

# Mini Review Article: Review and importance of precision medicine in cancer treatment and individual health

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## ABSTRACT

Precision medicine is a model of medicine that personalizes healthcare by providing medical decisions, practices, or pharmaceutical products that are specific to each patient. In this model, diagnostic tests are often used to find the optimal treatment based on an individual's genetic makeup. Tools used in precision medicine include molecular diagnostics and imaging. In this new study, researchers at Rutgers University applied personalized precision medicine to cancer treatment. Their analysis included the entire process of capturing PPM data, creating PPM products, and the social and economic consequences of using PPM. In the study, which was the result of work by several researchers at the university, the researchers report that PPM has the potential to revolutionize cancer treatment. Conventional approaches involve diagnosing a tumor and then using general treatment approaches such as surgery, chemotherapy, and radiation therapy. In contrast, in PPM, researchers use targeted treatment approaches that are more effective and have fewer unwanted side effects. These treatments are identified by analyzing specific tissues, gene mutations, and personal factors related to each unique case of cancer. Examples of these emerging treatments include immunotherapy, cancer vaccines, and ... In addition, these researchers have raised social issues related to precision and personalized medicine in health care and wellness. According to the researchers, before precision and personalized medicine becomes a part of standard cancer care, some challenges must be solved. These challenges include legal challenges, economic concerns, and the feasibility of using precision and personalized medicine, which is accompanied by economic, social, and individual problems. Today, precision and personalized medicine is becoming an effective and satisfactory approach, and before this therapeutic approach can be introduced into the fight against cancer, the aforementioned challenges must be overcome.

## Introduction

**C**ancer is one of the most complex and diverse groups of diseases in the field of medicine, with some types of

it easily treatable and some still have no cure. For diseases like cancer, we cannot go with a one-size-fits-all approach. Unfortunately, for decades, due to lack of technology, we have been using the same approach for different

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types of cancer. Although these treatments have saved millions of lives worldwide, they still have limitations such as side effects, recurrence and ultimately death in some cases, but now with the advancement of technology, cancer treatment has become more personalized which has proven to be a breakthrough for cancer treatment [1].

### Understanding Cancer

Cancer is a devastating disease that kills thousands of people. It is characterized by uncontrolled cell division and the spread of abnormal cells in the body. This growth eventually turns into a tumor and disrupts other tissues and functions of the body. The causes of cancer include: Changes in genetic material called mutations, which can vary from person to person depending on their lifestyle and environment [2].

### What is personalized medicine?

Personalized medicine is a modern approach in the healthcare industry that analyzes a person's genetic makeup, lifestyle, and environmental factors to tailor a medical treatment to a specific individual. In the case of cancer treatment, personalized medicine uses molecular and genetic information about a patient's tumor.

By analyzing these biomarkers, doctors can select a personalized and specific treatment for a specific individual. This treatment has proven to be a turning point in the field of cancer treatment.

This approach has gained popularity worldwide in recent years [3].

### Purpose of Genetic Testing

Genetic testing in cancer treatment is the basis of personalized medicine to select specific treatments according to a specific individual

and to identify biomarkers (biomarkers are substances that indicate the presence of cancer in a cell).

Tumors are not constant for different people, even with the same type of cancer. They can have genetic mutations that are unique to each individual, which may affect how cancer cells grow, spread, and respond to treatment. With the help of modern technologies, it is becoming easier for doctors and oncologists to track down these mutations and DNA shards that cause cancer [4].

### Tailored Treatment: A Precision Approach

A promising development in personalized cancer treatment is the invention of targeted therapies.

Targeted therapies attack specific molecules or pathways that are active during the growth and survival of cancer cells, while chemotherapy kills rapidly dividing cells more or less randomly. These therapies are generally based on the genetic profile of the tumor and aim to attack cancer cells more precisely while sparing healthy cells.

