Journal of The Gujarat Research Society

ISSN: 0374-8588
volume 21 Issue 7, July 2019

ADVANCEMENTS IN NANOMEDICAL APPLICATIONS: A COMPREHENSIVE REVIEW

Chethan. M
Assistant professor, Department of Physics, School of Sciences, B-II,
Jain (Deemed to be University), Bangalore-560027, India.
Email Id: m.chethan@jainuniversity.ac.in

Abstract

Nanotechnology-based instruments have begun to attract the interest of study worldwide in the last few decades. For most medical problems, they offer economic, rapid, reliable, and highly specific solutions. As a consequence, the global market for nano materials is increasing very rapidly. In 2015, the demand for nano materials was projected to be around $2.6 trillion. Different nanotechnology applications in medicine have shown their ability to revolutionize medical diagnosis, immunization, rehabilitation, and even health care items. A large collection of nanoparticles (NPs) can be coupled to the loading substances by several means: chemically (conjugation), physically (encapsulation), or by adsorption. The use of a suitable loading nano substance is based on the intent of the application. They can be used by endocytosis to distribute different chemicals (drugs, chemotherapeutic agents or imaging agents) or biological substances (anti genes, antibodies, RNA, or DNA). They can also be used when needed to deliver light and heat to their target cells. A brief description of the structure and shape of available NPs is given in the current review and addresses their applications in the medical sciences.

Keywords: *Cancer, Medical, Materials, Nano, Nanotechnology.*

I. INTRODUCTION

The creation of new industrial tools that allowed materials to be manipulated at their nanoscale gave medical science the opportunity for new, evolutionary applications. In essence, this opened the door for new solutions to old medical concerns, such as drug-resistant infections, the production of vaccines, and cancer therapy. The word (Nanotechnology) began to describe the techniques used for manipulating materials at their nanoscale after 1974, rendering at least one of their three dimensions (3D) around 1-100 nm[1].

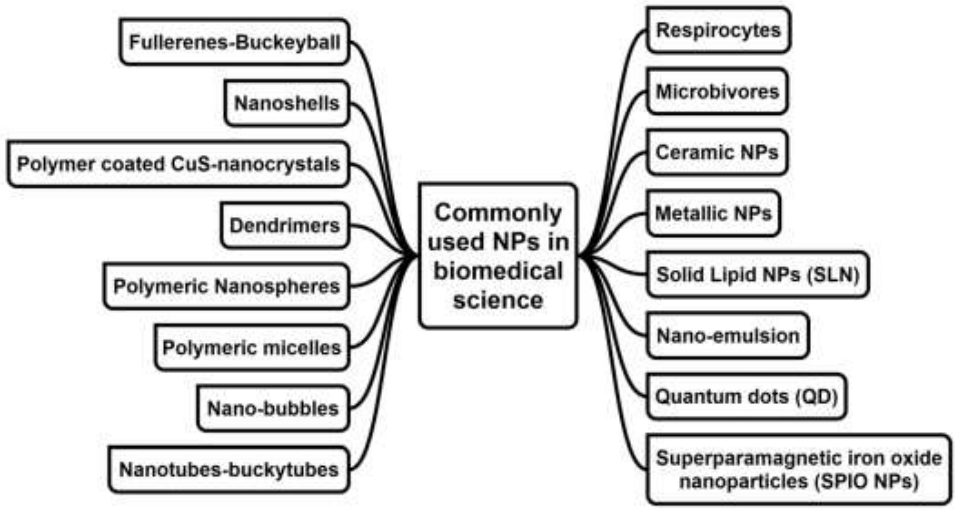

Figure 1: Illustrates Schematic illustration displaying the most commonly used NPs in medicine[2].

The new (Nano) situation was adapted to other expressions, such that terms such as Nano materials, Nanomedicine, Nano vaccines, or Nano theranostics began to be introduced. The use of different nano-technological methods to create better solutions to medical problems is nano-medicine[3].

