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Editorial

Nanotheranostic, Next Generation Prerequisite for Better Health

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The motivation of this editorial began with a brief introduction of Society for Personalized NanoMedicine (SPNM, http://www.s-pnm.org/), a non-profit foundation that aims to tailor medical intervention to patient- and disease-specific needs. The mission of the SPNM is to promote research, serve as a source of information on advanced nanotechnology, platform to establish collaboration and foster exchange of information, ideas, and research on personalized nanomedicine and rapid diagnostics analytical tools. The vision and goal of SPNM, with the leadership of Prof. Madhavan Nair and assistance of field experts, is to bring cross-disciplinary research together as a society in order to expand our understanding of current applications of nanotechnology in health care. These includes reconstructive surgery, targeted therapy, nano-enabling devices, drug development, drug delivery systems, microelectronics, smart diagnostics system, and numerical modeling for personalized medical use. Our society is determined to promote translational research that focuses on the interactions of advanced functional platforms, analytical systems, human immune system, substance abuse, HIV-infection, cancer, neurocognitive disorders, and ethical/regulatory issues in order to create a solid ground for the development and application of groundbreaking medical devices and systems for superior diagnostic and treatment. In this direction, SPNM is working towards developing a bridge of knowledge among researchers of various discipline through organizing conferences and meetings focused on nano-biotechnology and personalized nanomedicine towards theranostics (Figure 1).

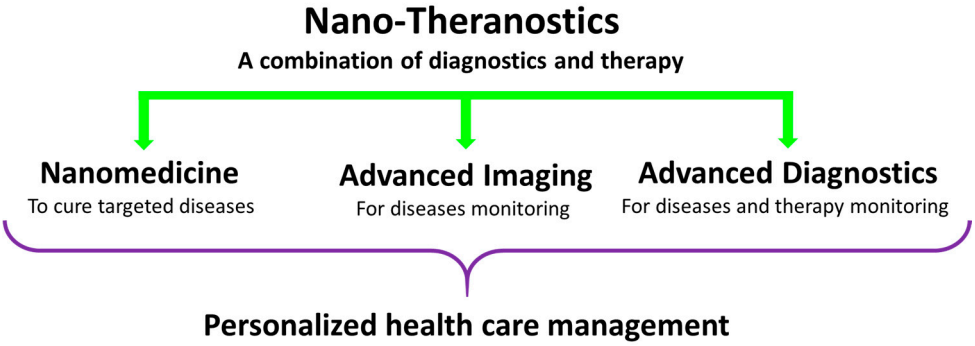

Figure 1. Nanotheranostics approach for personalized health care.

It has been forecasted by various health agencies globally that the socio-economic burden of health care will increase day by day, especially central nervous system (CNS) diseases and, at some point, may be difficult to afford by middle-income populations [1,2]. Thus, developing affordable therapies and disease monitoring analytical devices are in urgent need [3]. A significant

advancement in vaccine/drug/therapeutics development of better efficacy will be useful to cure targeted diseases. However, the high dose administration of such therapeutics is required due to limited delivery at targeted site. Thus, monitoring of a targeted diseases with/without therapy becomes essential to manage diseases [1–5]. This raised the demand of conducting research in the area of nano-biotechnology to explore novel biomaterials, drug delivery systems, drug delivery methods, rapid diagnostics tools, machine learning, smart devices, numerical modeling, deep learning, data analysis, and modeling in order to establish personalized health care in user friendly and cost-effective manner [6–8]. Overall, current developments in biomedical research are oriented towards nanotheranostics with a future trending from electronic to intelligent health, i.e., E-health to I-health.

