Editorial

Global Trends in Nanotechnological Approaches for Various Health Issues – Volume II

In parallel with a gradual rise in the global population, the annual number of deaths has likewise risen to approximately 56 million per year worldwide. Of these, ischaemic heart disease, stroke, lower respiratory infections and chronic obstructive lung disease represent the major causes of death over the past decade. In industrialized nations where lifespan has gradually risen over the last century, a notable rise in illness in the older age population was observed. In this regard, it is unclear whether this older population is living their additional years in good or poor health – with a "compression of morbidity" implying a reduced disability in old age, or an "expansion of morbidity" entailing an increase in poor health with increased longevity. Certainly, disorders such as type 2 diabetes mellitus, neurodegenerative disorders (NDs) and specific types of cancers appear to be on the rise.

Despite the development of numerous drug classes over the last century and the instigation of health care practices to effectively fight a broad number of diseases globally, the existence of incurable diseases appears to always prevail; impacting medically underserved areas by far the most. For certain diseases, such as NDs and type 2 diabetes mellitus, no effective agents that impact disease progression have thus far been developed. For other disorders epitomized by cancers, pulmonary infections and malaria, the development of resistance to once highly effective agents is equally frustrating. Such health issues impact individuals, communities, nations – indeed, us all – and challenge medical research to undertake the necessary research required to successfully develop disease control, treatment and prevention techniques with urgency to effectively manage current life threatening diseases. In today's era of sophisticated technology and medical nano-sciences, thousands of ongoing research projects are simultaneously being undertaken across different private, academic and government laboratories around the world. Advances are being made in each, but how does one optimally combine and focus them to maximize their impact on disease treatment? The aim of this special issue of Current Drug Metabolism (CDM) is to aid medical research in this endeavour by providing articles to overview current progress and future perspectives focused towards management strategies for diverse diseases with respect to global trends for nanotechnological approaches in various health issues.

Particular challenges facing numerous laboratories are those that involve laboratory bench to clinical bedside research in the path of successful drug discovery. Are there ways to optimize this across disorders, and are there rules that best should be followed? Authors of this special issue were requested to submit a review article to provide a beacon to identify guidelines for clinically translatable research that can enhance the rate of effectiveness of new treatments before reaching the public and impact public health goals globally. Substantial information relating to the positive and negative (toxicological) impacts of nanotechnology, responsibilities for its optimal use, rules and regulations for its effective implementation are now available and accessible via the internet [1-4]. Our focus has been to build upon this literature in an analytical and critical manner. In our previous Volume 1 special issue for CDM dedicated on same topic of "Global trends for nanotechnological approaches in various health issues", contributing authors covered the following subtopics:

1. A synopsis of nano-technological approaches toward anti-epilepsy therapy: present and future research implications
2. Therapeutic interventions for the suppression of Alzheimer's disease: quest for a remedy
3. Nanoparticle-based therapy in genomics
4. Nanobiotechnological approaches against multidrug resistant bacterial pathogens: an update
5. Recent advances in nanotechnology-based diagnosis and treatments of diabetes
6. Application of proteomic tools in modern nanotechnological approaches towards the effective management of NDs
7. Recent developments in nanomedicines for management of various health issues via metabolism and physico-chemical properties
8. Role of Graphene nano-composites in cancer therapy: theranostic applications, metabolic fate and toxicity issues

In the current Volume 2 of the special issue for CDM, authors contributed further on the current progress and future outlook of different nanotechnological approaches (Table **1**) on public health issues. In synopsis, both volumes of this special issue for CDM include examples of different exciting nanotechnological strategies for diagnosis and management of NDs, particularly Alzheimer's disease and Parkinson's disease, cancer and type 2 diabetes mellitus, which broaden our vision of the utility of nanotechnological approaches in medical sciences [5-9].

Table 1. Brief information about subtopics published in the volume 2 of the special issue of CDM.