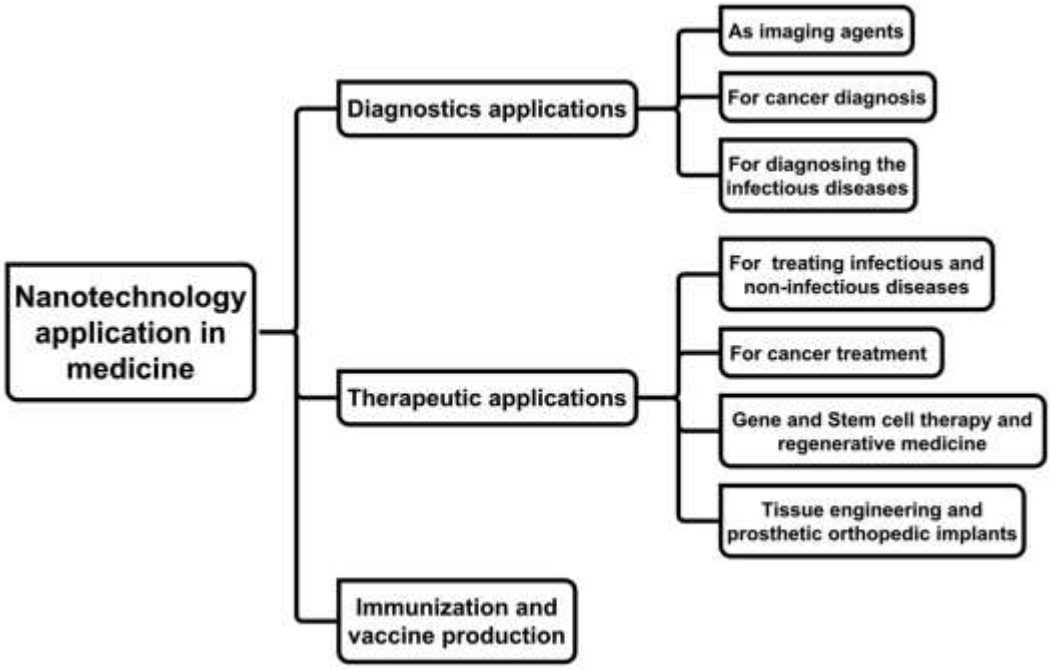

Figure 2: Illustrates the diverse applications of nanoparticles in medical science[4].

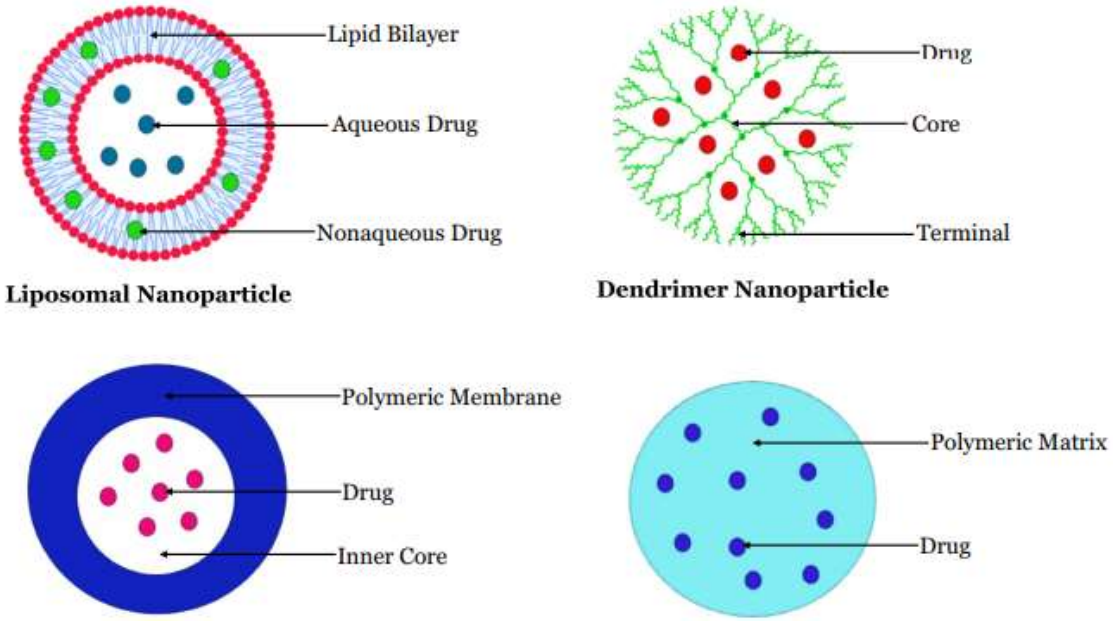

Figure 3: Illustrates the most commonly used nanocarriers for the delivery of nutraceuticals[5].

