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ASSESSING THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE DESIGN OF DRUG DELIVERY SYSTEMS

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Abstract:
Over ten years, increasing the interest has been fascinated towards the appeal of intelligent retrieval (IR) technology for data interpretation and illuminate the biological or transmitted information, speed up drug invention, and pinpointing of the selective small-molecule modulator control or rare particle and projection of their behavior. To make use of biomaterials, synthetic resin, fats, along IR is upcoming for the manufacture of drug deliverables. The request of the computerized workflows and databases for quick calculation of the vast amounts of data and artificial neural networks (ANNs) for growth of the narrative proposition and treatment schemes, forecast of disease development, and judgment of the pharmacological description of drug candidates may consequently improve treatment outcomes. Target fishing (TG) by quick projection or identification of the biological quarry might be of great help for linking quarry to the new substance.AI and TF methods in union with human knowledge may indeed transform the present-day diagnostic strategies, meanwhile verifying approaches are necessary to overcome the possible challenges and make certain higher perfection. In this review, the importance of AI and TF in the growth of drugs and transport systems and the possible challenging topics have been spotlighted.
Keywords: Artificial intelligence; biomaterials, polymers, lipids, Drug Delivery.

1. Introduction

Designing the embedded drug delivery systems requires consideration of several points such as quantity adjustment, quarry delivery, comfort release, and intelligent control system. sensual networks, downy argumentations, reconciler, and contractor have been put in for scheming the management system. The procedure of drug dispatch involves the concentration ultrasound, micro pump procedure, and select post by tiny robots. For the invention of tiny or small pieces for drug post, request of the tiny liquidlike stages is a hopeful engagement in conversation. utilizing the tiny liquid-like technique helps in the growth of smooth drug post structure. For example., Janus tiny or small pieces can dispatch many types of drugs. For processed drug dispatch, electrical elements, low wire transmission tools, and current process have been implanted in a small chip implementation specified by a pulsating liberate for about six months. In starting the clinical experiment, insert tiny chips have been executed in brittle bone patients for medicine dispatch. Restricted insulin dispatch and regular inspecting of glucose may directly decrease the problems of sugar level. In this context, a combination of sugar level devices, insulating dispatch process, analytical representation and restrict programming is useful. combining the injecting motor, quantity estimator, and sugar meter into equipment, a mechanical device has been supplied for examining of sugar and dispatch of injection. In creating brilliant dispatch software, on request adaptation of quantity, and equilibrium of medicines should be taken into consideration.

Concerning the self-appraisal dispatch process, suitable programs should be executed to command the quantity and schedule of drug existence. Intelligence automation, wireless information, and duplicate neuron web (DNWs)share the invention of a smooth drug dispatch software that may be used for rewriting the restrictions of protocol therapy programs [1-4]. Broadcast transmission regulates more ductile for supervising medicine dispatch gadgets. The component obtains the commands from the outermost wellspring, sends the record to the investigator, and controls the drug emitted. DNW's consists of the interrelated programming components which are generated via replicating the system of representation neurocyte, have been registered to grow system for imitating the organic programming, producing the jurisdiction set of rules, drug-energetic/pharmaco-forceful representation, supervised drug dispatched, and validating the success of a therapy plan of action [5-8]. Utilizing machine learning address for forecast substance-based quarry has to evolve in the immediate of quarry fishing (TF) in which substance set of data, quarry amino acid, and connection among the matter and approach can be used to forecast organic molecule approach of paperback substances with genetical programs [9-12]. The request for high automation is essential for the growth of the next production of medicine and transformation dispatch process. This results in the importance of machine learning(ML) and TF in the innovation of medicine and dispatched process and the developing demanding affairs.