CAI	Topic: Abstract
Mahmood Rasool **Center of Excellence in Genomic Medicine Research** **King Abdulaziz University** **Saudi Arabia** **E-m.: mahmoodrasool@yahoo.com**	Scope of Nanomedicines for the Management of Multiple Sclerosis: Multiple sclerosis (MS) is characterized by inflammation, demyelination and lesions in the central nervous system (CNS) that results in the physical and cognitive disabilities in patients. Immune cells get access into the brain region, after infection in the blood-brain barrier consequent to bacteria/virus or by genetic predisposition, where the autoimmune response may start the demyelination, inflammation as well as neurodegeneration within brain regions. Various types of therapeutics are used worldwide, approved by the FDA, for management of MS. Hence, adverse effect of conventional therapy goes hand in hand. The advancements in nanomedicines have opened a window for the management of various disorders of neurodegeneration, including MS. Several clinical trials are progressing to explore the etiology of MS and, in this regard, animal models - like experimental autoimmune encephalomyelitis (EAE) - have promising outcomes for the management of MS by using nanomedicines that are providing new insights. The current review elaborates the scope of nanomedicines with respect to MS patients.

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CAI	Topic: Abstract
Cornelia M Wilson **EA3842 Homéostasie cellulaire et pathologies and Chaire de pneumologie** **Expérimentale** **Université de Limoges** **France** **E-m.: cornelia.wilson@unilim.fr**	The ins and outs of nanoparticle technology in neurodegenerative diseases and cancer: As we enter the twenty-first century, several therapies based on using nanoparticles (NPs) ranging in size 1–1000 nm have been successfully brought to the clinic to treat cancer, pain and infectious diseases. These therapies bring together the ability of NPs to target the delivery of drugs more precisely, to improve solubility, to prevent degradation, to improve therapeutic index and to reduce the immune response. NPs come in all shapes and sizes, designed specifically for biomedical applications such as solid lipid polymers, liposomes, dendrimers, nanogels, and quantum dots. These NPs offer many attractive characteristics such as biological stability and biocompatibility can incorporate different biological or drug molecules. Among the major challenges in human disease therapy in neurological diseases and cancer is the development of nanomaterials that are able to be effective against the disease. In the case of neurodegeneration, one of the most difficult areas to penetrate for drug discovery in the body is the central nervous system, protected by the blood-brain-barrier. Whilst in the case of cancer, the biggest problem is how to specifically target the tumor with sufficient drug without causing side effects or inducing resistance. New generations of intellectual NPs are emerging in the treatment of human disease such as neurological disorders and cancer. The use of natural alternative therapy is an encouraging idea in drug discovery. To this end as we gain more knowledge into the biological function of exosomes, this will allow us to harness their potential as natural NPs in future therapeutics.
