



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**

'A Bridge Between Laboratory and Reader'

www.jibpas.com

ARTIFICIAL INTELLIGENCE FOR TARGETED DRUG DELIVERY SYSTEMS: NANOPARTICLES FOR CANCER THERAPY

YADAGIRI P^{1*}, WOMBEOGO M², SHINDE S³, ANGSOZUMAH B⁴ AND YVONNE PAM⁵

^{1,2,3} Faculty of Health and Allied Sciences, KAAF University College, Fetteh-Kakraba, Gomoa
East District, Central Region Ghana

^{4,5} Department of Health and Allied Sciences, KAAF University College, Fetteh-Kakraba,
Gomoa East District, Central Region Ghana

*Corresponding Author: Dr. Phalgunya Yadagiri: E Mail: yphalgun@kaafuni.edu.gh

Received 24th Oct. 2023; Revised 25th Nov. 2023; Accepted 7th March. 2024; Available online 1st Dec. 2024

<https://doi.org/10.31032/IJBPAS/2024/13.12.8505>

ABSTRACT

Cancer is an existence-threatening disease, ensuing in almost 10 million deaths global. There are various reasons of most cancers, and the prognostic statistics varies in every patient because of specific molecular signatures in the human body. However, genetic heterogeneity takes area due to wonderful cancer sorts and changes within the neoplasms, which complicates the evaluation and treatment. Targeted drug shipping is taken into consideration a pivotal contributor to precision medication for maximum cancers treatments as this technique allows supply medication to sufferers through using systematically increasing the drug cognizance on the targeted frame elements. In such times, nanoparticle mediated drug shipping and the combination of Artificial intelligence (AI) can assist bridge the space and decorate localized drug delivery systems capable of biomarker sensing.

Keywords: Artificial intelligence, Targeted drug delivery systems, nanoparticles, cancer therapy, Bioavailability, Biomarkers

INTRODUCTION

A department of computer generation called Artificial intelligence is purely centered on constructing machines which can perform tasks that could in any other case name for know-how and input from people [1]. The all of sudden developing place of Artificial intelligence (AI) is remodeling numerous industries, such as the healthcare area. In recent years, the field of drug delivery systems has visible encouraging consequences from the usage of artificial intelligence (AI). John McCarthy coined the word "A.I." for the number one time in 1956. AI may be used to create novel prescription drugs. The use of Artificial intelligence in method development is critical. In the arena of drug control, lots of synthetic network kinds, inclusive of deep or neural networks are used. A key tactic to improve and provide a higher success price for drug control is to target the proteins utilized in drug distribution [2]. Artificial intelligence (AI) is the potential of a machine to mimic human cognitive capabilities.

The pharmaceutical area has made good sized use of AI-based totally absolutely drug improvement, which is visible as a possible alternative to the cutting-edge way. AI-based drug transport systems have some of blessings and the potential to absolutely transform the pharmaceutical industry via manner of

enhancing medicine management and reducing toxicity. Artificial intelligence has made it feasible to formulate more accurate and effective medicine delivery systems. Drug delivery is the technique of giving a drug or pharmaceutical object to a patient so that you can advantage the meant healing outcome [3]. AI-assisted machine design has the ability to increase remedy bioavailability, that's one in each of its key benefits. Bioavailability is the quantity to which a drug will become completely to be had to its distinctive natural destination(s). The more appropriate name for this phenomenon is bioavailability, which refers to the pace and share of an initial dose of a remedy that during fact reaches the web page of action or the physiological fluid realm from which the drug's intended objectives have unfettered get right of entry to [4-6].

Cancer is a hooked up term for a significant category of ailment that takes place because of the transformation of everyday cells into tumor cells comprising of multi-degree progress from cancerous lesions to malignancy. Over a million maximum cancers incidences are said yearly, primary to high mortality fees [7]. Conventional maximum cancers remedy includes surgical methods for cancer in a localized stage, discovered with the aid of radiation remedy and chemotherapy

for advanced levels of most cancers [8]. In retrospect, it's been discovered that chemotherapeutic drugs goal cancer cells and specific normal cells in patients (**Figure 1**). Recently, Nano remedy and Nano-delivery structures have emerged as a way for localized drug transport for focused tumor web sites and

supporting as a diagnostic device [9]. Nanotechnology performs a important role in developing modern drug transport structures as herbal compounds in the interim are being investigated for treating most cancers and several different microbial and inflammatory ailments [10, 11].