2. AI for drug dispatch appeals:

The request of AI policies provides optimistic challenges for critical medical requests involving the faster examining of a difference of dis-sequence, projection of flagging and metabolic route and sufferer stimulates to methods and presenting customized surgery ways [13–16]. In contrast to the regular plans, a hopeful stage for prognosis made by ANNs might reach ≥ 90 % [17]. Such a prognostic capability may be a solution way in the growth of single therapy approaches. ANN process help to forecast the results of medicine in single sufferer [18-21]. In bronchial asthmatic sufferers taking the mono distributed emulsion of salbutamol sulfate, ANNs have been executed for designing the connections within the in-vitro record and in vivo. AI methods will be used to clear up the issues of duodecimal technology involving those interrelated to develop of monoculture, nano programming, and nano units sketch for which AI plans produce narrative innovative rules, decreased calculation time, methodical framework approximate and structure representation, or explanation of the trial and error discoveries [22-24]. AI patterns result in a chance to reboot the somatic restrictions of nanoscientific and results in nano-planning with a high competitive capacity [25-28]. Scrutinizing probe microscopy (SPM) is an important weapon for classifying illustrative-inquiry interchange, distinguish illustrative geography, or finding the address of micro molecules [29-32], gesture explanation is completely demanding. The request of AI approaches regulates a period of changes to directions probable provocation, obtain an extensive understanding regarding the interconnections among the inquiry and representatives, approximate the insulator unchanging situations of representatives and example-tip space, and much exact picture research. In sequence to best illuminate substance possessions, tasks identification visualizing (SPM approach) have been implemented in which the concept part investigation (PCA) and ANNs are used for clarification of the insert data, reducing of the number of individualistic adaptable, to draw out from datasets, and quick issue-resolving. Next, to appeal to the growth of stylish triggers, the AI technique is used for segregating the shape of characters of micro substances and regular testing of their influence on the biotic process [33-36].

In present-day medicine invention, implementing the particle set of books, inventing narrative medicine students with perfect properties, forecasting the bio-reasoning features of amino acids, and internal studying execute difficult tasks. Even for the preparation of Self-nano emulsifying drug delivery system (SNEDDS), In-situ gels, Nanofibers, Nanoethosomes, Films, [37-40]. In biomedical factories, using AI stages for detecting the biological record, inventing medicine goals, and finding for a different medical field may find much interesting medicine invention. In the rapid stage of medicine invention, deducting of the ideal or poisoned substances are of difficult importance. Nearby rapid removing or optical detecting process, artificial knowing differentiating process has been executed for testing and dividing of medicines or non-medicine groups and eliminating of poisons. Suggest borne transmission motors implying the particles construction headline and a set of rules are used for forecasting of the experiment of ferment disadvantage or ramification medicine inclusion. In a QSAR study, 1,4-dihydropyridine calcium passage opponents are been examined by low squares help vector equipment. Several technical stages will be over browned by the confluent of unnatural knowledge and microengineering. Several polymers were even explored such as Chitosan, Alginate, PLGA, Polyvinylpyrrolidone (PVP), Zein, Okra, Hyaluronic Acid, [41-44].

3. Appeal of AI in present-day medicine

The request for unnatural knowledge in pharma has two main branches: effective and somatic. The effective element is presented by instrument studying, (also called Deep Learning) that is written by analytical programming that implies better knowledge by involvement. There are three types of artificial learning programs: (i) unintendeded (ability to find patterns), (ii) superintend (classification and prediction algorithms based on previous examples), and (iii) strengthening of knowledge (use of sequences of rewards and punishments to form a strategy for operation in a specific problem space). Beginning, AI has improved and is still improving inventions in domestic and subatomic medicine by implementing an unnatural knowledge program and knowledge responsibility. An example of gain in pharma is the unexamined protein-protein interconnection program that leads to narrative therapy pinpoint inventions. The procedure used a merger of flexible revolutionary program and stage of drawing congregating procedures, named “revolutionary increase Markov congregating”. It authorizes forecasting of over 5000 amino acid complexes, of which over 70 % were improved by at least one heredity philosophy of existence function term [45]. Narrative computing procedure is also been increased to validate DNA alternative such as single nucleotide polymorphisms (SNPs) as prophecies of diseases or attributes, using narrative revolutionary implant program that is much vigorous and less liable to random errors problems that exists a representation has too many frameworks related to the number of examinations. Further optimizing the doses for Tablets, Solid Dispersions, Hydrogel, liposomal films [46-50]. Present-day “systems thinking” about health care not only centers on the traditional interchange among sufferers and suppliers but takes into consideration bigger unit companies and revolution. Later, the department of health care should not be stable but must learn from its implementations and struggle to discover constantly improving methods. This is a multiple-representatives process (MRP), where a set of representatives present in regular surrounding interaction with one another. This procedure includes constructing or

involving in a company, which uses AI to obtain outstanding results.

