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The Era of OMICs, Big Data, and Precision Medicine: Keep Pace with Future Medicine and Cutting-Edge Science

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Over the past decade, precision medicine (PM) has garnered significant attention as a breakthrough and a paradigm shift in medicine (1). In contrast to current one-fits-all therapies, PM approaches emphasize more precise diagnosis and treatment, based on individual or subgroups clinical and biological characteristics. The promise of PM is delivering the right treatments, at the right time, to the right person. While according to a PubMed search, the first mention of "precision medicine" dates back to 2011, the concept has been around for many years (2). For instance, right medication dosing in the right patient is a classic example of tailoring of medical treatment to the individual characteristics; however, overall, medicine has largely followed the 'one-size-fits-all' paradigm. Thus, the integration of PM in routine healthcare is still relatively limited (3). As a basis for patient-centered care, PM holds great promise for establishing improved disease prediction and prevention, more precise diagnosis, and more tailored interventions by bridging the gap between basic and clinical research.

The completion of the human genome project (HGP) along with the advent of high-throughput genomics technologies has dramatically increased our understanding of that how each individual's unique genetic blueprint can influence susceptibility to certain diseases, clinical outcome and response to the medicine.

During the past few years, the explosion in the development and application of the high throughput 'OMICs' approaches have fueled the movement toward PM by obtaining a detailed understanding of the function of the body from multiple omics levels (4). Aided by analytics, these technologies are providing comprehensive and more precise understanding of molecular and cellular alterations underlying disease development and progression, leading to a new, more precise disease classification. Integrating omics data into multiple existing data sources (e.g. clinical indications, pathology and laboratory tests, as well as imaging results) leads to a holistic understanding of the individual biological signatures. These unique features aid in steering the changing landscape of medicine and healthcare toward PM.

These large-scale omics-generating platforms are producing prodigious amounts of panomics data. Analysis and exchange of these massive data sets represent a major bottleneck in the field of PM. General accessibility and availability of data within the database resources and scientific publications are central sources to provide a wide range of collaborative opportunities globally. It is expected that the exchange of data will lead to more rapid and efficient generate cross-border knowledge, accelerating the advancement of PM (5).

Deep understanding of inter-individual differences in health and disease that are due to genetic and environmental factors, in combination with conventional clinical, histological, and laboratory findings will offer the ability to classify individuals into subpopulations that differ in their susceptibility to a particular disease or their response to a specific treatment.

As a groundbreaking new paradigm in medicine, PM has already led to a paradigm shift for oncology research where both diagnosis and treatment are increasingly based on molecular profile of tumor. Over the last decades, the only effort to individualize treatment in the field of medical oncology has been tailoring right dose of specific chemotherapies based on the tissue of origin and weight of the individual patient. Unlike many other diseases, cancer is very much a complex, heterogeneous disease of whole-genome alteration and dysregulation. De-

spite this complexity and variability, most types of cancers are treated with the same generic therapies. Current conventional medical treatments for cancer include surgery, chemotherapy treatment, radiation therapy, or a combination of all. Even though the emergence of selective targeted therapies during the past year has shed some to improve outcomes in patients with cancer, certain cancers with specific mutations still lack adequate targeted therapies.

As the genetic makeup of different cancer types varies significantly even among patients with the same type of cancer, the behavior of cancer and its response to treatment can also vary to a great extent. Therefore, most current standard treatments are effective in only a subset of the patient population while being ineffective and even associated with adverse unnecessary side effects in others (6). This is where PM is believed to greatly improve the disease diagnosis, evaluation and medical decision-making (7). In contrast to conventional therapeutic approaches that typically target all dividing cells, precision oncology takes advantage of cutting-edge OMIC technologies to characterize individual cancers at the molecular level. By exploiting unique properties and dynamics of each patient's cancer "actionable events" -or drivers- can be determined and selectively targeted as a therapeutic approach to eradicating cancer with minimal side effects. This approach not only spares patients from the burden of unnecessary toxicity of ineffective and costly intervention but also allows the earlier selection of alternative more appropriate treatment options and improves overall cost-effectiveness.

PM approaches also embrace more predictive and preventive healthcare by identifying the risk factors that predispose an individual to develop cancer (8). This has a significant impact on preventing the disease by effective modalities or optimally manage it at early stages.

Even though the wave of innovation in PM is at a critical turning point in oncology, as the field develops, it further contributes to forwarding steps in care and cure for a range of other health conditions (e.g., epilepsy, diabetes, and cardiovascular disease) (8-10).

Furthermore, as genetic variants have been shown to influence drug pharmacokinetics and pharmacodynamics, appraising the correlation between genetic variations and their effect on drug response is a core element of PM. Even though this field of PM, which is termed pharmacogenomics, is still in its infancy, its adaptation in routine patient care is not far from being a reality.

Given that the rapid pace at which PM is evolving, in association with the increasing availability and affordability of "multiple omics techniques", the time is coming in the relatively near future, when customized treatments become mainstream of clinical practice (11).

Collecting, merging, and analyzing large heterogeneous data derived from different populations around the world are imperative to discern the real impact of global interethnic variations. Thus, in order to pave the way toward the utopia of future medicine, where patients' genomes, and -omics related information can guide real-time, individualized prevention and therapeutics, as a worldwide effort, are required (12, 13). Extensive efforts for molecular profiling through high-throughput approaches have already been made and continue to be made across several countries and institutions. Combining such vast data resources from a range of ethnic backgrounds around the globe facilitates the identification of actionable mutations and diagnostic/prognostic markers that are key elements in getting personalized medicine to practice. In the case of rare disorders, it is even more crucial to work on an international level, where sharing identifiable genetic and phenotypic data will aid to identify causative mutations (s).

Undoubtedly, all medical and scientific communities around the world benefit from data sharing through publications and databases (14). In this respect, PMCO provides an international forum to publish fundamental, preclinical and clinical scientific researches related to PM, particularly in the areas of high-throughput OMIC approaches. We hope that by rendering an open-access platform, where cutting-edge advancements in the field of PM are shared, we can contribute to advancing the future of medicine. PMCO is committed to publishing high-quality scientific research works that have a high impact on science, future clinical practice and technological advances in the rapidly evolving field of PM.

Footnotes

Authors' Contribution: The authors contributed to the manuscript equally.

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