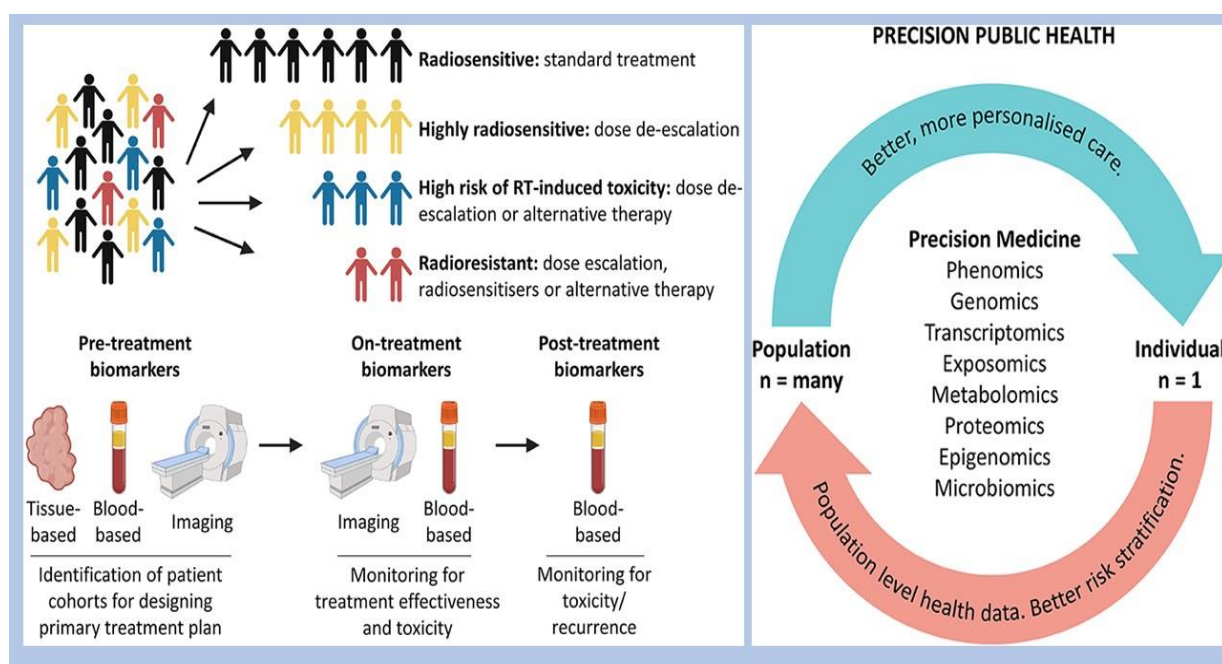
Various treatments and detection techniques have evolved over the years to work on the principle of this approach. Some of them are as follows:

**1- Immunotherapy (using the immune system):** An innovative parameter that has emerged in personalized medicine for cancer treatment is the advancement of immunotherapy to further stimulate the human immune system to fight cancer cells. Immunotherapy drugs work by blocking proteins that prevent immune cells from attacking cancer cells. Some cancers even find a way to escape the immune system by expressing proteins that are effective in suppressing the immune response.

Some drugs have successfully blocked these proteins, allowing the immune system to identify and destroy the cancer [5].

**2- Liquid biopsy (early diagnosis):** One of the biggest advances in cancer diagnosis is the innovation of biopsy. Liquid biopsy is a subset of biopsy in which doctors use blood and body fluids from a patient to diagnose cancer early with minimal invasiveness. It helps in understanding the pattern of genetic mutations. Personalized medicine is a new shift from a generalized, one-size-fits-all

approach to cancer treatment to a more targeted, individualized approach. Through genetic testing, biomarkers, and new therapies such as targeted therapies and immunotherapy [6], personalized medicine is making such treatments for cancers more precise, effective, and safe. Although challenges remain, the evolutionary personalization of cancers promises to make their treatment more specific, accessible, and successful than ever before (Figure 1).



**Figure 1.** Review and importance of precision medicine in cancer treatment and individual health

### What is personalized medicine for cancer?

Something exciting is happening in the fight against cancer. Doctors are finding new ways to treat each person's cancer. This approach is called personalized medicine [6].

Instead of using the same treatment for everyone, doctors create treatment plans based on individual differences. In this blog, we will explore personalized medicine in

oncology, its benefits, how it works, and its impact on cancer patients.

Typically, doctors use the same treatments for people with the same type of cancer, but everyone is different. The goal of personalized medicine is to understand these differences. It takes into account your genes, lifestyle, and health to determine the best treatment for you [7].

Doctors look at your genes to help you decide on the best treatment.

They do this by testing your DNA, which is like your body's manual. By reading it, doctors can learn a lot about your cancer. This helps them choose treatments that will work best for you.

#### **How does personalized medicine work?**

First, doctors take a small sample of your DNA. Then they examine this sample to identify any unique aspects of your genes that could affect your cancer. Once they know this, they can choose treatments that target those specific features. It's like using a secret code to find the right key to prevent cancer [8].

#### **Why is precision medicine so important for drug discovery?**

The ultimate goal of precision medicine is to transform patients' lives by personalizing their treatment. This can be achieved by identifying the underlying molecular cause, or biomarker, of disease in each individual patient. Knowing this, our goal is to match drugs to patients who are most likely to benefit from that particular treatment [9].

