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Nanosafety for Mankind

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Abstract: *With the advent of nanotechnology, nanomaterials are being widely used in many industries, in medicine and pharmacology as well. These technological innovations of nanotechnology for treatment, diagnosis, monitoring and control of biological systems, is recently referred as nanomedicine. Nanomedicine initiatives envisage that nanoscale technology begin yielding more medical benefits over the years. This include the development of nanoscale laboratory-based diagnostic and drug discovery platform devices such as nanoscale cantilevers for chemical force microscopes, microchip devices, nanopore sequencing etc. This review summaries the key findings from the consultation, exploring public aspirations and concerns, for potentially proved nanotechnology application, nanomedicine, in context of human health and mankind and nanosafety.*
Key Words*: Nanotechnology, Nanomaterials, Nanomedicine, Nanosafety.*

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I. Introduction

Nanobiotechnology is the branch of nanotechnology, deals with biological and biochemical applications, bridging areas in physics, chemistry and biology and often, studies existing elements of living organism, and nature to fabricate new nano-devices. Molecular nanotechnology has three-dimensional positional control of molecular structure to create materials and devices to molecular precision. The human body is comprised of molecules, hence the availability of molecular technology permits dramatic progress in human medical services. More than just an extension of 'molecular medicine', nanomedicine employ molecular machine systems to address medical problems and uses molecular knowledge to maintain and improve human health at the molecular scale. Nanomedicine have extraordinary and far-reaching implications for medical profession, for the definition of disease, for the diagnosis and treatment of medical conditions including aging and ultimately for the improvement and extension of human being's natural biological structure and function. Nanomedicine is the preservation and improvement of human health using molecular tools and molecular knowledge of the human body.

II. Nanotechnologies for Healthcare Diagnostics

Apart from conventional molecular imaging techniques, new imaging techniques at molecular level are important to probe nano-scale physiological processes in human organs. Such a system helps to diagnose the disease at the early stages, and to understand the effects of therapies given to a patient. Quantitative analytical tools help to understand how cell functions are regulated at the molecular level. The physical model of cell as a machine, is essential to understand how the components of cell work together to accomplish a task. Genomics, proteomics and metabolomics combined with the power of nanobiotechnology, help in understanding disease in a way previously not possible. Eventually, it is expected that the disease is targeted more effectively and precisely. Ex-vivo tests and improvement in current laboratory techniques allow for measurement with greater sensitivities and specificities.

ASPIRATIONS - Healthcare diagnostics are the top priority for applications of nanotechnology, with the concepts of "lab on a chip". Such applications could enable patients to undertake lifestyle changes and manage a disease before it advances. In this way, nanotechnology enables people to manage their own health more effectively. Early diagnosis is seen to have major benefits saving lives before diseases progressed too far and also have potential to reduce treatment costs in the longer term. There is strong preference for medical technologies that help, prevent rather than cure disease.

CONCERNS - There are three main concerns around this application. The first is whether information provided by diagnostic devices actually empowered people. This includes whether a treatment is available when the condition is diagnosed, to which types of condition could be tested in the home and which would need professional support. The impact on primary care is thought to be significant and the potential demand on services could overwhelm doctors' surgeries – particularly if the device exacerbated the concerns of the "worried well". The second concerns the efficacy of the devices themselves, particularly if screening for a large number of potential diseases, as the technology is proven and it results accurate and reliable. The third is related

to the access to information, that such devices would generate. Privacy – and more specifically who has access to the data, are major concerns to people. Finally, there is a strong preference that diagnosis and treatment systems should not be combined without careful thought given to the safety of the devices and the role of patients in managing disease.

III. Nanotechnologies for targeted delivery of Therapeutic Agents

Techniques in nanomedicine make it possible to deliver molecular therapeutic agents into targeted specific cells, cellular compartments, tissues and organs by using nanoparticulate carriers. Research into the rational delivery of molecular medicines and targeting of pharmaceutical, therapeutic and diagnostic agents is at the forefront of projects in nanomedicine. These involve the identification of precise targets related to specific clinical conditions and choice of the appropriate nanocarriers to achieve the required responses while minimizing the side effects. Today, nanotechnology and nanoscience approaches to particle design and formulation, beginning to expand the market for many drugs, forming the basis for a highly profitable niche within the industry. This keynote advocates rational approaches in design and engineering of nanoscale vehicles and entities for site-specific drug delivery and medical imaging after parental administration, including the advantage of the nanometer scale size range, biological behavior and safety profile.

ASPIRATIONS - It supports as it enables to promote the targeted delivery of therapeutic agents - particularly highly toxic drugs such as anti-cancers. This primarily benefits in patients' quality of life through the reduction of drugs side- effects. Devices that assist the delivery of drugs to hard to reach tissues and organs, such as the brain, is also found a valuable application. Despite the fate and toxicity of devices in the body are also equally concerns.