Sohail Akhter **Utrecht Institute of Pharmaceutical Sciences** **Utrecht University** **The Netherlands** **E-m.: sohailakhtermph@gmail.com**	Solid matrix based lipidic nano-approach in oral cancer chemotherapy: Application and pharmacokinetics: Chemotherapeutic delivery by the oral route in cancer patients has the potential to create "hospitalization free chemotherapy" which is a vision of oncologists, formulation scientists and patients. Such a therapeutic approach will improve patients' compliance, ease the burden of the patients' caregivers and significantly reduce the cost of treatment. Lipid nanoparticles (LNPs), such as solid lipid nanoparticles, nanostructured lipid carriers, nano lipid–drug conjugates, mixed micelles, liposomes, and nanoemulsions, have shown promising results for use in oral anticancer drug delivery through nanotechnological approaches. LNPs demonstrate enhanced oral bioavailability consequent to their ability to overcome first pass metabolism via lymphatic absorption by chylomicron-linked and/or M-cell uptake. LNPs reduce the inter- and intra-subject pharmacokinetics variability of administrated drugs. Moreover, certain classes of phospholipids and surfactants used in the formulations of LNPs can suppress the P-glycoprotein efflux system. This paper presents a discussion about the biopharmaceutical challenges in oral cancer chemotherapy and how the use of LNPs may provide solutions to such challenges. The effect of the gastrointestinal tract environment on LNPs and pharmacokinetics is also discussed.
Sanjay Singh **Institute of Life Sciences** **School of Science and Technology** **Ahmedabad University** **India** **E-m.: sanjay.singh@ahduni.edu.in**	Nanotechnology in Disease Diagnostic Techniques: Currently, the major research highlights of bioengineering and medical technology are directed towards development of improved diagnostic techniques to screen the complex diseases. Screening requirements are to identification of the cause of illnesses, monitoring the improvement or progression of the state of diseases such as cancer, cardiovascular or neurodegenerative diseases. Nanotechnology enables the manipulation of materials at nanoscale and has shown potential to enhance sensitivity, selectivity and lower the cost of diagnosis. The causative biomolecules (DNA, proteins) can be detected by red-shifted absorbance of gold nanoparticles or alteration in conductance of a nanowire or nanotubes, deflection of a micro or nano-cantilever. Various types of nanomaterials such as metal, metaloxides and quantum dots have shown ample advantages over traditional diagnosis, intracellular labelling and visualization of target cells/tissues. Nanotechnology has also opened several avenues which could be further developed to enable enhanced visualization of tissues, cells, DNA, proteins over a point-of-care device. Protein or gene chips created using nanomaterials could further be integrated into a convenient nanofluidic device to improve disease diagnosis.
Athanasios Alexiou **Department of Informatics** **Ionian University** **Greece** **E.m: alexiou@ionio.gr**	Application of Efficient Nanoparticles for Early Diagnosis and Treatment of Cancer: Cancer is one of the major causes of mortality and undoubtedly the most complex disease, while multiple cellular physiological systems are involved. During the last decade the application of nanotechnological products for cancer treatment has received considerable attention. These sophisticated tools and materials treat cancer though the early diagnosis, the prediction, the prevention and the personalized therapy. This technology enabled the development of nanoscale particles that can be conjugated with one or multiple functional molecules simultaneously. Nanoparticles have the capability to be delivered directly through blood vessels to the tumor site and interact with targeted tumor-specific proteins located inside or on the surface of cancer cells, since their size is a hundred to thousand times smaller than cancer cells. In this review, comprehensive outline of all the latest scientific and technological applications such as quantum dots and gold nanoparticles alongside with their applications in cancer diagnosis and treatment have been presented.

