



## Drug delivery system using nano technology: An overview

Chandana Priya S<sup>1</sup>, Shobha S<sup>2</sup>

<sup>1</sup> PG Student, Department of Chemistry, Indian Academy of Degree College, Bangalore, Karnataka, India

<sup>2</sup> Department of ECE, Cambridge Institute of Technology, Bangalore, Karnataka, India

### Abstract

Nano Technology in drug delivery systems improves the ability to deliver drugs and its applications occur based on designed nano particles. Nano particles plays a vital role in targeted drug delivery. The modern drug delivery system minimizes side effects and reduces dosages. Nano particle refer organic as well as inorganic materials that can be considered for specific applications. Nano technology applications in drug delivery systems include retaining the drug in the body for effective treatment, protection from biological environment, extension of drug bioactivity, Transportation of drugs and so on. Significant progress has been made in nano delivery systems. This article briefs about the recent developments in nano technology used in drug delivery systems.

**Keywords:** nanotechnology, diagnostics, nanoparticles, pharmaceuticals, nanomedicines, drug targeting

### Introduction

Nanotechnology transforms people's lives for the better. It identifies the cells of interest having unique properties that allows associated drugs to reach diseased cells evading healthy cells. The properties of some nanomaterials make them ideal for improving early diagnosis and treatment. The emergence of nanotechnology platforms enable development of delivery for bioactivity. Drugs have been used to improve health. Drug delivery concept is unified with the dosage and its administration. Route of drug administration refers to the path a drug enters the body and drug delivery involves engineering of delivery systems. Drug delivery systems regulates the proportion of the drug released in the body. Drugs can be injected into the body in several ways. Targeted drug delivery has grown considerably in the treatment of chronic diseases. Controlled drug delivery releases the drug at a predetermined rate for a specific period.

### Nano Technology in Drug Delivery System Recently

Developed nanoparticles are so sensitive that even a single nanoparticle is capable of enabling early identification of infections. Suitable and effective treatment saves the patient and prevents the spread of the pathogens [1]. The identification of the drug for the treatment of diseases or allergies assigns new tasks for pharmaceutical technology. Various issues are there in drug delivery regarding to solubility and restriction to inconvenient routes of administration. The rise of co-infections and the growth of drug-sturdy pathogens limit the efficacy of current treatments against infections. In spite of abundant efforts to progress in effective medicines and new technologies to produce drugs at low cost, the significant increase in drug resistance of infectious agents prevents efficient treatment of infections. Recent developments in nanotechnology addresses this issue by means of diagnosis and treatment. Evolving nanotechnology-based techniques have recently fascinated interest as an approach that may overcome the

problems of current diagnostic techniques through their specific mode of actions and unique physical properties i.e., shape, size, surface charge, and dimension [2]. These techniques may be applied to develop accurate, reliable, rapid, safe, cost-efficient, sensitive, specific, and easily accessible techniques for the detection of pathogens [3]. Nanotechnology circumvents some of these problems, hence suits for nanomedicines.

### Nano-Based Drug Delivery System (Nano-DDS)

Nano-DDS have the unique features of high solubility, thermo-sensitivity, and proficiency for controlled release of drugs, easy surface modification, and high surface area-to-volume ratios. These unique features of Nano-DDS may allow medical scientists to overcome the problems associated with the increased drug resistance of infectious agents. By scaling down the size of compounds, Nano-DDS can restrain and advance the performance of many drugs. Nano-DDS can enhance drugs stability, solubility, and absorption. Nano-DDS can also increase blood circulation time, deliver drugs to specific cells or tissues, and release them in a controlled manner in response to a specific stimulus [4].

### Usage of Nanoparticles in Drug Delivery

Remarkably Medicinal sciences are using nanoparticles to Lessen venomousness and side effects of drugs. A swarm of substances are currently under research for the grounding of nanoparticles for drug delivery, varying from biological substances and chemical nature containing nanoparticles. It is evident that the potential contact with tissues and cells, and the potential venomousness, significantly depends on the actual composition of the nanoparticle formulation. Nanoparticles are considerable for medical purposes based on their surface to mass ratio that is much larger than that of other particles, their quantum properties and their ability to adsorb and carry other compounds. Nanoparticles in drug targeting can be used, when reaching the desired diseased

site in the body. So, for drug delivery biodegradable nanoparticle formulations are needed as it is the intention to transport and release the drug in order to be effective [5, 6, 7]. The vital component of nanomedicines are nanoparticles and presently wide range of nanoparticle types exist depending on their structural features. These particles can proficiently carry and deliver healing agents to targeted sites.