Theranostic devices, that combine the diagnosis and delivery in a single system, are supported for a more limited range of conditions – particularly for certain groups who have difficulty in taking medicines such as the younger ones and the elderly. When considering drug discovery process more broadly, the use of nanotechnologies to screen drug candidates, seem to have major benefits in terms of cost savings and in helping to increase the speed at which treatments are made available to patients. Overall, the applications are supported when they help to empower people and help them control the diseases that affect them. Moreover, there is a vast array of intriguing nanoscale particulate technologies capable of targeting of different cells and extracellular elements in the body to deliver drugs, genetic materials and diagnostic agents specifically to these locations. The, research into the rational delivery and targeting of pharmaceutical, therapeutic and diagnostic agents via intravenous and interstitial routes of administration with nanosized particles are at the top level of projects in nanomedicine.

CONCERNS - Apart the safety and reliability of the technology, this ranges from whether nanotechnologies could always target diseased tissues precisely, questions about the mechanical effectiveness of devices. The potential for malfunction or damage to the device and the delivery of the wrong dosage of medicine is a major concern, and causes fear, worry among common men. Participants generally are concerned that such devices need to be retrievable from the body and are able to be controlled externally. Very intelligent devices that undertook monitoring and treatment of conditions make many people uneasy. People want to know what is going on in their bodies and such devices are perceived to disempower people from taking control of their lives and their health. Affordability, in terms of money is also a key criteria for these devices.

IV. Nanotoxicologies- Nanomaterials used in Nanomedicine

Technological impact of nanoscale systems, synthesize and characterization of nanoscale materials and their applications include systems for visualization, labeling, drug delivery and cancer research. Undoubtly, application of such multi-wavelength optical nanotools may eventually aid understanding of the complex regulatory and signaling networks that govern the behavior of cells in normal and disease states.

ASPIRATIONS - Because nanoparticles possess different physical and chemical properties than their fine-sized analogues due to their extremely small size and large surface area, they need to be evaluated separately for toxicity and adverse health effects. In addition, in the field of nanomedicine, intravenous and subcutaneous injections of nanoparticulate carriers deliver exogenous nanoparticles directly into the human body without passing through the normal absorption process. These nanoparticulate carriers themselves may be responsible for toxicity and interaction with biological macromolecules within the human body. Secondly, insoluble nanoparticulate carriers may accumulate in human tissues or organs. Therefore, it is necessary to address the potential health and safety implications of nanomaterials used nanomedicine.

CONCERNS - Toxicological studies for biosafety evaluation of these nanomaterials is significant for continuous development of nanomedical science. The nanotoxicity research show that the interactions between nanomaterials and cells, animals, humans and the environment are remarkably complex, also how the physical,

chemical and other properties of nanomaterials influence, and ultimately, leaves impact on health and on environment.

V. Conclusion- Public Perception of Nanotechnology and Nanomedicine

Thorough evaluation of desirable versus adverse effects,the requirement of safe applications of engineered nanomaterials (ENMs), and major challenges lie ahead to answer key questions of nanotoxicology. Foremost are assessment of human and environmental exposure, identification of potential hazards, and biopersistence in cells and subcellular structures to perform meaningful risk assessments. Similarly, safety assessment for medical applications as key contribution of nanotoxicology to nanomedicine relies heavily on nano-specific toxicological concepts, current findings and further research on a multidisciplinary collaborative approach involving nanomaterial scientists, medical physicians and toxicologists.

When considering clinical trial for the applications of nanotechnology, thoughts need to be given not only to research ethics also, the need for informed consent, around those likely to be enrolled, in trials – but also the types of disease that are likely to be prioritized to test devices. Cancers and other life threatening diseases are highlighted in this regard. The National Cancer Institutes have related programs too, with the goal of producing nanometer-scale multifunctional entities that can diagnose, deliver therapeutic agents and monitor cancer treatment progress. Research into public perceptions of nanoscience and nanotechnology is becoming more rigorous with social scientists developing and testing increasing complex theoretical models. Researchers explored, among other aspects, how the public reaction to nanotechnology depends on cultural predispositions, religiosity and the specific application of the nanomedicine. The increased public awareness of nanotechnology, on its own, lead to widespread acceptance to nanomedicine and, to nanosafety. In short, the discussions across all nanotechnologies or healthcare, participants are more likely to be supportive of applications that : (i) have a short-to-medium term pay off – rather than long term / high risk return on an investment, (ii) promote prevention rather than cure, (iii) promote patient control and agency, (iv) are affordable to healthcare systems, (v) are reliable, (vi) are target serious condition, (vii) also, can be recovered from the body.

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