Adding in the effective approaches of AI are electrical pharma documentation where required programs are utilized themes with a family history of a genetic illness or an increased possibility of a long term illness. AI is used for better company results by directing a single to acquire, share, and apply their interactive experience to make "optimum resolutions in present-day". As a result, electric pharma documents and health care program organizing are critical to attaining a specified standard. From present sufferers' documentation of different standards, data should be saved in automated procedure which should be easy to work as a single record also in collection pages for bioengineering investigation and arrangement. More work is expected from the academic community and the knowledge-oriented company to attain the required efficiency and less amount. The present stage of pharma documents is more in the process of realistic incommunicable underground related data for the health structure and comprehension purchase. Class conference and health care require to combine to often quickly the establishment of digital fitness data [51-54]. Documents are to be arrested in the present-day situation, and the organizations must introduce their transmission to promote brilliant operation. New research and impersonal research must be shared through access time, and the collection of the document should be exhibited for open-approach by a medical practitioner and researchers and executed as point-of-care information. Combination and ability to operate social, moral, and procedural review are more in number, especially with the upcoming edition of "field of study in biology" information. The calculations, ability of reading, and impersonal use of records must be made noticeable, and every consequence should be examined for impersonal aptness. Our category has changed in such a way as executed in figure 1.voltaic pharma or health documents are important weapons for customized medicine and early observation and spot line cancellation, again to improve their impersonal worth and reduce fitness amounts [55-63]. The next effective implementation of AI in medicine is the use of software robots, as sensitivity training incarnation for preparation of Proliposomes, Microparticles, Solid lipid Nanoparticles, Nanoparticles, Nanoemulsion, Nanocrystals, Nanowires [64-75]. Incarnation trunk from the familiar 2009 James Cameron movie features a mixture of human–foreign created to smooth interaction with people from the satellite known as Pandora.

4. Conclusion

The extensive quantity of time and value in medicine investigation and growth required to appeal of an increase in interesting procedures and approaches. AI procedures provide enormous options for examining the huge quantities of multi-component data, resolve the difficult questions built with constructing of the operational medicine dispatch process, making more correct conclusions, grading and designing of illness, speed up medicine invention, recognizing biosignatures, medicine spot lines, possible medicine students and their medical specialty resources, narrative directions for available healing, connections among the expressions and progress adaptable, and corporeal or diseased organism route, make perfect quantity proportion, and forecasting the biological activities and interconnections of medicines, particle efforts, disease stage, the structural unit of an organism response, effectiveness of medicinal connections, and therapy results. Next to analyzing the narrative corrective properties, request of AI-powered program for tone with patients and the mass applicable impersonal trial and error might outstandingly decrease mistakes and increase value-potency.

References:

1. Hassanzadeh P, Atyabi F, Dinarvand R. The significance of artificial intelligence in drug delivery system design. Advanced Drug Delivery Reviews. 2019 Nov 1;151:169-90.
2. Abdelhady, S., Honsy, K. M., & Kurakula, M. (2015). Electro Spun- Nanofibrous Mats: A Modern Wound Dressing Matrix with a Potential of Drug Delivery and Therapeutics. Journal of Engineered Fibers and Fabrics, 10(4), 155892501501000. https://doi.org/10.1177/155892501501000411
3. Hamet P, Tremblay J. Artificial intelligence in medicine. Metabolism. 2017 Apr 1;69:S36-40.
4. Ahmed, O. A. A., Kurakula, M., Banjar, Z. M., Afouna, M. I., & Zidan, A. S. (2015). Quality by design coupled with near infrared in formulation of transdermal glimepiride liposomal films. Journal of Pharmaceutical Sciences, 104(6), 2062–2075. https://doi.org/10.1002/jps.24448
5. Alhakamy, N. A., Ahmed, O. A. A., Kurakula, M., Caruso, G., Caraci, F., Asfour, H. Z., Alfarsi, A., Eid, B. G., Mohamed, A. I., Alruwaili, N. K., Abdulaal, W. H., Fahmy, U. A., Alhadrami, H. A., Eldakhakhny, B. M., & Abdel-Naim, A. B. (2020). Chitosan-based microparticles enhance ellagic acid's colon targeting and proapoptotic activity. Pharmaceutics, 12(7), 1–14. https://doi.org/10.3390/pharmaceutics12070652
6. Rafienia M, Amiri M, Janmaleki M, Sadeghian A. Application of artificial neural networks in controlled drug delivery systems. Applied Artificial Intelligence. 2010 Sep 8;24(8):807-20.
7. Alvarez-Lorenzo C, Concheiro A. Smart drug delivery systems: from fundamentals to the clinic. Chemical communications. 2014;50(58):7743-65.
8. Alhakamy, N. A., Fahmy, U. A., Ahmed, O. A. A., Caruso, G., Caraci, F., Asfour, H. Z., Bakhrebah, M. A., Alomary, M. N., Abdulaal, W. H., Okbazghi, S. Z., Abdel-Naim, A. B., Eid, B. G., Aldawsari, H. M., Kurakula, M., & Mohamed, A. I. (2020). Chitosan coated microparticles enhance simvastatin colon targeting and pro-apoptotic activity. Marine Drugs,

