

# Nanomaterials in drug delivery: existing scenario and potential scope

# 7

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## 7.1 NANOTECHNOLOGY IN DRUG DELIVERY

Nanotechnology employs engineered materials or devices in the nanometer size range (1–1000 nm). Richard Feynman introduced the concept of nanotechnology as an important field of future scientific research in 1959 (Feynman, 1960). Nanotechnology applications in drug delivery are witnessed by many novel nano-devices. There has been substantial attention to the growth of novel drug delivery using nanotechnology. Nanoparticles (NPs) symbolize a promising drug-delivery scheme of controlled and targeted release. The advantages of nanoparticles as drug-delivery systems include reduced drug toxicity, time-controlled drug delivery, enhanced bioavailability, improved therapeutic efficacy, and biodistribution (Ravi Kumar, 2000). Nanotechnology also protects sensitive drugs from degradation by environmental factors, namely, stomach acid and enzymes (Jores et al., 2004). Polymeric nanoparticles are in the size range of 10–1000 nm (Kreuter, 2001), and can be tailored with diverse ligands, namely, antibodies to create a smart targeting delivery system. Polymeric nanoparticles in the size range of 300 nm or less with surfactant coatings have been proved to be able to transport drugs across the blood–brain barrier (BBB) (Schroeder et al., 1998). Recent advancements and applications of nanotechnology in drug delivery have proven effective for treating many diseases. Nanotechnology growth is unprecedented in the development of nanotherapeutics such as controlled drug-delivery systems, site-specific/targeted drug delivery, gene delivery, lipid-based delivery systems, implants, smart/intelligent drug-delivery systems, polymeric nanosystems, colloidal systems, etc.

## PAPER PRESENTATIONS:

### INTRODUCTION OF NATIONAL LEVEL COMPETANCY / LICENSING EXIT EXAMS FOR PROFESSIONAL GRADUATES

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#### **Abstract**

*In recent times, India has transformed itself as a global higher educational hub, thanks to the clairvoyant policies adopted by our founding fathers post independence. A big revolution has swept over the field of Indian higher education and this has resulted in a plethora of institutions (mostly private colleges and deemed universities) which are catering to the increasing demands for seats in various professional disciplines. Moreover, the concept of STEM education as the mantra for the future has also given impetus to more higher education institutions being set up in the fields of Engineering, Health Sciences, Biotechnology, and other STEM disciplines. While this has been a welcome development for the nation, this has also brought along a big problem with potential harmful repercussions: the problem of dilution and falling standards across the board. While India has still elite institutions that offer very high quality higher education, today the nation is also plagued by sizeable numbers of professional degree colleges that abysmally fail in delivering quality education. Many fly by night institutions also prey on the vulnerability of students and cash in unethically on their desire to get a professional degree. In this light, the country risks severe damage to its image, especially regarding the quality of its professional graduates passing out of its various professional institutions. There is absolutely no guarantee regarding the competency of these graduates other than those that come out of the elite established institutions. Therefore, there is an URGENT NEED to implement a MANDATORY national level exit competency / licensing exam to ensure that the professional graduates, regardless of the institutions that they graduate from. This will ensure the minimum standards required for that particular profession and go long ways in improving the educational standards of the country. These exams could also be used as an output measure for the various institutions and become a viable scale in evaluating them. These exams could be online and the graduates could take them any time at their convenience, but within a reasonable time frame as deemed fit for that particular profession. If need be, there could also be a practical / oral evaluation. The test could feature real world problem solving with emphasis on SUSTAINABILITY and also on ETHICS. The sooner this is implemented, the better will be the educational prospects for our future generations as these exams will in one stroke ensure uniformity and more importantly, the much needed quality.*

#### **Introduction:**

When the founding fathers of this nation laid the first stones of elite higher educational institutions like the IITs post independence with the best of ideals and intentions, little would they have envisioned the behemoth that it has become today [1]. Higher education has become a mighty money churning industry today with private institutions and deemed universities (with notable exceptions) running like smooth and well oiled corporate machines with only emphasis on the bottom line of profits and more profits for their owners and stake holders. Little concern is given for education for the sake of education itself. Of course, increasing costs could be justified to some extent because of ever increasing costs of infrastructure and personnel. But what cannot be justified ever in higher education is falling standards and a lack of ideals in graduates. And certainly, universities cannot become agencies for jobs. Unfortunately, this is what they are becoming when the emphasis is not placed on the merit during admissions but money. Naturally, the customer who pays big money looks for something more in return and creates enormous pressure on the management to dilute standards and allow them to coast through their degrees. This has also lead to the pernicious situation called as degree inflation in almost all fields of higher education [2].