Considering potential challenges in mind, at Institute of NeuroImmune Pharmacology and Center for Personalized Nanomedicine of the Department of Immunology and Nano-Medicine, Florida International University, Dr. Nair and his team are focusing on advanced research in the area of developing advance drugs of better efficacy and its successful delivery to the CNS to manage various brain diseases such as neuroAIDS and Alzheimer's diseases [1,3,5,9–11]. A magnetically-guided delivery of magneto-electro nanoparticles (MENPs) to the brain of mice has been demonstrated without observing any side-effects (Figure 2) [12]. The MENPs are well-established bio-compatible drug nano-carriers and exhibit on-demand release of the drug by applying external ac-magnetic field via customized electromagnetic coils [10,13,14]. The outcomes of our four NIH funded projects suggest that the combination MENPs based nanomedicine and its magnetically guided delivery to the brain will be a future therapy in order to treat/manage CNS diseases. To develop multifunctional drug nano-carriers, we have also developed magneto-plasmonic platform which can deliver drug across the blood-brain barrier (BBB) along with the advantages of image guided monitoring [15]. Multifunctional nanomedicine based on layer-by-layer approach has also been developed in our group with ability to cross the BBB for the treatment of neuroHIV and symptoms related with drug abuse. [16]. Along with magnetic oxides based drug nanocarriers, smart multifunctional micro/nano gels, and hybrid nanocomposites hydrogel are being explored in our research group to design and develop smart drug delivery systems of higher efficacy without side-effects and which can also act as longer therapeutic agents [5,17–19].

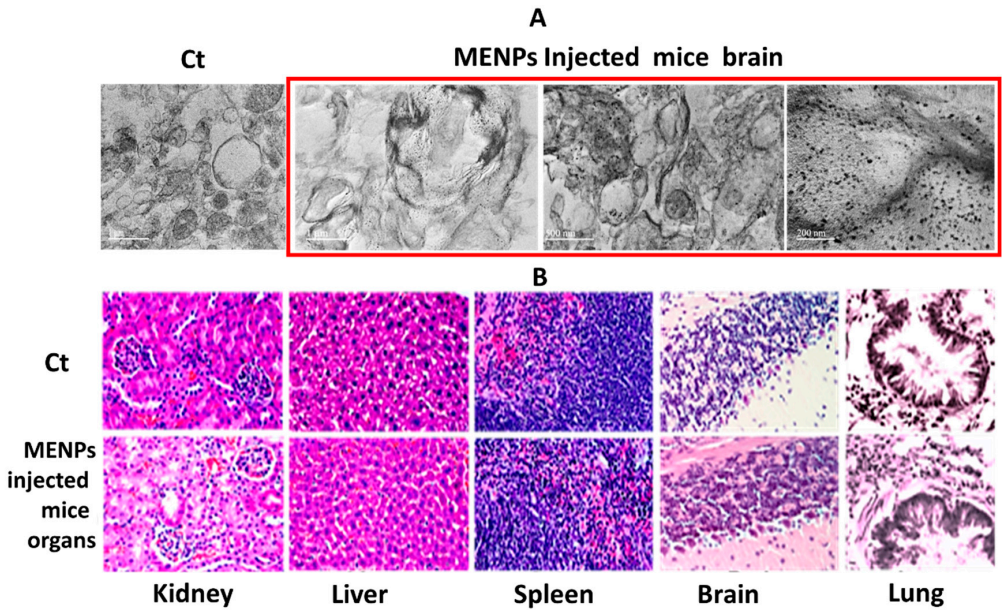

Figure 2. Assessment bio-distribution and bio-safety of magnetically-guided delivered MENPs to the mouse brain. (**A**) MENPs are uniformly distributed in all cell types of the mouse brain. (**B**) The MENPs presence in mice, including the brain, does not affect the morphology of major regions of interest, such as the kidney, liver, spleen, brain, and lung.

In addition to this, we are also exploring nanotechnology for developing smart and miniaturized electrochemical sensing platform for the detection of a targeted biomarker such as Ebola [20], beta-amyloid [21,22], cortisol [23,24], and zika-virus [25–27] in order to establish methodologies of rapid diagnostics and disease progression monitoring with/without therapy [6]. This bioinformatics is very useful for timely therapy decision and establishing a correlation between diseases progression and pathogenesis. Such developed smart miniaturized sensors are capable to perform sensing at diseases site-location for point-of-care application. Additionally, the integration of these systems with a smartphone will make device easy to use, user friendly, rapid data analysis, and data sharing remotely. Recently, we have developed a chip based electrochemical system to monitor electrophysiology of cells infected with HIV, cocaine, and treatment with specific drugs (Figure 3). We believe that this patented technology can be promoted as electrochemical sensing system for rapid diagnostics of HIV-infection to monitor therapy efficacy, and decide new therapies in a timely fashion [28,29]. Such cost-effective and sensitive systems, potential alternate of ELISA and PCR, are in demand to manage HIV diseases in personalized manner.

