

Aspirations to develop medical treatments to the individual character of each patient

What is precision medicine?

The National Research Council of the National Academy of Sciences defines precision medicine as:

Precision Medicine refers to the tailoring of medical treatment to the individual characteristics of each patient. It does not literally mean the creation of drugs or medical devices that are unique to a patient, but rather the ability to classify individuals into subpopulations that differ in their susceptibility to a particular disease, in the biology or prognosis of those diseases they may develop, or in their response to a specific treatment. Preventive or therapeutic interventions can then be concentrated on those who will benefit, sparing expense and side effects for those who will not.

The key insight is that humans like all organisms have different characteristics based on their genetics, environment, and other clinically relevant features. Every person is unique. However, treatments are often prescribed as if every person is the same. Medicine is built largely on this false scientific premise, and that reduces the effectiveness of medical treatment. Precision medicine is entirely aspirational, there is no significant usage of this in medical contexts, but sequencing has only recently come down in price enough to be used commercially at a mass scale. Several companies are forming around precision medicine.

Applications and Future Directions

Genome sequencing has decreased in cost and increased in accuracy. The cost of a whole genome sequence has gone from \$2.7 billion dollars (the first time) to below \$500 in the last two decades. Services that sequence clinically significant parts of the genome cost as little as \$100. In combination with comparative and functional genomics, we are increasingly able to use this sequence data as a diagnostic tool.

In the future, if clinical trials consider the individual characteristics of each patient, we will have a dataset to map the outcome to the specific character of the individuals in the trial. In this way will be able understand why some drugs have a therapeutic effect in some patients but not others, directly enhancing the field of functional genomics.

Symptom checker or artificial intelligence (AI)-driven medical apps are an early form of personalized medicine. In these apps, the chronic conditions of the patient as well as their past consultation history are used as an input to determine the current possible indications in the active consultation. These apps may incorporate genetic information, lab results, and other individual medical data in the future.

Precision Medicine in China

China is taking precision medicine seriously. China's Precision Medicine initiative allegedly has \$9 billion in appropriations and wide access to the medical records of its citizens. There are three companies that are relevant in China. iCabonX, the largest and a spinoff of Beijing Genomics Institute (BGI), is an AI company creating a medically relevant "digital me" for every customer and hopes to use this in precision medical contexts including preventative medicine. WuXi NextCODE is developing a similar tool to iCabonX but is focusing more on partnerships with pharma companies. Both companies are in early development. A third company, Yidu Cloud is focusing on making sense of the medical records for China's billion-plus citizens, using natural language processing and other technologies to find medically relevant patterns.

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