If you look at the research landscape, almost 90 percent of it follows a precision medicine approach, compared to about 10 percent in 2009. This includes a wide range of advanced technologies for both laboratory and informatics, tumor tissue detection, molecular testing, and clinical diagnostics, allowing the physician to have the right information at hand when interacting with the patient [10].

#### **How has data transformed genomic research?**

In the area of sequencing technologies, our ability to generate high-quality data from raw samples has improved. Having advanced

algorithms allows us to turn raw data into useful information [11].

For example, by comparing raw genomic data to a reference genome, we can identify parts of an individual's genome that are different from others in the population.

We also have the ability to perform more advanced analyses at a later stage, such as using machine learning and artificial intelligence (AI) to explore these genetic variations to gain more insight into biology [12].

One thing we have been focusing on recently is using advanced analytical frameworks on this data to ask more questions and discover answers. For example, why is this genetic variation important in this individual? Does it cause disease? Does it change how they respond to treatment?

At AstraZeneca, we have a genomics workflow that processes all genomes from our genomics initiative. Our goal is to analyze up to two million genomes by 2026 [13]. This process has been optimized so that we can now perform comprehensive analysis of around 1,300 sequences per hour. To put that in perspective, this means that our efficiency has increased 10-fold since 2017, thanks to the optimization of genomics analysis [14].

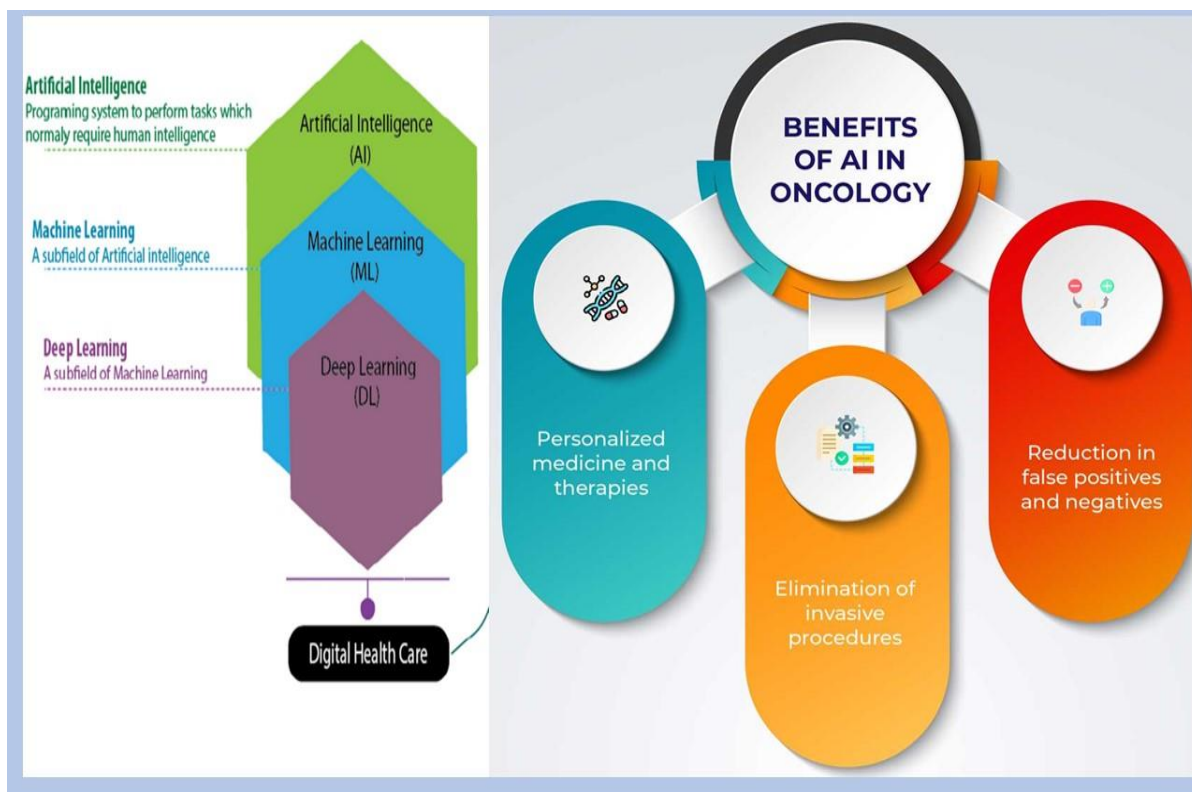
#### **The Impact of Artificial Intelligence on Cancer Treatment**

Artificial intelligence, with its amazing capabilities, is also used in various fields, including medicine. Cancer treatment is one of the fields in which it can play an important role. By accurately analyzing medical data, artificial intelligence can help to more accurately understand the disease and diagnose it more quickly.

