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Nanotechnology in Medical World: A Futuristic Planning

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The technology based upon the study of smallest possible particles whose measurements in at least one dimension smaller than a nanometer and which is a billionth of a meter is known as nanotechnology. It is an exciting field of research and there is growing interest in its application for biological and environmental safety. In 1867 James Clerk Maxwell was the first scientist who provided some information related with nanotechnology. After that in 1959 Richard Feynman, a physicist, who presented the topic of nanotechnology in his famous lecture entitled "There's Plenty of Room at the Bottom" and finally in 1974 the term nanotechnology was coined by Norio Taniguchi at Tokyo Science University. To synthesize nanoparticles various processes are being utilized like chemical, physical and biological [1]. The synthesized nanomaterials show different properties than their bulk material like effect of gravity will be almost negligible, surface tension and Van der Waals attraction would become more important for this, and have a relatively greater surface area than do larger particles of the same mass of material etc [2]. After synthesis, these nanomolecules have a wide range of potential applications within agricultural, industrial and medical fields. As the human health care is one of the important topic to be discussed in today's life which is full of toxic substances. Therefore, in this report main focus is given to the application of nanotechnology in medical fields and its effects on human health (Fig. 1).

In order to create nano-revolution in medical field, the researchers show burgeoning interest in nanotechnology, which is an interdisciplinary area of science. The nanomaterials used as nanoelectronic biosensors, as a disease diagnostic tool and in various molecular technologies. With the help of macroscale devices made up of sensitive nanoscale components, such as micro-/nanocantilevers, nanotubes, and nanowires can detect even the rarest biomolecular signals at a very early stage of the various disease like cancer, diabetes mellitus, neurodegenerative diseases and it can also detect infections caused by microorganisms and viruses such as pathogenic bacteria, fungi, and HIV viruses. Development of these kinds of devices will change the whole scenario of medical field. A nano-scale material was developed by Hamid Ghandehari to deliver drugs directly to tumor cells, so that it will minimally absorbed by non-target organs. It will also improve cancer gene therapy and the oral administration of drugs. It will selectively kill tumour cells by transforming electromagnetic energy into heat which will be lethal to cancer cells. Researchers from Germany, Brazil and France have reported that the use of nanoparticles to carry antibiotics across biological barriers can be effective in treating lung infections. Doing so allows better delivery of the drug to the site of infection, and hence prevents the development of antibiotic resistance. A nano-scale micro-electromechanical system (MEMS) device was developed by Bill Bentley and his collaborators that provide proper dosage of medicine only when and where it is required.

Microarry is another device to detect DNA analysis, protein analysis and whole cell analysis. Nanotechnology also has an impact in this device by creating densely packed, nano-sized arryays that could allow faster screening of large number of biochemical. During sample detection it plays an important role in the form of quantum dot (QD) because as compared to the conventional flourscence organic dyes it is more stable, sensitive and monochromatic [3]. It was found that with the help of silver and gold particle of uniform size of 40 to 120 nm, sensitivity of sample detection can be enhanced up to 10 fold compared to convention fluorescence markers. The respirocyte proposed by Freitas is also a kind of nanodevice that could function to replace defective or improperly functioning cells. This respirocytes are capable of providing oxygen more effectively than an erythrocyte. Primary applications of respirocytes may involve transfusable blood substitution, partial treatment of anaemia, prenatal/neonatal problems, and lung disorders. Researchers reported that titanium dioxide (TiO_2) nanoparticles can trigger rapid and long-lasting defensive responses in mouse microglia, specialized cells that protect the brain from harmful external stimuli [4].

In future this nanotechnology has a potential to save more lives. The drugs which are formed by nanotechnology are called "smart drugs". These smart drugs have lesser side effect compared to traditional one. These "smart drugs" can help in the treatment of Cancer, Parkinson's, Alzheimer's and other neurodegenerative diseases**.** Similar to the living systems this technology also helps in the formation of molecular systems which can be used for the regeneration or replacement of disease infected and accidental body parts. In order to improve the quality of human life by treating some diseases with the help of 'nanorobots,' that might be sent into a person's body to cure cancer or repair cells, or possibly even extend the person's life span by a number of years. These predictions for the future have great significance in encouraging research and other development in the field of nanotechnology particularly in medical field.