In this rapidly changing world with the triple threats of global warming, climate change, and terrorism, we need a big systems reboot concerning higher education. We need highly skilled graduates who are ethical and more importantly focussed on bringing ecologically sustainable goals for the problems besetting the world today. The triple threats facing the world are not going to go away any soon and require efforts on a war footing to bring them under control, leave alone neutralizing them completely. This is because of the almost unstoppable momentum these triple threats have garnered over decades of apathy.

And what we as humans cannot afford in this context are graduates who have literally purchased their degrees from dubious institutions. Tackling the triple threats mentioned above need high integrity over and above high skills. Therefore, we urgently need a national system which ensures the professional viability of graduates in all professional disciplines. And this system could be in the form of mandatory competency exams. These exams must be rigorous and test the graduates holistically. There could a common paper across all disciplines, followed by an area specific paper. These examinations could be held online and the graduate should be given a time frame of possibly of a maximum of 2 years after graduation. This, in turn, will ensure uniformity of standards and will be an objective measure independent of which institution the candidate has graduated from. Already such exit exams have been envisioned and proposed for the medical and the pharmacy professional degrees [3,4].

### **Salient features of this proposed exit test**

- Should be online and be of high standards matching the best international institutions.
- Skill (real world problem solving, ethics, and sustainability based
- Question papers to be formatted both from academia and industry

- 2 papers: one common across all disciplines and other individual area based
- Should be taken within a maximum period of 2 years from completion of undergraduate degree
- Should also act as a foreign equivalency exam
- Should regulate the number of graduates per year as per real world demand. Therefore the passing benchmark for these tests would be correspondingly adjusted just like it is done with the Chartered Accountancy exams.

#### **Advantages of these exit tests:**

- Ensures uniformity of standards of exiting graduates just like the CA exams.
- An objective skill based test regardless of the institution the graduate hails from.
- Ensures viable employability
- Mandatory for professional practice as well as becoming eligible for post-graduate studies.
- Raises the standards and respect of the Indian UG professional degree uniformly all over the nation.
- Will act as good outcome measure of any UG professional degree institution and can become an excellent NAAC tool for evaluation of an institution. Could become a gold standard.
- Exam rules and content can be changed as per changing norms and demands of the real world.
- Great platform for Industry / Academia interaction.
- Could be a good regulatory tool on the number of graduates coming out per year for a given professional degree based on real world demand and supply.
- Educational institutions will be encouraged to crank up their standards and genuinely work towards raising the standards of their students.
- Will also be encouraged to espouse the value of ethics and integrity to their students and in turn will become more than fee collecting agencies.
- Will act as a great tool in weeding out dubious institutions that are out there to just make money at the expense of hapless students.
- Those institutions who do not consistently meet set criteria of passing percentage of their graduates in these tests will be put on probation and inspection.
- Will really work against the insidious degree inflation.