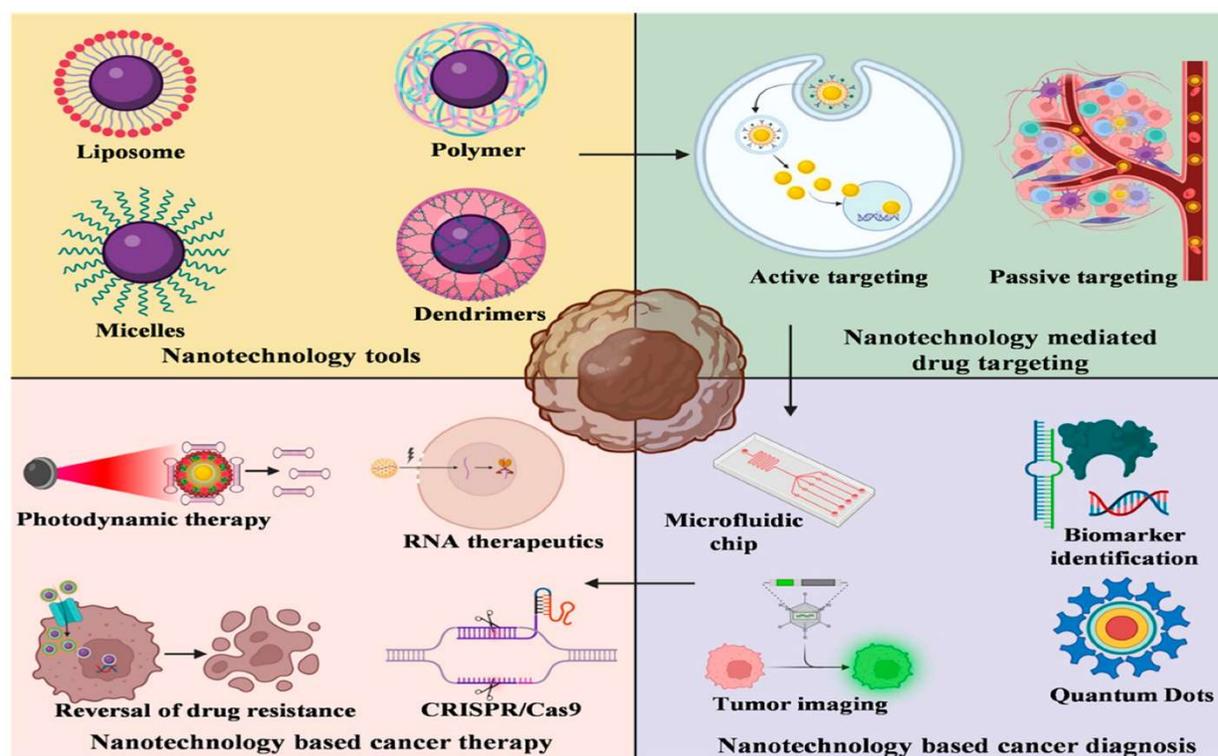


Figure 1: Nanoparticles for drug delivery systems and cancer therapy

Targeted drug delivery methods for cancer treatment

Over the beyond a long time, there were numerous advances and successes in maximum cancers treatments, in the foremost because of a progressed expertise of carcinogenesis strategies, cell biology, and tumor microenvironment [12]. However,

maximum cancers is a complicated sickness; consequently, many sorts of cancer though have a immoderate fatality price. Targeted drug transport in this context is notably critical for enhancing the survival charges of most cancers patients with information which can make sure the correct delivery of anticancer tablets [13]. In addition, drug focused on lets

in to define the selective launch of maximum cancers pills on the specific tumor web page with a higher pharmacological impact. Two concentrated on techniques may be achieved the usage of NPs: active and passive [14].

