revolutions. 'Precision Medicine' has emerged as a machine approach to functionally interpret omits and huge data, and facilitate their application to tending provision. to achieve these goals, Precision medicine (PM) aims to develop machine models that integrate data and knowledge from every clinic and basic analysis to attain a mechanistic understanding of illness, thereby facilitating tailor-made treatment choices. this is often Associate in Nursing particularly formidable goal, but adopting such associate approach may bring varied rewards.

Precision Medicine (PM) approaches

Precision Medicine presently uses very little panels of biomarkers to achieve a degree of patient stratification into health problem subgroups. However, patient's unit of measurement still for the foremost half stratified on one molecular marker, just like the mutation standing of 1 sequence. like several daring initiative, kind of hurdles exist to the whole implementation of PM. The PM community hopes to form on the previous successes of

systems biology, whereas at a similar time avoiding the pitfalls of data domain collaboration by implementing the teachings learned from the emergence of systems biology over the previous decade. variety of the challenges and bottlenecks that will got to be overcome to successfully implement Precision Medicine approaches inside the clinic's unit of measurement out there.

Why Precision Medicine?



Foundation of Precision medicine (PM)

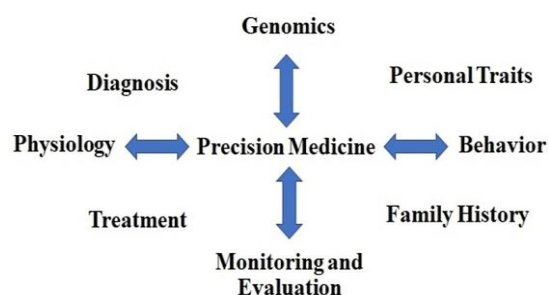
The implementation of PM on a wider basis desires higher identification of “the right patient,” World Health Organization (WHO) got to receive a particular treatment and “the right dose,” dose required to tend to each patient with the potential to retort. Hence, it's essential to grasp the key reasons for variation in response to treatment, which could be thought of below a pair of main groups.

A. Pharmacokinetic variability includes variability in.

- Subject phenotype: weight, body expanse, organ standing, age, ethnicity, gender, little community.
- Subject genotype: polymorphisms in metabolizing enzymes or transporters.
- health problem response or progression with time.
- vogue and environmental factors like concomitant medications, diet, and smoking.
- Adherence to treatment, drug formulation, route of administration, and dosing program.

B. Pharmacodynamics variability includes.

- Polymorphism in drug target or downstream pathway and driver mutations of health problem no uniformity.



Challenges and solutions for the most effective implementation of Precision Medicine (PM)

Genomic studies have unveiled the actual fact of tumors—they square measure tremendously

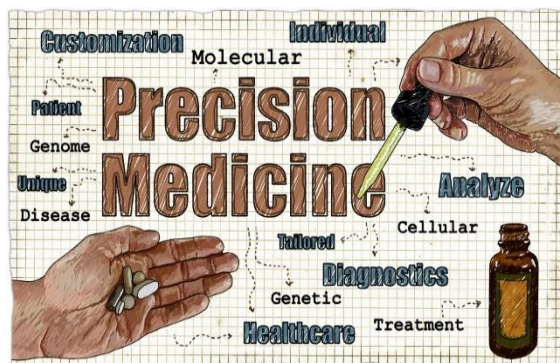
heterogenetic and complex, and optimized treatment usually does not result from classical clinical analysis and follow models. PM studies demonstrate the key challenges in springing up with trials for this new paradigm. First, the speed of matching patients to medication.

Tools of Precision Medicine (PM) strategy

- Failure to match patients is attributed to.
 - Enrollment of individuals with end-stage health problem, World Health Organization deteriorate or die early;
 - Use of little sequence panels that yield restricted unjust alterations;
 - Delays in receiving and deciphering genomic results; and
 - Problem accessing targeted treatment medication and/or restricted drug availability.
- Some solutions provided by trials with higher matching rates, include: -
 - Use of run navigators and drugs acquisition specialists;
 - Application of Associate in Nursing outsized NGS panel with > 2 hundred genes;
 - Creation of merely in-time electronic molecular growth boards instantly upon doctor Request; and
 - Exploitation of biomarkers to match patients to medical aid, secretion treatment, and medical aid (in addition to gene-targeted agents).

Other major hurdles encountered inside the implementation of Precision Medicine (PM) embrace the following.