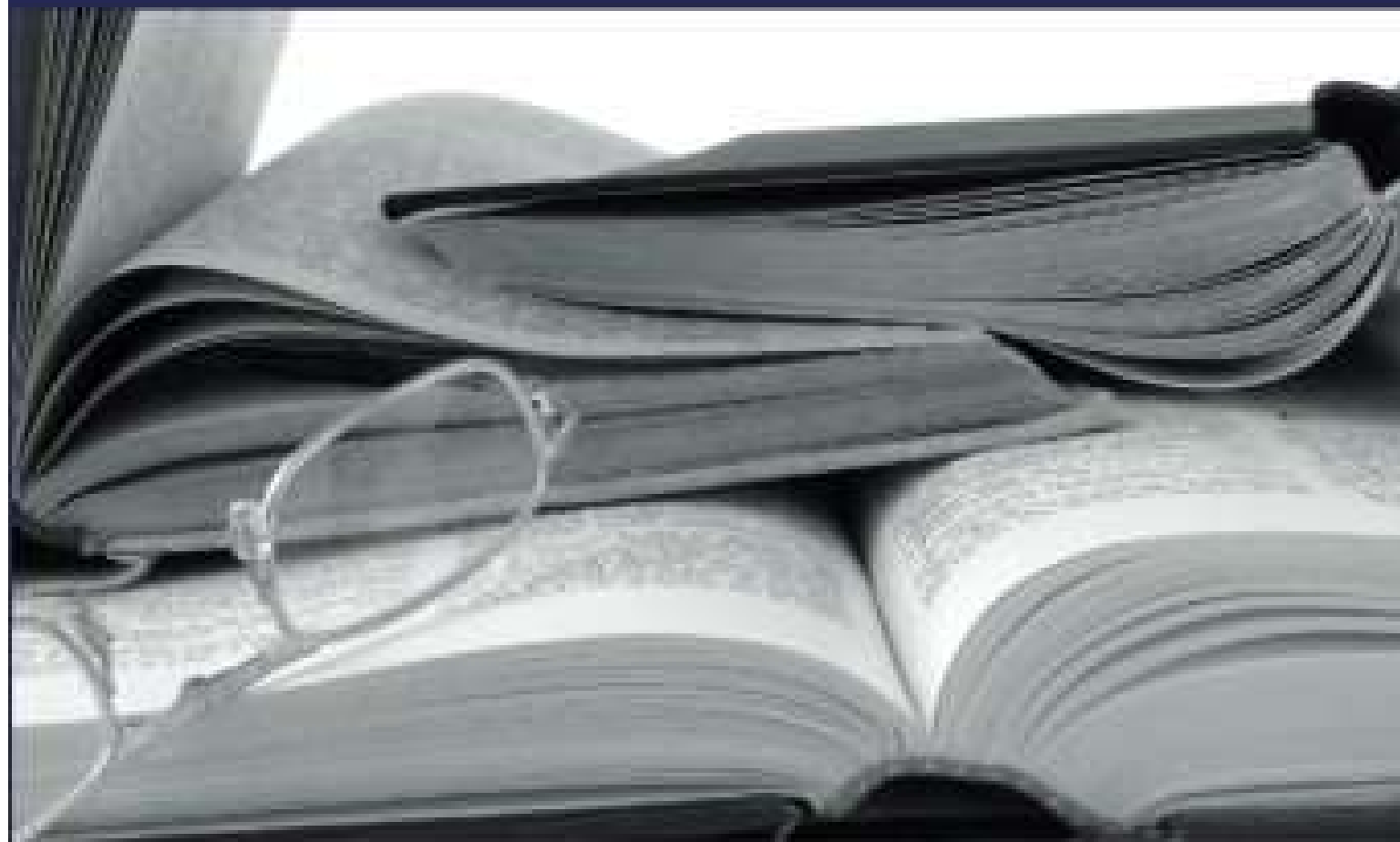
**Conclusion:**

National level competency exams / exit tests for all professional degrees is the need of the hour in the current context. The sooner this system is implemented or at least tabled for discussion the better it will be for the future healthy trajectory of our educational institutions.

**References:**

1. Komov B, Khanna R, and Sharma RK “Journey of Higher-Education in India: An Analysis of Post-Independence era, *Asian J Multidimensional Res* 2012: 1(1).
2. Rampell C “Degree Inflation? Jobs that newly require Bas” 2012: [http://economix.blogs.nytimes.com/2012/12/04/degree-inflation-jobs-that-newly-require-b-a-s/?\\_r=0](http://economix.blogs.nytimes.com/2012/12/04/degree-inflation-jobs-that-newly-require-b-a-s/?_r=0)
3. Bhatnagar S “The Unending debate over “Exit Test” after MBBS 2016: <http://examswatch.com/the-unending-debate-over-exit-test-after-mbbs/>
4. Britto Duraisingh L, Sankar V, and Hariharan S “The need for a National level Competency exam for the Doctor of Pharmacy degree in India” *Amer J of Pharm Edu* 2013: 77(6), doi: 10.5688/ajpe776133.