General aspects of AI in Nano medicine

In biomedical studies, huge growth in research for AI-enabled computational techniques for drug discovery and other pharmaceutical research has been witnessed [15]. AI has been influential in figuring out compounds, increasing productiveness, ensuring regulatory compliance and reworking facts, and scaling and optimizing pharmaceutical sports. In recent years, AI equipment were increasingly used for nanotechnology research in various regions, including scanning probe microscopy, simulations, and Nano computing. While diverse AI techniques exist, a particular method called purposeful reputation has been used to perceive the neighborhood actions from spectroscopic reactions. In precise, Artificial Neural Network (ANN) has been recognized to be influential in determining the local conduct of

the imaged materials, simplifying the procedure and permitting most effective suitable variables to be considered [16]. There is an indispensable courting among method, manner elements, and controlled release in drug transport structures that is non-linear; therefore, interconnected networks and optimization of managed launch records are important [17]. In such cases, neural community architectures are best proper as they encompass more than one layers of a node, with every layer connected, main to prediction, classification, or reputation effects (Table 1). The popular feed-ahead neural community is the most regularly used method in figuring out molecular structures, molecular fragments, topological indices, and descriptors, which include analyzing physiochemical properties from huge training sets [18]. In addition, in drug layout and discovery, ANNs are investigated in pharmaceutical research, knowledge pre-formulations and predicting drug behaviors appropriately.

Table 1: A comprehensive detail of AI applications in pharmaceutical research

s.no	AI Technologies	Applications
1	SMILES	Drug-receptor binding
2	QSPR (Estimation program interface suite)	Determination of physicochemical properties of small molecules
3	Chem Mapper Deep learning	Drug-target interaction
4	Deep learning Neural networks with ADMET predictor and ALGOPS programme	Lipophilicity and solubility prediction
5	Deep Tox, eTOXPred,	Drug toxicity prediction

	Targe Tox	
6	PrOCTOR	Predict if drug would fail in clinical trial due to toxicity
7	BNMs Dirichlet process mixture model mTPI, MCMC	Dose selection

Existing challenges in cancer imaging that may be addressed using AI and NPs

High-awesome most cancers imaging necessitates multifaceted, disease-specific information, inclusive of examinations, photo positioned up-processing, and interpretation for clinical reporting and remedy planning. The imaging strategies consciousness on figuring out tumor entities and metastatic patterns and acquiring supplementary medical information from various imaging modalities to assess tumor reaction to treatment plans and emerge as privy to complications and opportunities of tumor recurrence [19].

Therefore, cutting-edge inclinations have focused on the mixture of molecular imaging and drug shipping for visually assessing the drug shipping method in actual-time and expertise the recuperation retailers' in vivo efficacy. In addition, traditional strategies face the challenges of comparing pharmacokinetics and pharmacodynamics facts, however molecular imaging decreases the workload, producing extra particular facts for growing candidate drugs with ideal goal

specificity and pharmacodynamics efficacy, respectively [20].

CONCLUSION

The subject of Nano remedy is all at once evolving, and flexible drug vendors are being evaluated for their effectiveness in accomplishing the targeted tumor web sites and enhancing localized drug delivery. Furthermore, combining Nano treatment options with hybrid methods is continuously evaluated to enhance remedy efficacy for most cancers' sufferers. Therefore, this have a take a look at aimed to offer a pathway on how the mixing of AI can help overcome a number of the restrictions of fabrication techniques and the probably impact on nanoparticle imaging, patient profiling help beautify the consequences of nanotechnology-based totally therapeutics. Future works can also bring about building clever solutions for biomarker detection and nanoparticle monitoring and assessment structures through taking important insights from the survey.