It can also be used to diagnose the type of cancer and determine the appropriate treatment method.

Artificial intelligence can also be useful in predicting and preventing side effects, as well as assessing a patient's response to various treatments. The use of artificial intelligence in

cancer treatment can improve the delivery of medical services and improve the treatment performance of patients. For this reason, this technology will be the most important factors in improving cancer treatment in the future (Figure 2).



**Figure 2.** The Impact of Artificial Intelligence on Cancer Treatment

### How does artificial intelligence help in cancer treatment?

Artificial intelligence (AI) can be useful in cancer treatment as an auxiliary tool. It can also recognize cancer patterns and profiles with the help of medical images and help to start treatment earlier by examining symptoms and markers that may include cancer more accurately and quickly.

Using artificial intelligence, it is possible to automatically identify and review cancer images in the cervix, breast, skin, brain, liver

and other organs. It can also quickly identify innovative potentials to reduce the side effects of cancer treatment using natural language processing (NLP).

In general, artificial intelligence facilitates clearer and faster diagnosis, examination and treatment of cancer by using advanced algorithms [14].

### Is cancer treatment with artificial intelligence reliable?

The use of artificial intelligence in cancer treatment is currently being used in many medical centers and institutions, and many studies have shown that this technology can help reduce errors and increase accuracy in diagnosing and treating cancer.

However, it is still better to consider artificial intelligence as a complementary tool at the service of doctors and to make final decisions in cancer treatment only by doctors present with patients. This can be done simultaneously according to the doctor's expertise, the patient's condition, the combination of all treatment methods and the specific needs of each patient, which will lead to a more accurate treatment path [15].

### Disadvantages of treating cancer with artificial intelligence

The disadvantages of treating cancer with artificial intelligence include the following:

**1- Cost:** To implement artificial intelligence, tools such as deep learning systems and neural networks are required, which are associated with a high cost [17].

**2- Risk of error:** Artificial intelligence methods face many frictions and shortcomings compared to conventional cancer diagnosis methods. Therefore, more safety measures must be taken to reduce these risks.

**3- Data-lockedness:** An important limitation that artificial intelligence technologies face is the limitation in the quality and quantity of data used. This limitation makes the final accuracy of the method require initial accuracy in the input data [18].

**4- Failure to provide the required treatments:** For many patients, diagnosis and treatment planning can be long and difficult, and in the meantime, they expect these systems to make this process easy, but this does not take into account that the treatment of each patient is different and requires personal consideration [19].

### The Role of a Personalized Physician

A personalized physician, as a health consultant and guide, is responsible for designing a comprehensive program to improve a person's health by analyzing the person's health conditions, medical history, eating habits, daily activities, and even psychological and social aspects. This allows the physician to identify the specific needs of each person and adjust the content of his or her program accordingly.

Using modern technologies, personalized physicians can collect data related to a person's health through mobile applications, wearable devices, and other smart devices. This data can include information such as heart rate, physical activity level, sleep quality, and even body fluid excretion. Analyzing this data helps the physician not only address the patient's current condition, but also make predictions about the patient's future health [20].

### Benefits of a Personalized Physician

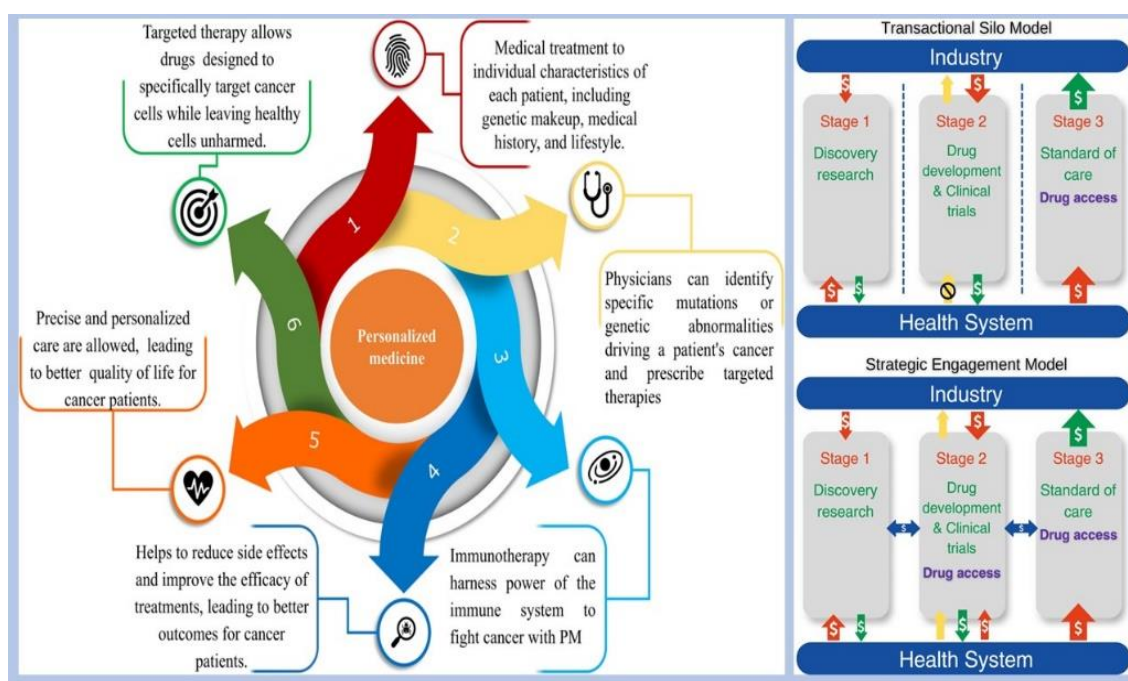
**1- Personalized Treatment:** One of the main benefits of a personalized physician is personalized treatment. Instead of treatment being based on general protocols and general standards, each person will have their own treatment, tailored to their characteristics and needs.