But on the other hand the development of nanotechnology raises some difficult question also about enormous cost associated with the development of new drugs and other nanodevices. It was reported in a study that average cost of devising a single

new drug and to put it on the market is about $800 million. So, the synthesis of new drugs based upon nanotechnology will be more expensive because it requires even more specialized equipment and a greater level of precision [5]. Furthermore, nanotechnology is still a developing field, so it is not clear that what will be the effect of a specific nanomolecule on the biological entities including human beings. So, the development of this nanotechnology particularly for our medical arsenal in the war against chronic disease require great regulation in order to allow these technologies to be available on a large scale and to truly raise the global standard of living.

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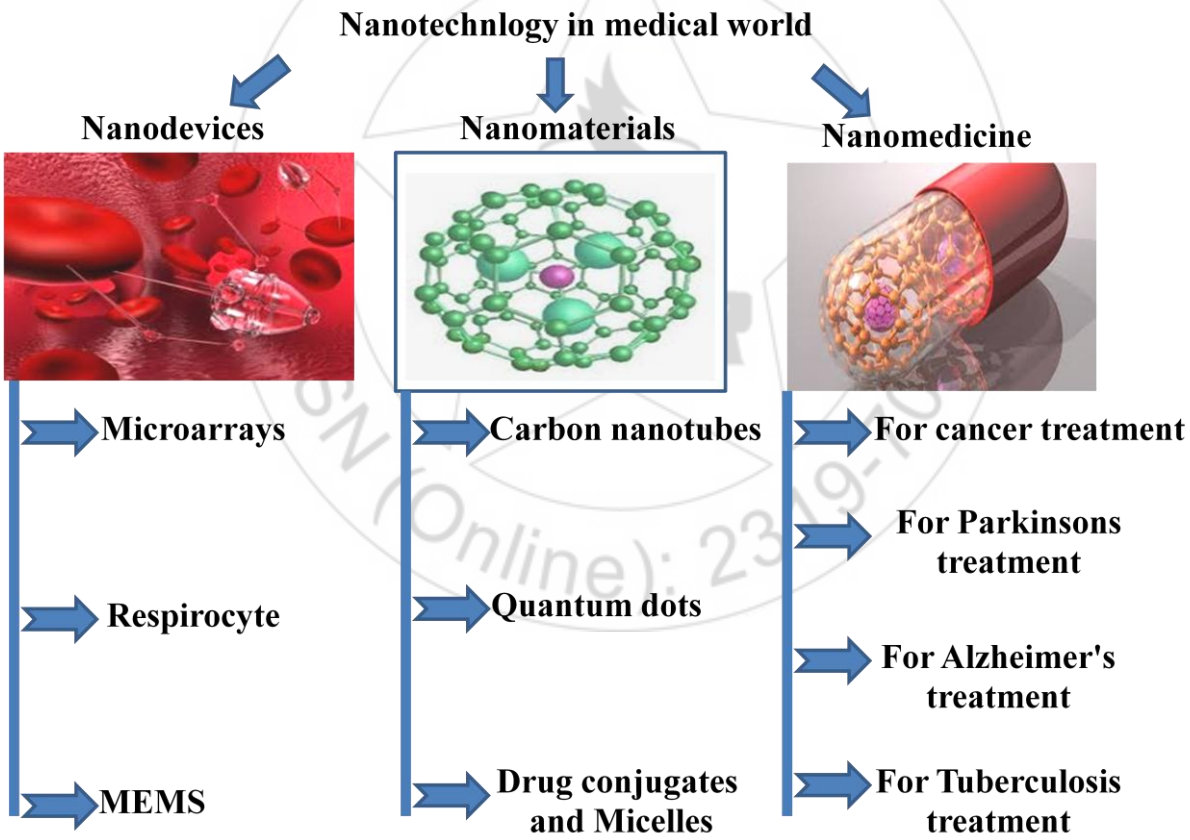

Fig. 1: Flow chart showing different uses of nanotechnology in medical fields