### Nanostructures and Nanophases in Drug Delivery

Nanotechnology by means of nanostructures and nanophases is used specially in nanomedicine and nano based drug delivery systems. Nanostructures stay in the blood circulatory system for an elongated period and allow the discharge of integrated drugs as per the specified dose. These nano sized structures pierce in the tissue system, enable acceptance of the drug by cells. They permit an efficient drug delivery and ensure action at the targeted location. The nanostructures treat the diseased cells with improved efficiency and negligible side effects. However, insufficient knowledge about nanostructures venomousness is a major concern and certainly needs further research to improve the effectiveness with higher safety to empower safer administration of these medicines. Hence, careful usage of nanoparticles is needed to combat the problems associated with them [8, 9, 10].

### Nanomedicine and Nano Delivery Systems

Nanomedicine and nano delivery systems, are used to function as problem-solving tools to specifically embattled sites in a controlled manner. The use of nanotechnology for medical purposes is mentioned as nanomedicine and nanomaterials are used to improve quality of life of patients. Nanomaterials physicochemical properties considerably provides opportunities in drug development. Nanomaterials in nanomedicine efficiently cures a wide range of diseases significantly. Intracellular transport is a means of delivering nanomedicines. Intracellular transport is enabled through intracellularization. A nanoparticle in nanomedicine advances intercellular transport that eases cell infusion and affects nanomedicine absorption, propagation and evacuation [11, 12, 13].

### Smart Drug Delivery Systems

Idyllically, nanoparticle drug delivery accumulate in the required location and at the same time, enter target cells to deliver the bioactive agent. Such accumulation is achieved

by passive or active targeting. Intracellular delivery is achieved by means of cell penetration. Hence a drug delivery system is multifunctional which can enable necessary functions at its appropriate time. Smart Drug Delivery Systems is the exceptional attainments in the drug delivery field. The concept in this is based on swift changeovers of a physicochemical property of polymer systems on a stimulus. The physical stimulus are temperature, light, electricity... and chemical stimulus are pH, ionic strength. These stimuli can be internal or external. Internal stimulus results from changes in the physiological condition and external is from artificially induced desired events. This system is based on the release-on-demand strategy where as in conventional system it is on predetermined drug release [14, 15].

### Starch: A Natural Polymer in Drug Delivery

Starch is a common carbohydrate whose molecules consist of a number of sugar molecules bonded together. Starch use in Medicine is widespread. It is used as co-polymer in controlled drug delivery. Starch nanoparticles are used in transdermal drug delivery. Drug delivery in these methods is through skin which acts as an effective barrier to drug passage. Starch is the second most rich natural polymer used in drug delivery systems as binder, disintegrant and filler [16].

### Conclusions

Delivering drug to the patients suitably is a significant task. Drug delivery system should be ideal in such a way that less drug dosage having the same benefit. The technology used would deliver the drug to the right place in the body, increase the effectiveness of the drug in the desired site and eliminate or reduce side effects. Advances in nanotechnology in drug delivery system to fully commercialization is yet a big challenge. Nanotechnology deals with the design, characterization, production and application of structures, devices and systems by controlling shape and size at nano scale. Nanotechnology play a vital role in drug delivery system. Currently the usage of nanotechnology in drug delivery is extensive in pharmaceutical industries. Nanotechnology play a prominent role in the research areas such as target specific drug therapy and early diagnosis of pathologies. Table 1 shows the comparison of nanotechnology with conventional delivery systems.