18(4), 226. https://doi.org/10.3390/md18040226
9. Reddy S, Fox J, Purohit MP. Artificial intelligence-enabled healthcare delivery. Journal of the Royal Society of Medicine. 2019 Jan;112(1):22-8.
10. Hasnain, M. S., Kiran, V., Kurakula, M., Rao, G. K., Tabish, M., & Nayak, A. K. (2020). Use of alginates for drug delivery in dentistry. In Alginates in Drug Delivery (pp. 387–404). Elsevier. https://doi.org/10.1016/b978-0-12-817640-5.00015-7
11. Jordan AM. Artificial intelligence in drug design—the storm before the calm?. 2018: 1150-1152.
12. Hasnain, M. S., Nayak, A. K., Kurakula, M., & Hoda, M. N. (2020). Alginate nanoparticles in drug delivery. In Alginates in Drug Delivery (pp. 129–152). Elsevier. https://doi.org/10.1016/b978-0-12-817640-5.00006-6
13. He J, Baxter SL, Xu J, Xu J, Zhou X, Zhang K. The practical implementation of artificial intelligence technologies in medicine. Nature medicine. 2019 Jan;25(1):30-6.
14. Hosny, K. M., Aldawsari, H. M., Bahmdan, R. H., Sindi, A. M., Kurakula, M., Alrobaian, M. M., Aldryhim, A. Y., Alkhalidi, H. M., Bahmdan, H. H., Khallaf, R. A., & El Sisi, A. M. (2019). Preparation, Optimization, and Evaluation of Hyaluronic Acid-Based Hydrogel Loaded with Miconazole Self-Nanoemulsion for the Treatment of Oral Thrush. AAPS PharmSciTech, 20(7), 297. https://doi.org/10.1208/s12249-019-1496-7
15. Hall W, Pesenti J. Growing the artificial intelligence industry in the UK. Department for Digital, Culture, Media & Sport and Department for Business, Energy & Industrial Strategy. Part of the Industrial Strategy UK and the Commonwealth. 2017.
16. Kurakula, M., & A. Ahmed, T. (2015). Co-Delivery of Atorvastatin Nanocrystals in PLGA based in situ Gel for Anti-Hyperlipidemic Efficacy. Current Drug Delivery, 13(2), 211–220. https://doi.org/10.2174/1567201813666151109102718
17. Wang Y, Zhang W, Gong C, Liu B, Li Y, Wang L, Su Z, Wei G. Recent advances in the fabrication, functionalization, and bioapplications of peptide hydrogels. Soft Matter. 2020;16(44):10029-45.
18. Kurakula, M., Ahmed, O. A. A., Fahmy, U. A., & Ahmed, T. A. (2016). Solid lipid nanoparticles for transdermal delivery of avanafil: optimization, formulation, in-vitro and ex-vivo studies. Journal of Liposome Research, 26(4), 288–296. https://doi.org/10.3109/08982104.2015.1117490
19. Adir O, Poley M, Chen G, Froim S, Krinsky N, Shklover J, Shainsky-Roitman J, Lammers T, Schroeder A. Integrating artificial intelligence and nanotechnology for precision cancer medicine. Advanced Materials. 2020 Apr;32(13):1901989.
