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Novel Drug Therapies and Diagnostics for Personalized Medicine and Nanomedicine in Genome Science, Nanoscience, and Molecular Engineering

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Editorial

Nanomedicine, an emerging field of medicine, applies recent developments in nanoscience, molecular engineering, and genome science for personalized medicine and public health. Further, nanomedicine promises to offer novel diagnostic and therapeutic techniques for accurate diagnosis, prognosis, and treatment in a disease-specific and patient-specific manner [1-3]. More specifically, drugs may be tailored to individual patients with similar or related genetic or physiologic characteristics by using the advances made in nanoscience, molecular engineering, genomics, and pharmacogenomics. For example, accumulating evidence reveals that selected single nucleotide polymorphisms (SNPs) could be used as genetic markers to affect clinical drug response and side effects for antipsychotic drugs in patients with schizophrenia [3,4]. By tailoring treatment based on individual SNPs, pharmacogenomics may provide a valuable tool to fulfill the promise of personalized medicine [3,4]. With the advent of modern technologies in genome science, nanoscience, and molecular engineering, we may utilize nanometer-scale materials or devices that can interact with biological systems at the molecular level and can target different molecules with high precision. Thus, we are able to design new drugs as well as novel diagnostic tools to address the needs of personalized medicine and public health for treatment and therapeutic interventions in a wide variety of human diseases such as neuropsychiatric and neurodegenerative disorders, addictive disorders, inherited cancers, and cardiovascular diseases.

One of the research areas in nanomedicine investigates computational and statistical methods to aid in the engineering of metabolism inside cells for producing therapeutic small-molecules (such as anti-bacterials, anti-cancer agents, and cholesterol-lowering agents) and biopharmaceuticals (including proteins, vaccines, and virus particles) [5]. To provide cost effective chemical and drug synthesis, microorganisms are increasingly utilized to synthesize a variety of therapeutic small-molecules (such as anti-bacterials, anti-cancer agents, and cholesterol-lowering agents) and biopharmaceuticals (including proteins, vaccines, and virus particles). The goal is to increase the production of a molecule produced by the cell (for example, biopharmaceuticals) by manipulating cellular metabolic and regulatory processes. Because cellular metabolic and regulatory networks are often large and complex, many innovative computational tools such as metabolic flux analysis have been developed to aid these processes [6]. Computational intelligence primarily consists of a set of nature-inspired computational techniques and approaches, such as fuzzy logic systems, artificial neural networks, evolutionary computation, and their derivatives (for example, Dempster-Shafer theory, chaos theory, multi-valued logic, swarm intelligence, and artificial immune systems) [7]. Computational intelligence techniques have been widely applied to many challenging real-world problems where traditional rigorous methods are infeasible.

Another approach in nanomedicine utilizes computer-based methods and critical experiments to establish a variety of software tools to tackle nanometer-scale aspects of material behavior [8]. The main advantage of this computational nanotechnology approach is to increase the confidence that new nanometer-scale materials will possess the desired properties. In addition, it helps avoid using the highly ineffective and costly method of trial and error. Soft computing techniques such as swarm intelligence, cellular automata, and evolutionary algorithms can be applied to system design for nanometer-scale materials and devices [7]. Furthermore, the simulation methods that are used to establish the mathematical modeling include molecular statics, molecular dynamics, coarse graining, micromechanics, and finite elements [9]. Organic and inorganic nanometer-scale materials provide innovative strategies for designing next generation drug delivery devices and medical diagnostic devices. For example, quantum dots can be used as markers for diagnosis and monitoring tasks [10]. Another example is that nanometer-scale materials such as dendrimers and nanospheres can be used as drug carriers [11,12]. First, future work is needed to further employ novel algorithmic techniques and software tools in order to enable the development of high performance nanometer-scale materials and devices. These devices contain complex heterogeneous structures, with physical and chemical phenomena spanning length scales from nanoscale, to micron scale, to mesoscale, and macroscale. Furthermore, we can develop diagnostic tools as well as nano-enabled delivery systems to address the needs of personalized medicine for treatment and therapeutic interventions. In future work, novel mathematical models and computational tools will be constructed for studying the biological mechanisms, the cellular and intracellular trafficking behavior, and the dynamics of nanometer-scale materials to be used for the delivery of therapeutic and imaging agents.

At the present time, practical computational tools and software in novel drug therapies and diagnostics for personalized medicine and nanomedicine are not yet available [2-4]. In addition, it is critical to develop feasible solutions and tools to compensate for the big data problems and computational challenges exacerbated in data-intensive health sciences owing to the combinatorial explosion of ever larger data sets [2-4]. The latest advances in data-intensive health sciences will certainly trigger more new software tools and more novel clinical applications in the fields of public health, nanomedicine, and personalized medicine in light of nanoscience, molecular engineering, and genome science. Addressing and anticipating these emerging issues in personalized medicine and nanomedicine is of great relevance

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not only for a particular region such as the Asia-Pacific but also for global health.

References

1. Freitas RA Jr (2005) What is nanomedicine? Nanomedicine 1: 2-9.
2. Lane HY, Tsai GE, Lin E (2012) Assessing gene-gene interactions in pharmacogenomics. Mol Diagn Ther 16: 15-27.
3. Lin E, Tsai SJ (2012) Novel diagnostics R&D for public health and personalized medicine in Taiwan: current state, challenges and opportunities. Curr Pharmacogenomics Person Med 10: 239-246.
4. Lin E, Tsai SJ (2011) Gene-gene interactions in a context of individual variability in antipsychotic drug pharmacogenomics. Current Pharmacogenomics and Personalized Medicine 9: 323-331.
5. Vemuri GN, Aristidou AA (2005) Metabolic engineering in the -omics era: elucidating and modulating regulatory networks. Microbiol Mol Biol Rev 69: 197-216.
6. Orth JD, Thiele I, Palsson BØ (2010) What is flux balance analysis? Nat Biotechnol 28: 245-248.
7. Fogel GB (2008) Computational intelligence approaches for pattern discovery in biological systems. Brief Bioinform 9: 307-316.
8. Soundararajan V, Warnock K, Sasisekharan R (2010) Multifunctional nanoscale platforms for targeting of the cancer cell immortality spectrum. Macromol Rapid Commun 31: 202-216.
9. Cheng X, Ivanov I (2012) Molecular dynamics. Methods Mol Biol 929: 243-285.
10. Clift MJ, Stone V (2012) Quantum dots: an insight and perspective of their biological interaction and how this relates to their relevance for clinical use. Theranostics 2: 668-680.
11. Vilar G, Tulla-Puche J, Albericio F (2012) Polymers and drug delivery systems. Curr Drug Deliv 9: 367-394.
12. Canal F, Sanchis J, Vicent MJ (2011) Polymer-drug conjugates as nano-sized medicines. Curr Opin Biotechnol 22: 894-900.