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# **Assessment of vitamin D on Metabolic Disorders in Arthritic Prediabetes**



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**ABSTRACTS**



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only in 50% of patients with advanced disease. Curcumin, a chemopreventive and chemotherapeutic agent, inhibits a key transcription factor called NF $\kappa$ B, which is constitutively active in breast cancer cells. Curcumin also exerts its effect by interfering with other signaling molecules such as IGF-1, TGF- $\beta$ , RANKL, IL-6, and PTH; all of which are known to stimulate cancer cells in the bone marrow microenvironment and stimulate osteoclast-mediated bone resorption. Alendronate (ALN) is a nitrogen containing bisphosphonate molecule used as an adjuvant treatment in metastatic cancer patients, which has a high affinity towards bone mineral component called hydroxyapatite. We have coencapsulate bortezomib with curcumin to synergistically inhibit NF $\kappa$ B and increase efficiency of the formulations. We have formulated a composite multifunctional nanoparticle system that provides significant advantages over traditional systemic chemotherapy. We have developed a novel functionalization technique that allows us for rapid, efficient and higher attachment of any ligand containing reactive NHS group on the surface of PLGA nanoparticles. The nitrogen containing bisphosphonates, such as ALN, at

neutral pH, exists in partially electropositive state, which can be attached to the chemical cross-linker immobilized in the PLGA matrix. The high affinity towards bone will help to carry the nanoparticles and the encapsulated drug to the bone. Moreover, combination of chemotherapeutic agents for treatment of cancer provides an advantage for achieving higher efficacy in cell killing, less side effects and a better quality of life for cancer patients. The combinations of these drugs also provide beneficial effects in reducing osteoclastogenesis as well as bone resorption. Further modification of these multifunctional nanoparticles result in tumor remission, bone healing and improved quality of life. We have also developed a microfluidics-based strategy for optimal scale up of the nanoformulations for preclinical and clinical applications. By this we hypothesize that delivery of chemotherapeutic drugs in combination, in sustained-release biodegradable nanoparticles targeted preferentially to bone, is an effective therapy for bone-metastatic cancers (This work was supported by grant awards from National Institutes of Health R21CA194295, P20 MD006882 and U54MD006882).

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## Targeting neuro-inflammatory pathways to have neuroprotection in cerebral ischemic condition

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Different molecular mechanism has been proposed and reports available on the biochemicals involved in the signal cascade mechanism. The major biochemicals which are responsible for the incidents of stroke are glutamate, aspartate, reactive oxygen species, inflammation, hypoxia, metabolic imbalance and calcium. The present treatment protocols used in the treatment of stroke include fibrinolytic agents, anticoagulants, NMDA antagonist and cerebral vasodilators.

In our earlier report, we have reported that treatment of memantine, nimodipine and its combination are neuroprotective, however, the biochemical changes during ischemia, differs from time to time. In initial phase there will be release of excitatory amino acids due to calcium

influx. In later phase to compensate the excitation GABA is released. Subsequently there will be activation of pro inflammatory mediators which promotes inflammation and neurodegeneration. Hence dissolving the clot alone might not be sufficient to have neuroprotection after ischemic insult.

In clinical situation, some patients also experiences, elevation of intra cranial pressure, edema formation leading to brain death. In these patients, there will be more infarct volume observed. Hence it is clear that stroke is a complex event different biochemical and neurochemical are responsible for the complex event and it is time dependent. Taking this point into consideration in the presentation the role of different inflammatory pathways in the mediation





on neurodegeneration in ischemic stroke condition will be made. Intervention of anti-inflammatory drugs will also be discussed to assess the neuroprotective effect and suitable

combinations. The pathways studied will include COX, GSK 3 beta, TLR4 and estrogen receptor beta.

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## Understanding anatomy and reproductive biology of medicinal plants for long term conservation in Western ghats

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The Western Ghats of India (WGI) has been recognised as a World heritage site by UNESCO due to its rich biodiversity and endemism. WGI is the hottest hotspot which encompasses rich diversity and about 1500 species of medicinal plants including many IUCN red listed species. This is a mega diversity nature park and the world's second most irreplaceable geographical landscape with threatened organisms. Many types of forests and ecosystems are represented in a significant manner and the WGI is still a potential habitat for evolution and origin of many more species in future along with extant species. The diverse ecological niches and habitats are pertinent for the variety and abundance of life forms, communities and geological resources. Our study is based on few network projects carried out in the last ten years that reveals the accomplishment of biological understanding, mapping the distribution, propagation and restoration of some important medicinal plants, aromatic plants and tree species. All such species are propagated by seeds, stem cuttings and or micro propagation and considerably multiplied in large numbers. The biology with reference to anatomy, phenology and reproduction has been studied in detail. Propagated plants

were distributed to botanical gardens of few colleges, Universities and restored in the original and simulated habitats by community participation program involving forest department and tribal communities of respective forest regions. The major accomplishment of the project was the perceptive of the ecological, physiological and social drawbacks on reproduction, survival, dispersal and sustenance of species in their natural habitats. The factors responsible for constructive vegetation and long term sustainability of these species are worked out through participation of the stake holders of WGI. Though, there seems to be aggressive threat by the stake holders, political and natural calamity to the WGI the survival and conservation of all species still depends on the above said factors. Though, all kinds of plants are medicinally important their long term sustenance should be protected by judicious utilization and developing commercially viable propagation and conservation strategies. Thus, the lecture would shed light on the management of natural resources by paving good connectivity through scientific, social and political means for the continued existence and conservation of medicinal plants and their associated organisms.