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CAI	Topic: Abstract
Gohar Mushtaq **Department of Biochemistry** **College of Science,** **King Abdulaziz University** **Saudi Arabia** **E-m:** **gmushtaq2001@gmail.com**	Nanoparticles Neurotoxicity and Neurodegenerative Diseases: Our modern era is witnessing an increased prevalence of neurodegenerative diseases such as AD, Parkinson's disease, Huntington's disease and brain tumors. This is accompanied by an increased production of nanoparticles (NPs) and the subsequent release of NPs in the environment shared by humans. NPs are extremely small molecules measuring about 100 nm in diameter. Due to minuscule size, NPs have the potential to penetrate human body through various pathways and eventually cross the blood-brain barrier to potentially cause neurotoxicity, neuroinflammation and neurodegeneration of the central nervous system. Until recently, the mechanisms by which NPs cause neuroinflammation and neurodegeneration were unknown. However, recent *in vivo*, *ex vivo* and *in vitro* studies have significantly advanced our understanding of the mechanisms by which NPs may cause neurotoxicity and neurodegeneration. In light of this understanding, various pathways have been identified as the basic mechanisms by which NPs cause damage in the brain. The goal of this review is to summarize new mechanistic findings and different pathways of NP-induced neurotoxicity. Better knowledge of such pathways can lead researchers to devise effective therapeutic strategies for neuroprotection against nanoparticles.
Mohd Sajid Khan **Department of Biosciences** **Integral University** **India** **E.m: research.sajid@gmail.com**	Magnetic Nanoparticles: properties, synthesis and biomedical applications: Importance of magnetic nanoparticles in daily life including biomedical applications in near future cannot be overlooked. This review focuses on the properties such as various approaches for synthesis and biomedical applications of magnetic nanoparticles (MNPs). First part of this review focuses on the classes, physical properties, and characteristics of MNPs. While second part sheds light on strategies developed for the synthesis of MNPs with special attention given to biological, physical, and chemical approaches as well as recent modifications in the preparation of mono-dispersed samples. Furthermore, this review deals with the biomedical applications of MNPs, which includes applications in targeted drug delivery, diagnostics, gene therapy, hyperthermia and advantages in the field of medicine.
Ghulam Md Ashraf **King Abdulaziz University** **Saudi Arabia** **E.m: gashraf@kau.edu.sa**	An overview on global trends in nanotechnological approaches for Alzheimer Therapy: Despite extensive research for over two decades, the medical science is yet to assign the exact aetiology and mode of progression of AD. The modern era of AD drug development began with the proposal of the cholinergic hypothesis of memory impairment. Since then, despite the proposal and phase trials of many therapeutic options, only few drugs have shown some efficacy and safety. The reasons behind this have been many including the ineffectiveness of tested drugs and inadequacy of clinical development methods. In this manuscript, we present an account of modern structural, functional and molecular imaging developed for AD therapy. A comprehensive review of all the current and future treatment options for AD, ranging from cholinergic drugs, NMDA receptor antagonist, immunotherapy, drugs reducing Aβ production, and drugs targeting tau protein and mitochondrial dysfunction have also been provided. However, the failure of all the proposed treatment options to provide a complete cure of AD has been pushing for the need of new therapies. The recent advent of nanodrugs has been proposed to provide crucial breakthroughs in AD therapy. Hence, a detailed outline of the usage and applications of nanodrugs in AD therapy, and outstanding developments in nano-drug metabolism and disposition have been discussed.
Athanasios Alexiou **Ionian University** **Greece** **E-m: alexiou@ionio.gr**	Applications of nanotechnology in diagnostics and therapeutics of Alzheimer's and Parkinson's disease: In this paper, an extended review analysis has been presented concerning the developments in brain drug delivery through new and efficient applications of nanotechnology. Modern nanotechnological approaches for early diagnosis and treatment of AD and Parkinson's diseases are described along with simultaneous analysis of safety and practical clinical usage of these strategies.
Mohammad Amjad Kamal **King Abdulaziz University** **Saudi Arabia** **E-m: prof.makamal@lycos.com**	An overview of current screening and management approaches for prostate cancer: Prostate cancer is the fourth leading cause of mortality in Australian men. The prevalence and incidence is increasing in both developed and developing nations, thus there is a need for better screening and management of this disorder. While there is no direct known cause of prostate cancer, management is largely focused on early detection and treatment strategies. Of particular concern is advanced prostate cancer which can manifest as castrate resistant prostate cancer characterized by therapy resistance. This short review outlines the epidemiology of prostate cancer, clinical manifestations, risk factors, current screening strategies including first line clinical screening as well as the use of circulating biomarkers, and treatment of prostate cancer through mainstream therapeutics as well as the cutting edge peptide and nano-technology based therapeutics that are being implemented or in the process of development to overcome therapeutic obstacles in the treatment of prostate cancer.

AD, Alzheimer's disease; CAI, Corresponding Author Information

I would like to end this editorial by thanking Chandra Prakash, the Editor-in-Chief of CDM, as well as Beenish Anwer, the Managing Editor, and all the contributing authors who have passionately responded to my request to provide informative articles. I furthermore extend my thanks to all peer-reviewers for their time and expertise by providing fruitful and constructive feedback. I am also highly grateful to Nigel H. Greig (Chief, Drug Design & Development Section, Intramural Research Program, National Institute on Aging, National Institute Health, USA) for his support in my research activities and editing of this editorial manuscript.

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