**2- Disease prevention:** A personalized doctor can identify early signs of diseases based on data analysis and take measures to prevent them. This will make people face fewer diseases and, as a result, incur lower treatment costs [21].

**3- Development of a healthy lifestyle:** Personalized doctors can help patients adopt a healthier lifestyle by providing nutritional, exercise and psychological advice. These changes not only help improve the quality of life, but also reduce the risk of many diseases.

**4- Positive interaction with the doctor:** A personalized doctor, as a close advisor to the patient, can establish a better relationship with him. This close and personal connection makes the patient feel more comfortable and can easily share their questions and concerns with the doctor [22].

**5- Use of new technologies:** By using new technologies and tools, the personalized doctor can manage data more accurately and achieve better results from examinations and examinations (Figure 3).



**Figure 3.** The Role of a Personalized Physician

### Challenges and the future of the personalized doctor

Despite all the benefits of the personalized doctor, this concept also faces challenges. One of the challenges is the high costs of personalized services, which may not be affordable for some people [23].

Also, concerns about the privacy of medical information and data security are other

challenges in this area. The future of the personalized doctor depends on the advancement of technologies and the creation of cultural changes in society [24].

Given the growing trend of using wearable technologies and digital platforms, it seems that personalized medicine as a new approach to healthcare will become one of the fundamental pillars of healthcare systems in

the near future. Personalized medicine has taken a big step towards improving the quality of healthcare services by personalizing medical services and creating a closer relationship with the patient. This approach can help people not only benefit from better treatments, but also experience a better life by preventing diseases and changing their lifestyle. In this way, the integration of personalized medicine into the healthcare system can bring a great transformation in the health of society [25].

### Discussion

#### What does social health and a healthy community mean?

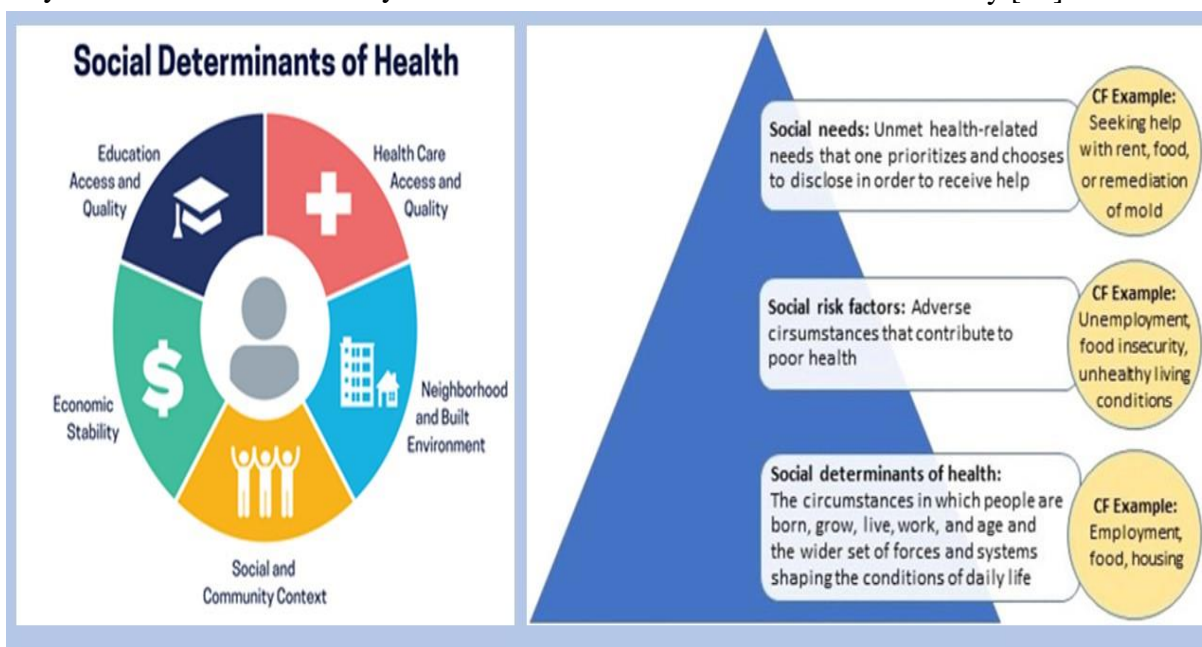
Social health is an important component of the overall health of a country and directly affects various health outcomes. Today, medical research has given us an understanding of the importance of this issue. Based on these findings, social health includes: maintaining a strong social fabric that values diversity and unity, providing ample opportunities for everyone to interact freely and build