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## Participatory research in medicinal and aromatic crops- A better approach for promotion of organized production.

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Demand for wild botanical species in pharmaceutical and cosmetic industries is growing with increase in human needs and commercial trade, because of which many species

are being over-exploited. Hence, the situation is warranting domesticating the wild species under managed cultivation systems. Of more than 400 plant species used by the Indian

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# Ethosomes: An Exciting and Promising Alcoholic Carrier System for Treating Androgenic Alopecia

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Veintramuthu Sankar, Santhanam Ramesh and  
Karthik Siram

Additional information is available at the end of the chapter

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## Abstract

Androgenetic alopecia (male-pattern hair loss) is characterized by the deposition of dihydrotestosterone at the pilosebaceous unit of the scalp. Oral administration of drugs (like finasteride) which can reverse androgenic alopecia causes undesired effects to the body. Targeting these drugs directly to the pilosebaceous unit of the scalp will enhance the pharmacological response at the desired site by reducing undesired systemic side effects. This chapter discusses about ethosomes, a specially tailored ethanolic vesicular carriers which can efficiently deliver various drugs with different physicochemical properties to and through the skin. The unique characteristics of the ethosomal carriers, their composition, preparation methods, and the mechanism of permeation, safety, and practical experience (finasteride and herbal extracts) have been discussed in detail.

**Keywords:** androgenic alopecia, ethosomes, finasteride, nanoparticles

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## 1. Androgenic alopecia

Hair growth in the scalp is an androgen-dependent process. Many androgens target tissues in scalp hair follicles and are more responsive to dihydrotestosterone than testosterone. Two types of 5 $\alpha$ -reductase enzymes, which convert testosterone to dihydrotestosterone, are present in humans. Scalp skin contains type 1 5 $\alpha$ -reductase in the sebaceous glands and type 2 5 $\alpha$ -reductase in the dermal papillae of hair follicles and connective tissue sheaths. Male-pattern hair loss, also referred to as androgenic alopecia, is a type of hair loss that occurs due to shrinkage of hair follicles by the influence of androgenic hormones. Type 2 5 $\alpha$ -reductase promotes conversion of testosterone to dihydrotestosterone. When compared to the occipital

# Pharmaceutical nanotechnology: Brief perspective on lipid drug delivery and its current scenario

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### In Silico and In Vitro Studies of Benzohydrazide Analogues as Potent Androgen Receptor Antagonist

H. A. Arjun, Ravi Kumar Rajan, R. Elancheran, K. Lakshmithendral, M. Ramanathan, Atanu Bhattacharjee and S. Kabilan

In the late '50s, the Prostate Cancer (PCa) is commonly diagnosed in men. The growth of PCa is largely due to the stimulation of the AR by androgens. Currently, hormonal therapy, surgery, and oral chemotherapeutic drugs are the main therapeutic for the treatments of prostate cancer. About 1,74,650 men were diagnosed and 31,620 deaths due to PCa in the U.S reported by the American Cancer Society. Androgens, testosterone, and Dihydrotestosterone binds with the ligand binding domain (LBD) of the androgen receptor (AR) and incite the growth of prostate cancer. There are few available drugs for androgen receptor antagonists such as bicalutamide, flutamide, and enzalutamide are used to prevent the activation of the androgen receptor. Currently, Sipuleucel-T is used as a drug for the immunotherapy to inhibit PCa. To reduce toxicity, lower the doses, and minimize drug resistance, numerous studies are enduring for the development of target based drugs. Recently, benzohydrazide derivative was reported for antifungal–antibacterial, anti-inflammatory, cruzipain inhibitor. Entamoeba histolytic, antimalarial, anti-tuberculosis activities, and as EGFR Tyrosine Kinase Inhibitors. Thus, benzohydrazides are the important moieties which play a vital role in effective inhibition against different cancer cell line HepG2, HeLa, A549, and MCF-7.

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