**Table 1:** Nanotechnology VS Conventional Drug Delivery Systems

Parameters	Nanotechnology	Conventional
Drug path	Drugs rightly reach the affected site.	Drugs reach the affected site through unaffected areas.
Dosage delivery	Controlled drug dosage timely.	Initially high dosage is required.
Effectiveness	Drug concentration is more optimized in affected site.	Drug concentration is less in affected site.
Side Effects	Less contact of unaffected sites to drugs.	More contact of unaffected sites to drugs.

### References

- Muhammad Qasim, Dong-Jin Lim, Hansoo Park, Dokyun Na. Nanotechnology for diagnosis and treatment of infectious diseases, *Journal of Nano Science and Nano Technology*, 2014;14(10):7374-87. doi:10.1166/jnn.2014.9578.
- Daum N, Tscheka C, Neumeyer A, Schneider M. Novel approaches for drug delivery systems in nanomedicine: Effects of particle design and shape, January 2012 Wiley Interdisciplinary Reviews Nanomedicine and Nanobiotechnology, 2012;4(1):52-65
- Nathaniel L Rosi, Chad A Mirkin. Nanostructures in biodiagnostics, *Chem Rev*, 2005;105(4):1547-62. doi: 10.1021/cr030067f.
- Fernanda Andrade, Diana Rafael, Mafalda Videira, Domingos Ferreira, Alejandro Sosnik, Bruno Sarmento. Nanotechnology and pulmonary delivery to overcome resistance in infectious diseases, *Adv Drug Deliv*

- Rev,2013:65(13-14):1816-27.doi:10.1016/j.addr.2013.07.020. Epub 2013 Aug 7.
5. Wim H De Jong, Paul JA Borm. Drug delivery and nanoparticles: Applications and hazards, *International Journal of Nanomedicine*,2008;3(2):133-149.Published online 2008 Jun. doi: 10.2147/ijn.s596.
  6. Mansour HM, Rhee YS, Wu X. Nanomedicine in pulmonary delivery. *Int. J. Nanomedicine*,2009;4:299-319.
  7. Bailey MM, Berkland CJ. Nanoparticle formulations in pulmonary drug delivery. *Med Res Rev*,2009;29:196-212.
  8. Jayanta Kumar Patra, Gitishree Das, Leonardo Fernanades Fraceto, Estefania Vangelie Ramos Campos, Maria del Pilar Rodriguez-Torres *et al.* Nano based drug delivery systems: Recent Developments and Future Prospects, *Journal of Nanobiotechnology*,2018;16:71.Open Access Published: 19 September 2018.
  9. Martinho N, Damgé C, Reis CP. Recent advances in drug delivery systems. *J Biomater Nanobiotechnol*,2011;2:510.
  10. De Villiers MM, Aramwit P, Kwon GS. *Nanotechnology in drug delivery*. New York: Springer; 2008.
  11. Rabia Hamid, Ifrah Manzoor (October 30th 2020). *Nanomedicines: Nano based Drug Delivery Systems Challenges and Opportunities* [Online First], 2020.IntechOpen, DOI:10.5772/intechopen.94353.
  12. Eric DK. *Engines of Creation. The Coming Era of Nanotechnology*. Doubleday; NY, USA, 1986.
  13. Langer R, Weissleder R. Scientific discovery and the future of medicine. *JAMA*,2015;313:135-136.
  14. Martins Ochubiojo Emeje, Ifeoma Chinwude Obidike, Ekaete Ibang Akpabio, Sabinus Ifianyi Ofoefule (October 31st 2012). *Nanotechnology in Drug Delivery, Recent Advances in Novel Drug Carrier Systems*, Ali Demir Sezer, Intech Open, 2012. DOI:10.5772/51384. Available from: <https://www.intechopen.com/books/recent-advances-in-novel-drug-carrier-systems/nanotechnology-in-drug-delivery>.
  15. Charman WN, Chan HK, Finin BC, Charman SA. "Drug Delivery: A Key Factor in Realising the Full Therapeutic Potential of Drugs", *Drug Development Research*,1999;46:316-27.
  16. Rajesh Singh, James W. Lillard, Jr. Nanoparticle-based targeted drug delivery, HHS Public Access, 2009. Published online 2009 Jan 7. DOI: 10.1016/j.yexmp.2008.12.004.