meaningful relationships with others. Social health also relates to a healthy community, where people can share their common experiences without judgment [39].

Therefore, it emphasizes the importance of building bridges between geographically distant communities or challenging cultural stereotypes through education and dialogue. Based on this concept, mutual respect in communities is vital for the growth of a healthy society that provides support networks and accessible resources for all its citizens regardless of race, gender identity, or social and economic background [40].

#### The most important factors in improving the health of society

Health is a vital factor in determining the quality of life of individuals and society as a whole. Therefore, it is essential to understand the most important factors in improving the health of society (Figure 4). Advances in medical science are undoubtedly one of the most important elements in ensuring better health outcomes for society [41].



**Figure 4.** The most important factors in improving the health of society

As such, medical science continues to work diligently to develop reliable, effective and affordable treatments for some of the deadliest diseases, as well as effective treatments for the spiritual health of society. From identifying risk factors associated with diseases to discovering new treatments, medical research has helped save millions of lives while also contributing to a better quality of life and a longer lifespan [42].

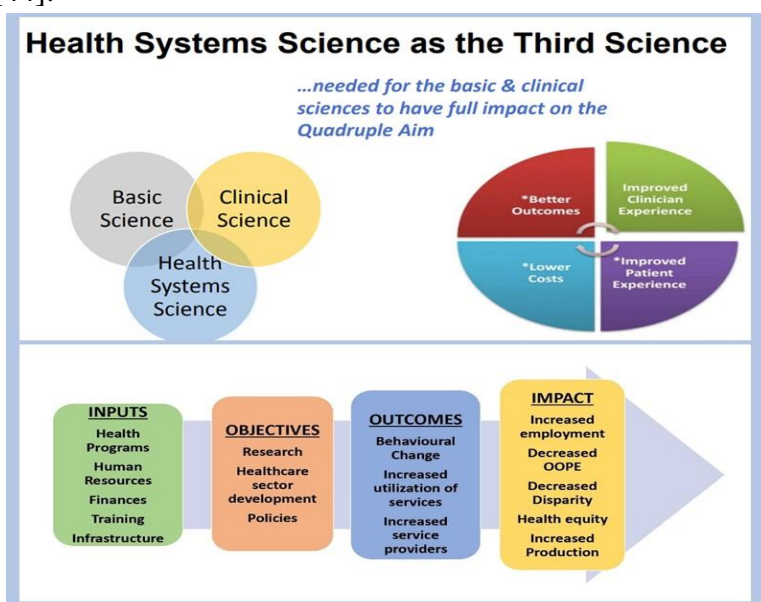
Therefore, by acknowledging its extraordinary contribution to overall health outcomes, we can ensure that our societies can benefit from the pioneering discoveries of general medicine [43].

### The role of medical science in improving the health of society

Medical science plays a significant role in improving the health and well-being of society. With the advancement of medical technology, medical professionals are able to accurately diagnose, treat and manage various health conditions [44].

This has led to better healthcare outcomes, lower mortality rates and improved quality of life for many people. Medical science has also helped to increase human lifespan by developing new treatments and therapies for diseases [45]. In addition, it has revolutionized public health campaigns by providing reliable evidence-based information on the best ways to maintain a healthy lifestyle. In this way, medical science has been essential in helping to improve the health of society as a whole (Figure 5).