- Potential variations in response to matched treatment depending on general anatomy and/or genomic co-alterations.
- The Unsimilarity, complexity, and constant evolution of genomic landscapes. owing to important unsimilarity between primary tumor and pathologic process sites, molecular identification of tumor tissue obtained from one lesion won't forever be representative of the final health problem.
- The got to screen large numbers of patients therefore on hunt down specific/rare genomic defects. Incomplete biologic/molecular profiles thereupon to select therapy; suboptimal technology and resources to grasp totally the drivers of cancer in individual patients;
- Considerable delays inside the activation of clinical trials;
- Differences within the metabolism and adverse effects of study medicine in varied ethnic groups;
- Lack of agreement between assays from totally different diagnostic companies/laboratories; and
- Most significantly, lack of access to medicine for patients with restricted resources yet as excessive eligibility criteria that rule out massive swaths of patients with real-world co-morbidities.



Role of Therapeutic Drug watching in Precision Medicine (PM)

Therapeutic Drug Monitoring (TDM) encompasses a substantial role to play within the execution of PM because it permits doses to be adjusted in individual patients so as to realize a preset target exposure, thereby, reducing pharmacokinetic variability with a discount in overall response variability. Drug doses could also be adjusted supported markers like glucose/glycosylated hemoprotein, sterol, prostate specific matter, pressure level, etc. once appropriate biomarkers area unit out there, their use to guide dosing would be expected to cut back response variability, more so, than the dose adjustment supported plasma drug concentration. Recent studies suggesting the presence of exposure impact relationships support the potential price of TDM for life agents in rheumatism and a few walkers; trials are current to see if adjusting dose to keep up a target exposure can improve efficaciousness.

The following mistakes ought to be avoided within the implementation of Precision Medicine

- Instead of Traditional ancient medication, it's before acknowledged that ancient medication is that the basis of PM.
- Precision Medicine isn't adequate to an easy convergence of latest technologies. As an example, info relevant to genetic science information wants effective integration with biological science, metabolomics and clinical phenotypes (including symptoms, signs, organic chemistry, image and pathological features) to compose an entire personalized biological information, by that to contribute to a diagnosing and treatment supported personalized patient's condition.
- Precision Medicine isn't adequate to an easy personalized medication, however a medication mode combined standardization with discrimination.

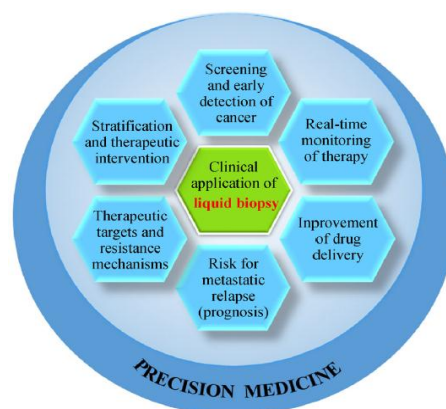
The TDM Process



APPLICATIONS OF PM

• Diagnosis and intervention

Having the power to seem at a patient on a private basis can give an additional correct diagnosing and specific treatment arrange. Genotyping is that the method of getting somebody's DNA sequence by victimization biological assays. A tool that's getting used currently to check effectualness and safety of a drug specific to a targeted patient group/sub-group is companion medical specialty. This technology is associate assay that's developed throughout or once a drug is formed offered on the market and is useful in enhancing the therapeutic treatment offered supported the individual. These companion medical specialty have incorporated the pharmacogenomics info associated with the drug into their prescription label in an attempt to help in creating the foremost best treatment call attainable for the patient.



• Drug development and usage

Having somebody's genomic info are often important within the method of developing medicine as they expect approval from the agency for public use. Having an in depth account of somebody's genetic make-up are often a serious plus when making a decision if a patient are often chosen for inclusion or exclusion within the final stages of a run.

• Theranostics

Theranostics could be an individualized approach to treating cancer, victimization similar molecules for each imaging (diagnosis) and medical care.

• Radiotheranostics

Radiotheranostics could be a subspecialty of Theranostics victimization similar prescribed drugs for each imaging and medical care with radiation.

• Respiratory proteomics

Respiratory diseases have an effect on humanity globally, with chronic respiratory organ diseases (e.g., asthma, chronic preventive pulmonic Unwellness, upset pulmonic pathology, among others) and carcinoma inflicting in depth morbidity and mortality.

• Cancer genetics

Over recent decades cancer analysis has discovered an excellent deal concerning the genetic kind of sorts of cancer that seem a similar in ancient pathology. There has additionally been increasing awareness of tumor heterogeneousness, or genetic diversity among one tumor. Among alternative prospects, these discoveries raise the chance of finding that medicine that haven't given sensible results applied to a general population of cases could nonetheless achieve success for a proportion of cases with specific genetic profiles.

• Population screening

Population genetics screening are often accustomed establish individuals in danger for Unwellness, which may assist in preventative efforts.