II. DISCUSSION

In order to detect various pathological parameters, foreign proteins/antigens, and toxic substances, multipurpose nanosized sensors were developed. Bio-barcodes have also recently been produced to target protein disease markers such as PSA (prostate specific antigen). Based on anti-PSA antibodies, such biosensors can diagnose prostatic cancer very early. The sensitivity of the developed assay for the diagnosis of prostatic cancer using bio-barcode is about one million times greater than the traditional methods used at the time[6]. Due to specific optical, chemical, and physical properties, ideal imaging agents are now produced using different nano materials. For ultrasound, MRI, PET, and SPECT, we provide better contrast, controlled bio delivery, and multi-model imaging. The NPs appear to accumulate in the tumor interstitial spaces because of the leakage in capillaries constructed in the cancer tissues. This allows the diagnosis of very small lesions that classical imaging agents do not identify[7].

ISSN: 0374-8588
volume 21 Issue 7, July 2019

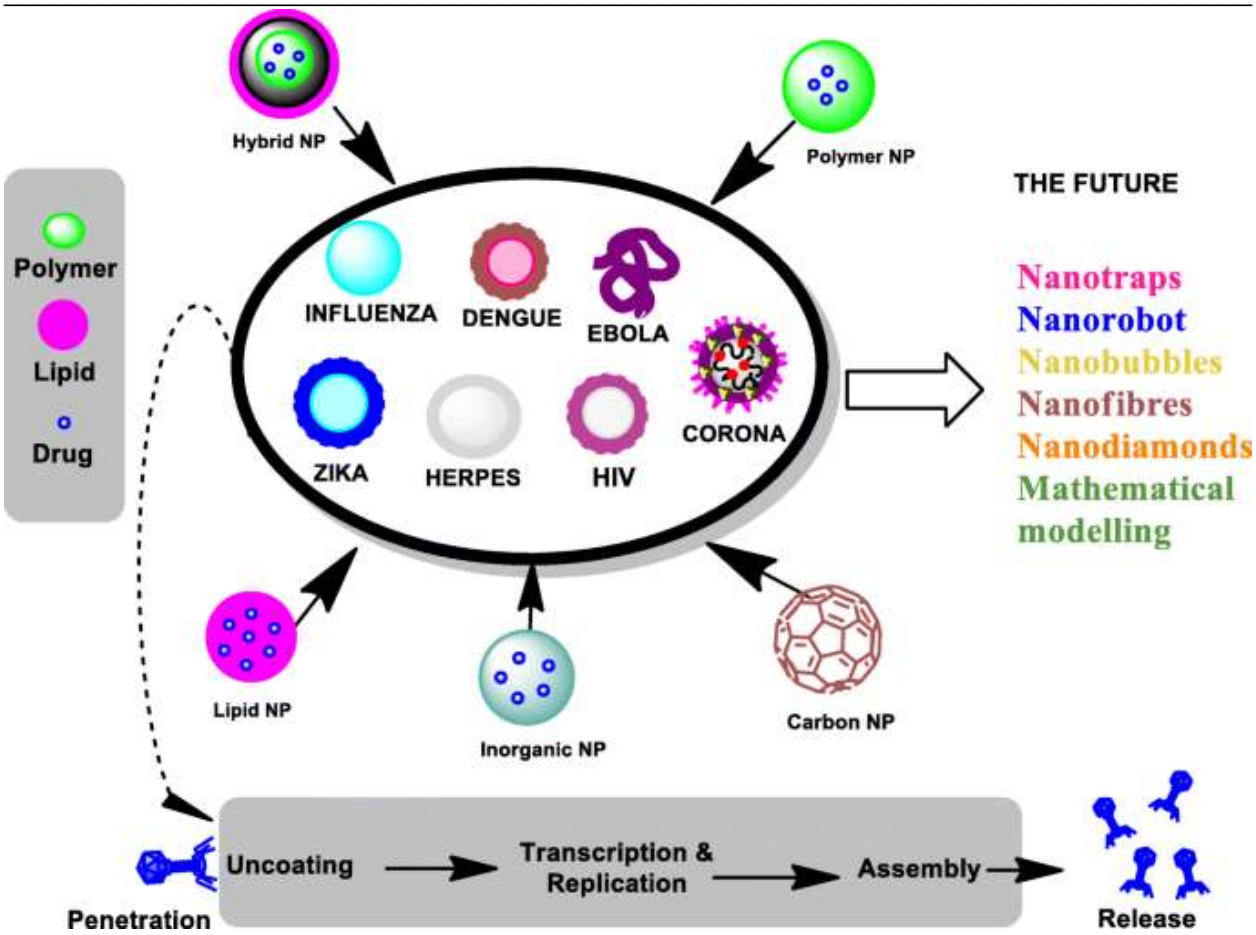

Figure 4: Illustrates the nanotechnology based antiviral therapeutics[8].