20. Kurakula, M., El-Helw, A. M., Sobahi, T. R., & Abdelaal, M. Y. (2015). Chitosan based atorvastatin nanocrystals: Effect of cationic charge on particle size, formulation stability, and in-vivo efficacy. International Journal of Nanomedicine, 10, 321–334. https://doi.org/10.2147/IJN.S77731
21. Colombo S. Applications of artificial intelligence in drug delivery and pharmaceutical development. InArtificial Intelligence in Healthcare 2020 Jan 1 (pp. 85-116). Academic Press.
22. Vaishya R, Javaid M, Khan IH, Haleem A. Artificial Intelligence (AI) applications for COVID-19 pandemic. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2020 Apr 14.
23. Kurakula, M., & Koteswara Rao, G. S. N. (2020). Moving polyvinyl pyrrolidone electrospun nanofibers and bioprinted scaffolds toward multidisciplinary biomedical applications. European Polymer Journal, 136, 109919. https://doi.org/10.1016/j.eurpolymj.2020.109919
24. Alexander JC, Joshi GP. Anesthesiology, automation, and artificial intelligence. InBaylor University Medical Center Proceedings 2018 Jan 2 (Vol. 31, No. 1, pp. 117-119). Taylor & Francis.
25. Sriram RD, Reddy SS. Artificial intelligence and digital tools: future of diabetes care. Clinics in Geriatric Medicine. 2020 Aug 1;36(3):513-25.
26. Kurakula, M., Naveen, N. R., & Yadav, K. S. (2020). Formulations for Polymer Coatings. Polymer Coatings, 415–443. https://doi.org/10.1002/9781119655145.ch19
27. Contreras I, Vehi J. Artificial intelligence for diabetes management and decision support: literature review. Journal of medical Internet research. 2018;20(5):e10775.
28. Kurakula, M., & Raghavendra Naveen, N. (2020). In situ gel loaded with chitosan-coated simvastatin nanoparticles: Promising delivery for effective anti-proliferative activity against tongue carcinoma. Marine Drugs, 18(4), 201. https://doi.org/10.3390/md18040201
29. Maddox TM, Rumsfeld JS, Payne PR. Questions for artificial intelligence in health care. Jama. 2019 Jan 1;321(1):31-2.
30. Ellahham S, Ellahham N, Simsekler MC. Application of artificial intelligence in the health care safety context: opportunities and challenges. American Journal of Medical Quality. 2020 Jul;35(4):341-8.
31. Kurakula, M., Rao, G. K., Kiran, V., Hasnain, M. S., & Nayak, A. K. (2020). Alginate-based hydrogel systems for drug releasing in wound healing. In Alginates in Drug Delivery (pp. 323–358). Elsevier. https://doi.org/10.1016/b978-0-12-817640-5.00013-3
32. Wu J, Paudel KS, Strasinger C, Hammell D, Stinchcomb AL, Hinds BJ. Programmable transdermal drug delivery of nicotine using carbon nanotube membranes. Proceedings of the National Academy of Sciences. 2010 Jun 29;107(26):11698-702.
33. Rao, G. S. N. K., Kurakula, M., & Yadav, K. S. (2020). Application of Electrospun Materials in Gene