In the recent second international consensus report from the Precision Medicine in Diabetes Initiative (PMDI), published in Nature Medicine, researchers summarized systematic reviews and consensus among the PMDI consortium on precision medicine for the prevention, diagnosis, treatment and prognosis of monogenic diabetes mellitus (MDM), gestational diabetes (GDM), type 1 diabetes (T1D) and type 2 diabetes (T2D).



**Figure 5.** The role of medical science in improving the health of society

Precision medicine is an innovative approach to evidence-based medicine that aims to increase the accuracy of health advice and medical judgement. In this approach, the origin, clinical manifestations, and pathophysiology of common types of diabetes are examined as a major global health concern. Despite its lofty goals, it offers realistic and cost-effective solutions. In the present statement, researchers reviewed 15 systematic reviews and expert recommendations that demonstrate immediate or near-term clinical application prospects for integrating precision medicine research into reality.

#### **Current knowledge gaps and precision medicine applications in diabetes**

Precision medicine for diabetes seeks to address the global diabetes epidemic by personalizing diagnoses and treatments for similar population groups. However, information gaps exist in the areas of affordability, equity and justice in health, predictive accuracy, accountability, and access.

The revision of criteria aims to reduce errors and increase the accuracy of medical choices and health recommendations. Personalized medicine uses individual-level data to objectively assess the safety, effectiveness, and tolerability of treatments. Studies explicitly designed to evaluate precision medicine hypotheses should be included in drug development pipelines, in order to optimize treatment recommendations. Precision medicine requires new research focusing on physiological processes identified by biomarkers.

However, the complexity of the process and proprietary considerations hinder

commercialization. Balancing access and commercialization is essential, taking into account economic, social, and ethical considerations.

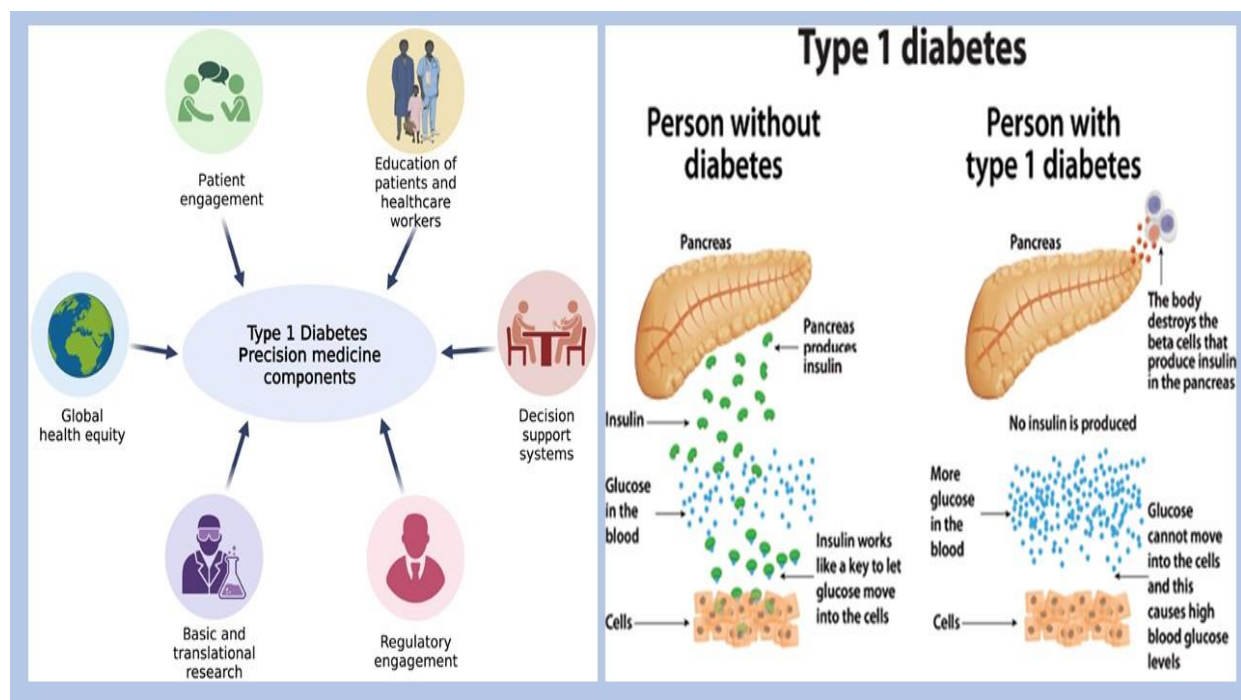
#### **Type 1 and Type 2 Diabetes**

Type 1 diabetes, which is caused by the destruction of pancreatic beta cells, accounts for 2% of all diabetes worldwide. It is classified into phases and has significant health costs due to the low age of onset and the price of insulin. Autoantibodies to pancreatic islet cells predict the progression of diabetes and are routinely used in clinical practice.