CONCLUSION

With our method definition, we have a tendency to propose that "Precision Medicine" may not be viewed because the end-point of a unique stratification of patients with clinical utility, however rather as an extremely refined and a lot of complicated method. As such, stratified medication and tailored medical aid are often interim outputs of the method, of that the results ought to be fed back to achieve data and so any increase the exactness. Accountable decision-making within the climate of escalating health care prices is needed to confirm that exactness medication is often properly tested on a scale to work out if this approach can result in higher patient outcomes. PM has replaced the term 'personalized medicine' because it just refers to trade of medical treatment to the individual characteristics by classifying subpopulations mistreatment their common genetic patterns, lifestyles, drug responses, environmental, and cultural factors. Long run goals of PM square measure higher unwellness delineation and stratification, detection and observance of unwellness symptoms as early as potential, identification of preclinical people, observance the evolution of the unwellness, and management of unwellness, creating it less expensive and with fewer adverse effects. Another concern surround a number of the grander claims of exactness medication proponents is whether or not the mixture of biological and environmental quality can prove too nice to be globally overcome by modelling within the close to future. this means that "precision medicine" can be the a lot of adequate term to replicate

the continual method of feedback loops, that current efforts for even a lot of exactness and discrimination are needed which recently gained data, presumably from new knowledge sources, will nonetheless any improve accuracy.

ACKNOWLEDGEMENT

The Authors are thankful to Principal, Dharashive V. M. for providing the laboratory facility and her persistent creative encouragement and valuable guidance throughout the research work. Also, I would like to thank my supervisor, for all his help, guidance and assistance throughout the course of the work. It has been a great pleasure and wonderful learning experience to work under his supervision.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENECES

1. Stone A. Precision medicine: Health care tailored to you. The White House Blog, 2016.
2. Levy G. Pharmacologic target-mediated drug disposition. Clin Pharmacology Ther, 1994; 56: 248-52.
3. Flores M, Glusman G, Brogaard K, et al. P4 medicine: how systems medicine will transform the healthcare sector and society. Per Med, 2013; 10: 565-76.
4. Tredan O, Wang Q, Pissaloux D, et al. Molecular screening program to select molecular-based recommended therapies for metastatic cancer patients: analysis from the Profiler trial. Ann Oncol, 2019; 30: 757-65.
5. National Research Council, Committee on A Framework for Developing a New Taxonomy of Disease. Toward Precision Medicine: Building a Knowledge Network for Biomedical Research and a New Taxonomy of Disease. National Academies Press; Washington DC, 2011.
6. Ashley EA. The precision medicine initiative: a new national effort. JAMA, 2015; 313: 2119-20. doi: 10.1001/jama.2015.3595
7. President's Council of Advisors on Science and Technology. Priorities for Personalized Medicine. Washington DC, Executive Office of the President, 2008.
8. Dong JH. Modern concept and clinical practice of precision hepatic surgery. Chin J Dig Surg, 2012; 11: 8e10.
9. Toledo RA, Sekiya T, Longuini VC, Coutinho FL, Lourenc,o DM Jr, Toledo SP. Narrowing the gap of personalized medicine in emerging countries: the case of multiple endocrine neoplasias in Brazil. Clinics. 2012; 67(Suppl 1): 3-6, [http://dx.doi.org/10.6061/clinics/2012\(Sup01\)02](http://dx.doi.org/10.6061/clinics/2012(Sup01)02).
10. Peck R. Precision medicine is not just genomics: The right dose for every patient. Ann Rev Pharmacol Toxicol, 2018; 58: 105-22.

11. Kola I, Bell J. A call to reform the taxonomy of human disease. *Nat Rev Drug Discov*, 2011; 10: 641-2.
12. Personalized Medicine Coalition. Retrieved, April 26, 2014.
13. Hess GP, Fonseca E, Scott R, et al. Pharmacogenomic and pharmacogenetic-guided therapy as a tool in precision medicine: current state and factors impacting acceptance by stakeholders. *Genetics Res*, 2015; 97: 13.
14. Dugger SA, Platt A, Goldstein DB. Drug development in the era of precision medicine. *Nat Rev Drug Discov*, 2018; 17: 183-96.
15. Committee on a Framework for Developing a New Taxonomy of Disease; National Research Council. *Toward Precision Medicine: Building a Knowledge Network for Biomedical Research and a New Taxonomy of Disease*. Washington DC, The National Academies Press, 2011.
16. Jameson JL, Longo DL. Precision medicine: personalized, problematic, and promising. *New Engl J Med*. 2015; 372:2229-2234. <http://dx.doi.org/10.1056/NEJMs1503104>.