Delivery. Electrospun Materials and Their Allied Applications, 265–306
34. Vuong QH, Ho MT, Vuong TT, La VP, Ho MT, Nghiem KC, Tran BX, Giang HH, Giang TV, Latkin C, Ho CS. Artificial intelligence vs. natural stupidity: Evaluating AI readiness for the vietnamese medical information system. Journal of clinical medicine. 2019 Feb;8(2):168.
35. Langen PA, Katz JS, Dempsey G, Pompano J, inventors; Digital Equipment Corp, assignee. Remote monitoring of high-risk patients using artificial intelligence. United States patent US 5,357,427. 1994 Oct 18.
36. Kurakula, M., & Rao, G. S. N. K. (2020). Pharmaceutical assessment of polyvinylpyrrolidone (PVP): As excipient from conventional to controlled delivery systems with a spotlight on COVID-19 inhibition. Journal of Drug Delivery Science and Technology, 60, 102046. https://doi.org/10.1016/j.jddst.2020.102046
37. Drucker DJ. Advances in oral peptide therapeutics. Nature reviews Drug discovery. 2020 Apr;19(4):277-89.
38. Kurakula, M., Sobahi, T. R., El-Helw, A., & Abdelaal, M. Y. (2014). Development and validation of a RP-HPLC method for assay of atorvastatin and its application in dissolution studies on thermosensitive hydrogel-based nanocrystals. Tropical Journal of Pharmaceutical Research, 13(10), 1681–1687. https://doi.org/10.4314/tjpr.v13i10.16
39. Yang YJ. The future of capsule endoscopy: The role of artificial intelligence and other technical advancements. Clinical Endoscopy. 2020 Jul;53(4):387.
40. Sacha GM, Varona P. Artificial intelligence in nanotechnology. Nanotechnology. 2013 Oct 11;24(45):452002.
41. Kurakula, M., Srinivas, C., Kasturi, N., & Diwan, P. V. (2012). Formulation and Evaluation of Prednisolone Proliposomal Gel for Effective Topical Pharmacotherapy. International Journal of Pharmaceutical Sciences and Drug Research, 4(1), 35. www.ijpsdr.com
42. De Momi E, Ferrigno G. Robotic and artificial intelligence for keyhole neurosurgery: the ROBOCAST project, a multi-modal autonomous path planner. Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine. 2010 May 1;224(5):715-27.
43. Li RC, Asch SM, Shah NH. Developing a delivery science for artificial intelligence in healthcare. NPJ Digital Medicine. 2020 Aug 21;3(1):1-3.
44. Mallesh, K., Pasula, N., & Kumar Ranjith, C. P. (2012). Piroxicam proliposomal gel: a novel approach for tropical delivery. Journal of Pharmacy Research, 5(3), 1755–1763.
45. Kurakula M, Mohd AB, Rao PA, Diwan PV. Estimation of piroxicam in proliposomal formulation using RPHPLC method. Int. J. Chem. Anal. Sci. 2011; 2: 1193. 2011;1196.
46. Kurakula M, Naveen NR. Prospection of recent chitosan biomedical trends: Evidence from patent analysis (2009–2020). International Journal of Biological Macromolecules. 2020 Oct 15.
47. Shah P, Kendall F, Khozin S, Goosen R, Hu J, Laramie J, Ringel M, Schork N. Artificial intelligence and machine learning in clinical development: a translational perspective. NPJ digital medicine. 2019 Jul 26;2(1):1-5.
48. Venkatesh, M., & Mallesh, K. (2013). Self-Nano Emulsifying Drug Delivery System (Snedds) for Oral Delivery of Atorvastatin- Formulation and Bioavailability Studies. Journal of Drug Delivery and Therapeutics, 3(3), 131–140. https://doi.org/10.22270/jddt.v3i3.517
49. Lavigne M, Mussa F, Creatore MI, Hoffman SJ, Buckeridge DL. A population health perspective on artificial intelligence. InHealthcare management forum 2019 Jul (Vol. 32, No. 4, pp. 173-177). Sage CA: Los Angeles, CA: SAGE Publications.
50. Kurakula M, Mohd AB, Samhuidrom AP, Diwan PV. Estimation of prednisolone in proliposomal formulation using RP HPLC method. Int. J. Res. Pharm. Biomed. Sci. 2011; 2: 663. 2011;1669.
51. Sutariya V, Groshev A, Sadana P, Bhatia D, Pathak Y. Artificial neural network in drug delivery and pharmaceutical research. The Open Bioinformatics Journal. 2013 Dec 13;7(1).
52. Kearney E, Wojcik A, Babu D. Artificial intelligence in genetic services delivery: Utopia or apocalypse?. Journal of Genetic Counseling. 2020 Feb;29(1):8-17.
53. Murali, V. P., Fujiwara, T., Gallop, C., Wang, Y., Wilson, J. A., Atwill, M. T., Kurakula, M., & Bumgardner, J. D. (2020). Modified electrospun chitosan membranes for controlled release of simvastatin. International Journal of Pharmaceutics, 584, 119438. https://doi.org/10.1016/j.ijpharm.2020.119438
54. Chang HM, inventor; Chang, Hou-Mei H., assignee. Relational artificial intelligence system. United States patent US 5,473,732. 1995 Dec 5.
55. Kantarjian H, Yu PP. Artificial intelligence, big data, and cancer. JAMA oncology. 2015 Aug 1;1(5):573-4.
56. Thrall JH, Li X, Li Q, Cruz C, Do S, Dreyer K, Brink J. Artificial intelligence and machine learning in radiology: opportunities, challenges, pitfalls, and criteria for success. Journal of the American College of Radiology. 2018 Mar 1;15(3):504-8.
57. Venkatasubramanian V. The promise of artificial intelligence in chemical engineering: Is it here, finally?. AIChE Journal. 2019 Feb;65(2):466-78.
58. Naguib, Ghada Hussein, Al-Hazmi, F. E., Kurakula, M., Abdulaziz Al-Dharrab, A., Mohamed Hosny, K.,