A review of 71 randomized controlled trials (RCTs) found that new technologies may reduce glycosylated hemoglobin (HbA1c) levels, increase continuous glucose monitoring, reduce the risk of hypoglycemia, and improve diabetes-related outcomes. Epidemiological research has uncovered new genetic, biochemical, and phenotypic features in patients with type 1 diabetes.

Type 2 diabetes is a chronic condition of altered blood sugar that affects approximately 500 million people worldwide and is expected to affect more than one billion people by 2050. The diagnosis is unique, and dietary or lifestyle changes can delay the development of the disease.

However, interindividual heterogeneity in response to preventive measures is high. Accurate prevention requires identifying predictors of response and those most likely to benefit from those approaches. A comprehensive analysis of 33 studies involving lifestyle modifications, dietary changes, and supplements found subgroups of type 2 diabetes reproducibly identified using machine learning technologies (Figure 6).



**Figure 6.** Current knowledge gaps and precision medicine applications in diabetes

### Monogenic diabetes and gestational diabetes

Monogenic diabetes, or MDM, is an uncommon type of diabetes diagnosed in infancy or before age 45, accounting for up to 5% of all diabetes cases. Precision medicine provides diagnostic options. However, many people are misdiagnosed as type 1 or type 2 diabetes due to overlapping clinical symptoms.

A review of ninety-eight studies found that targeted next-generation sequencing, genetic panels, multiplex ligation-dependent probe amplification assays, and rapid Sanger sequencing of the glucosidase gene have enabled accurate diagnostic tests to determine the different types of diabetes. Sulfonylureas are the most effective treatment for neonatal diabetes due to potassium channel mutations. Gestational diabetes mellitus, or GDM, is a pregnancy-related metabolic disorder that

poses serious health concerns for the mother and her unborn child.

A comprehensive evaluation of 116 GDM prevention programs showed that lifestyle improvements reduced the incidence of GDM compared with control care. Metformin interventions showed greater risk reduction in the pre-pregnancy period than during pregnancy. Exercise and diet have successfully improved GDM among overweight women, older women, those with a history of GDM, and those with elevated fasting blood glucose levels. This consensus statement on integrating precision medicine into the global problem of diabetes emphasizes the need for specific diagnostics and biomarkers for accurate prevention, treatment, and prognosis. The lack of data from non-European populations should be addressed in order to achieve generalizability in precise diabetes management. Meta-

analyses of clinical trials, innovative trial designs, identification of genetic and non-standard biomarkers, and clinically accessible features to better predict response and drug selection are among the goals of future research. Standardization and sharing of laboratory technology, assays, and pipelines will improve the assessment and quantification of biomarkers within healthcare systems and at the point of care. Standardized reporting criteria, openness of computational algorithms, and artificial intelligence techniques can improve accessibility and reproducibility. Systems for routinely assessing diabetes heterogeneity and revising current diabetes classifications across the lifespan are also needed.

A framework tailored to the target population is essential to enable the translation of accurate diabetes research into clinical practice.

### Conclusion

Personalized medicine, or precision medicine, is a new model of delivering healthcare to patients based on their genetic profile. This was only a dream when whole genome sequencing was invented, but now, with new genetic techniques, we will be able to sequence the entire genome of a patient in a very short time frame and at reduced costs, thus providing the best and most effective treatment for patients. In this way, in addition to increasing the quality of medical care, the need for unnecessary tests is reduced and, consequently, the cost of treatment for patients is reduced. A new study conducted in the United States on people with advanced cancer shows that telehealth can have a significant impact on the lives of patients and improve their quality of life. The use of

telehealth has increased significantly during the Covid-19 pandemic, and people have been able to communicate better with technology. Considering the above explanations and the effectiveness of telehealth, a weekly 3-minute online questionnaire was developed, which includes questions about common cancer symptoms, nausea, insomnia, as well as questions about the patient's financial issues. This questionnaire is designed so that if symptoms worsen and if a patient needs a consultant, he can pay the costs through this. This study was conducted among 1,191 participants with an average age of 62 years and shows that older people have no problem using digital health services. The program designed to do this is called PRO-TECT, and according to data published in the Journal of the American

Medical Association, 33 percent of patients who used the program saw improvements in physical function and 15 percent better symptom control compared to those who were assessed in person. Overall, the use of telehealth technology will result in lower healthcare costs, because investing in preventive programs reduces costly emergency room visits and doctor consultations later on.

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