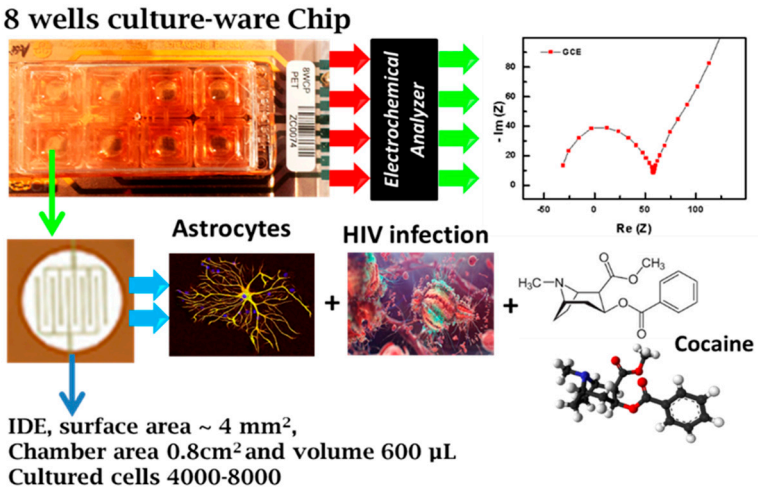

Figure 3. Illustration of electrochemical chip developed for cell physiology monitoring during infection and with/without therapy.

In addition to scientific research determinations, considerable efforts of government-private/public sector partnership are also required. The involvement of these agencies and appropriate funding will be helpful for public awareness, establishing regulatory, and directing fundamental research toward applied research. Thus, a motivated and focused translation research is most required in order to plan scaling up of a best appropriate approach via commercial industries support/partnership. We feel that a multidisciplinary platform involve scientists, government/private funding agencies and industries is an essential need to develop nanotheranostics of better performance [2,4].

Keeping all this in view, SPNM initiated collaboration with MDPI to establish the Journal of Nanotheranostics (JNT, http://www.mdpi.com/journal/jnt), as the official journal of society, dedicated to exploring nano-enabled theranostics and systems for personalized health care. Similar to SPNM, the mission of JNT will be towards exploring fundamentals, as well as applied research to investigate novel theranostics approaches. Such approaches are needed to develop effective diagnostics, as well as therapeutics for disease management aiming to improve personalized health needs. Based on objectives and future requirements, this journal will cover all the aspects of advanced research related to the following areas:

- Advanced nanomaterials for biomedical applications
- Miniaturized systems for health care
- Nano-enabled sensing systems for target analyte detection

- Point-of-care systems for personalized health care
- Image guided therapy
- Personalized nanomedicine
- Nano-enabled tissues and gene engineering
- Nanotechnology based drug delivery systems
- Nano-pharmacology
- Nano-biotechnology for drug addiction
- Translational and clinical research
- Theoretical aspects of diseases managements
- Bioinformatics for diseases management
- Ethical and regulatory issues in theranostics

The JNT will be a unique platform to understand aspects of smart nanomaterials, nano-devices, for biomedical application, rapid diagnostics, and effective therapeutics developed using nanoscience and nanotechnology. The possibilities of numerical simulation, theoretical aspects, regulatory issues, and ethical knowledge in order to manage clinical and translational research of a targeted disease will be covered here. To support the aims of MDPI, overall, this journal will serve as a guide to researchers to strategize future research toward developing nano-enabled theranostics.

This editorial is a global call in support of conducting advanced research of high significance and with a request to support us by submitting high-quality original research papers to JNT. In addition to research papers, editorials, technical notes, opinion, research highlights, brief communications, letters, books, book reviews, comprehensive reviews, and important announcements are also welcome.

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Conflicts of Interest: The authors declare no conflict of interest.

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