Mohammed Alkhalidi, H., Tharwat Hamed, M., Habiballah Hassan, A., Al-Mohammadi, A. M., Mohamed Alnowaiser, A., & Henry Pashley, D. (2018). Zein coated zinc oxide nanoparticles: Fabrication and antimicrobial evaluation as dental aid. International Journal of Pharmacology, 14(8), 1051–1059. https://doi.org/10.3923/ijp.2018.1051.1059

59. Choudhury A, Asan O. Role of artificial intelligence in patient safety outcomes: systematic literature review. JMIR medical informatics. 2020;8(7):e18599.
60. Batin M, Turchin A, Sergey M, Zhila A, Denkenberger D. Artificial intelligence in life extension: from deep learning to superintelligence. Informatica. 2017 Dec 27;41(4).
61. Duft G, Siekelova A, Kolencik J. Incorporating cognitive artificial intelligence systems and real-time data analytics in clinical care delivery. American Journal of Medical Research. 2019;6(1):61-6.
62. Naveen, N. R., Gopinath, C., & Kurakula, M. (2020). Okra-thioglycolic acid conjugate-synthesis, characterization, and evaluation as a mucoadhesive polymer. Processes, 8(3), 316. https://doi.org/10.3390/pr8030316
63. Hanson CW, Marshall BE. Artificial intelligence applications in the intensive care unit. Critical care medicine. 2001 Feb 1;29(2):427-35.
64. Wahl B, Cossy-Gantner A, Germann S, Schwalbe NR. Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings?. BMJ global health. 2018 Aug 1;3(4):e000798.
65. Raghavendra Naveen, N., Kurakula, M., & Gowthami, B. (2020). Process optimization by response surface methodology for preparation and evaluation of methotrexate loaded chitosan nanoparticles. Materials Today: Proceedings. https://doi.org/10.1016/j.matpr.2020.01.491
66. Ganapathy K, Abdul SS, Nursetyo AA. Artificial intelligence in neurosciences: A clinician's perspective. Neurology India. 2018 Jul 1;66(4):934.
67. Ho CW, Soon D, Caals K, Kapur J. Governance of automated image analysis and artificial intelligence analytics in healthcare. Clinical radiology. 2019 May 1;74(5):329-37.
68. Vanitasagar, S., Srinivas, C., Subhashini, N. J. P., & Mallesh, K. (2012). Solid dispersion-a comparative study on the dissolution rate of aceclofenac. International Journal of Pharmacy and Pharmaceutical Sciences, 4(SUPPL.3), 274–278.
69. Ishak WH, Siraj F. Artificial intelligence in medical application: An exploration. Health Informatics Europe Journal. 2002 Jun;16.
70. Hosny KM, Alhakamy NA, Almodhwahi MA, Kurakula M, Almehmady AM, Elgebaly SS. Self-Nanoemulsifying System Loaded with Sildenafil Citrate and Incorporated within Oral Lyophilized Flash Tablets: Preparation, Optimization, and In Vivo Evaluation. Pharmaceutics. 2020 Nov;12(11):1124.
71. Dlamini Z, Francies FZ, Hull R, Marima R. Artificial intelligence (AI) and big data in cancer and precision oncology. Computational and Structural Biotechnology Journal. 2020 Aug 28.
72. Tsay D, Patterson C. From machine learning to artificial intelligence applications in cardiac care: Real-world examples in improving imaging and patient access. Circulation. 2018 Nov 27;138(22):2569-75.
73. Kurakula M, Rao GK. Probiotics in Lung Cancer: An Emerging Field of Multifarious Potential and Opportunities. InProbiotic Research in Therapeutics (pp. 125-158). Springer, Singapore.
74. Jamshidi M, Lalbakhsh A, Talla J, Peroutka Z, Hadjilooei F, Lalbakhsh P, Jamshidi M, La Spada L, Mirmozafari M, Dehghani M, Sabet A. Artificial intelligence and COVID-19: deep learning approaches for diagnosis and treatment. IEEE Access. 2020 Jun 12;8:109581-95.
75. Jha S, Topol EJ. Adapting to artificial intelligence: radiologists and pathologists as information specialists. Jama. 2016 Dec 13;316(22):2353-4.