In cancer therapy, the existence of some forms of cancer that are extremely active and can resist traditional treatment is a major obstacle. The use of gene therapy to switch off major cancer regulatory genes is one of the potential facets of cancer therapy[9]. The key challenge of the method is the creation of short half-lives of synthetic RNA fragments in the circulation. One of the most promising concepts of tumor treatment protocols has been cancer gene therapy. The degree of treatment success depends on the form and stage of the cancer, the patient's immune status, and whether gene therapy is given alone or in conjunction with chemotherapy/radiation[10]. Figure 1 illustrates Schematic illustration displaying the most commonly used NPs in medicine. Figure 2 illustrates the diverse applications of nanoparticles in medical science. Figure 3 illustrates the most commonly used nanocarriers for the delivery of nutraceuticals. Figure 4 illustrates the nanotechnology based antiviral therapeutics.

III. CONCLUSION

In the diagnosis and treatment of both infectious and non-infectious diseases such as drug-resistant pathogens, intracellular pathogens, various forms of cancer, and even several chronic non-infectious diseases, the newly developed nano technological assays have contributed to a medical revolution. Various nano materials have been used for a number of biomedical applications, such

as drug delivery systems, optical imaging, bio imaging, bio sensing, and bone grafting, based on the physical and chemical properties of their surface. Parallel advances in gene therapy and vaccine preparation have been encouraged by nanotechnology. NPs have many benefits in immunization and vaccine development, such as increasing the solubility of hydrophobic antigen, providing less side effects after vaccination, continuous and regulated release of antigens, affecting tissues directly, and requiring smaller amounts and fewer doses, and more.

IV. REFERENCES

[1] A. Oyelere, "Gold nanoparticles: From nanomedicine to nanosensing," *Nanotechnol. Sci. Appl.*, 2008, doi: 10.2147/nsa.s3707.

[2] J. I. Borissoff, H. M. H. Spronk, and H. ten Cate, "The Hemostatic System as a Modulator of Atherosclerosis," *N. Engl. J. Med.*, 2011, doi: 10.1056/nejmra1011670.

[3] M. E. Lobatto, V. Fuster, Z. A. Fayad, and W. J. M. Mulder, "Perspectives and opportunities for nanomedicine in the management of atherosclerosis," *Nature Reviews Drug Discovery*. 2011, doi: 10.1038/nrd3578.

[4] A. Hidalgo, A. Cruz, and J. Pérez-Gil, "Pulmonary surfactant and nanocarriers: Toxicity versus combined nanomedical applications," *Biochimica et Biophysica Acta - Biomembranes*. 2017, doi: 10.1016/j.bbamem.2017.04.019.

[5] Y. Liu, M. Solomon, and S. Achilefu, "Perspectives and potential applications of nanomedicine in breast and prostate cancer," *Med. Res. Rev.*, 2013, doi: 10.1002/med.20233.

[6] J. Ezzati Nazhad Dolatabadi and M. De La Guardia, "Nanomaterial-based electrochemical immunosensors as advanced diagnostic tools," *Analytical Methods*. 2014, doi: 10.1039/c3ay41749b.

[7] K. B. Narayanan and S. S. Han, "Icosahedral plant viral nanoparticles - bioinspired synthesis of nanomaterials/nanostructures," *Advances in Colloid and Interface Science*. 2017, doi: 10.1016/j.cis.2017.08.005.

[8] K. Eric Drexler, *Engines of Creation: The Coming Era of Nanotechnology*. 2012.

[9] E. N. Kumar and E. S. Kumar, "A Simple and Robust EVH Algorithm for Modern Mobile Heterogeneous Networks- A MATLAB Approach," 2013.

[10] S. Kumar, A. Gupta, and A. Arya, *Triple Frequency S-Shaped Circularly Polarized Microstrip Antenna with Small Frequency-Ratio*. International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)/ISSN(Online): 2320-9801, 2016.

ISSN: 0374-8588
volume 21 Issue 7, July 2019