REFERENCES

- [1] Manish V. Artificial Intelligence: The beginning of a new Era in Pharmacy

- Profession. Asian Journal of Pharmaceutics.2018;12(2):72.
- [2] Poonam Joshi, Itika Guleria, Ayush Dangwal, Purabi Saha, Sunil Kothari, Sapna Rawat Artificial Intelligence in Controlled Drug Delivery System.2022 1430 – 1437.
- [3] Roop K Khar, S. PVyas, Farhan J Ahmed, Gaurav K Jain “the theory and practice of industrial pharmacy “4th edition lachman’s/ lieberman’s CBS Distributors, 2013,87(2),943.
- [4] Currie GM. Pharmacology, Part 2: Introduction to Pharmacokinetics. J Nucl MedTechnol. 2018 Sep;46(3):221-230.
- [5] Herkenne C, Alberti I, Naik A, Kalia YN, Mathy FX, Pr at V, Guy RH. In vivo methods for the assessment of topical drug bioavailability. Pharm Res. 2008 Jan;25(1):87-103.
- [6] Chow SC. Bioavailability and Bioequivalence in Drug Development. Wiley Interdiscip Rev Comput Stat. 2014;6(4):304-312.
- [7] World Health Organization. Cancer. (2022). Available at: <https://www.who.int/news-room/fact-sheets/detail/cancer> (cited August 29, 2022).
- [8] Olusanya TOB, Haj Ahmad RR, Ibegbu DM, Smith JR, Elkordy AA. Liposomal drug delivery systems and anticancer drugs. Molecules. 2018, 23(4):907.
- [9] De Jong WH, Borm PJ. Drug delivery and nanoparticles: applications and hazards. Int J Nanomedicine. 2008, 3(2):133–49.
- [10] Kumar A, Sharipov M, Turaev A, Azizov S, Azizov I, Makhado E, *et al.* Polymer-Based hybrid nanoarchitectures for cancer therapy applications. Polymers (Basel). 2022, 14(15):3027.
- [11] Qindeel M, Sargazi S, Hosseinikhah SM, Rahdar A, Barani M, Thakur VK, *et al.* Porphyrin-based nanostructures for cancer theranostics: chemistry: fundamentals and recent advances. Chemistry Select. 2021, 6(48):14082–99.
- [12] Patra JK, Das G, Fraceto LF, Campos EVR, Rodriguez-Torres MDP, Acosta-Torres LS, *et al.* Nano based drug delivery systems: recent developments and future prospects. J Nanobiotechnol. 2018, 16(1):71.
- [13] Gupta AK, Gupta M. Synthesis and surface engineering of iron

- oxidenanoparticles for biomedical applications. *Biomaterials*. 2005, 26(18):3995–4021.
- [14] Adir O, Poley M, Chen G, Froim S, Krinsky N, Shklover J, *et al*. Integrating artificial intelligence and nanotechnology for precision cancer medicine. *Adv Mater*. 2019,32(13):e1901989.
- [15] Shamay Y, Shah J, Işık M, Mizrachi A, Leibold J, Tschaharganeh DF, *et al*. Quantitative self-assembly prediction yields targeted nanomedicines. *Nat Mater*.2018,17(4):361–8.
- [16] Chenthamara D, Subramaniam S, Ramakrishnan SG, Krishnaswamy S, Essa MM, Lin FH, *et al*. Therapeutic efficacy of nanoparticles and routes of administration. *Biomater Res*. 2019,23(1):20.
- [17] Kou L, Bhutia YD, Yao Q, He Z, Sun J, Ganapathy V. Transporter-Guided delivery of nanoparticles to improve drug permeation across cellular barriers and drug exposure to selective cell types. *Front Pharmacol*. 2018,9,55-61.
- [18] Wechsler ME, Ramirez JEV, Peppas NA. 110th Anniversary: nanoparticle mediated drug delivery for the treatment of Alzheimer’s Disease: crossing the blood-brain barrier. *Ind Eng Chem Res*. 2019, 58(33):15079–87.
- [19] Hua S, de Matos MBC, Metselaar JM, Storm G. Current trends and challenges in the clinical translation of nanoparticulate nanomedicines: pathways for translational development and commercialization. *Front Pharmacol*. 2018, 9(7)90-94.
- [20] Sonnenschein C, Soto AM. Over a century of cancer research: inconvenient truths and promising leads. *PLoS Biol*. 2020,18(4):e3000670.