Faculty of Pharmacy

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

ज्ञानं विज्ञानं च भक्तिसहितं

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APRIL-JUNE 2022

SCINTILLA

QUARTERLY E-NEWS LETTER

DEPARTMENT OF PHARMACEUTICS

http://www.msruas.ac.in/academics/pharmacy

SCINTILLA

QUARTERLY E-NEWS LETTER

Scintilla is the quarterly E-news letter of Department of Pharmaceutics, FPH, RUAS which seeks to provide to world outside, News, Views, and Creative expressions from the members of the department. Scintilla comes directly from Latin, where it carries the meaning of "spark" - that is, a bright flash such as you might see from a burning ember or spark of specified quality or feeling, which is almost synonymous to department's intent, hence the name Scintilla

EDITORIAL BOARD

SCINTILLA

EDITORIAL

Hello Pharma Folks and Readers!!!

I hope this edition finds you all living the life of your dreams.

A new edition of Scintilla is now available, with an intriguing theme featuring current trends in pharmaceutical sciences with an emphasis on formulation development. There are 8 articles contained in this issue covering myriad aspects of pharmaceutical technology, including the latest technological developments as well its implications in clinical practice.

The saying goes that 30% is better than zero percent, so give yourself credit for trying. There is a dire need to get updated and upgraded now, more than ever, in the ever expanding, competitive professional sector. To deliver this quintessential wisdom to all stakeholders, the teaching profession needs to prepare itself for this mammoth challenge in understanding and delivering value-based service backed by the technological renaissance. Sensitizing pharma students and pharmacy professionals on the recent technological advancements leading to a high level of sophistication is of paramount importance. Never to forget the famous adage 'A good leader is a good reader'. The onus of creating future leaders capable of driving the profession to newer heights strongly relies on the academicians to inspire the students to spend sufficient time with the printed materials and the ability, passion and self-interest in oneself keeping abreast of current developments and technological marvels rocking the profession. In this regard, an earnest attempt has been made by the Scintilla team in pooling few striking articles to appraise the readers about the magnanimous change the pharmaceutical professional is undergoing.

My profound thanks go to all the 7 manuscript writers and contributors who expressed an interest in synchronizing their passionate efforts in structuring the article for publication in this present issue of Scintilla. As always, the editorial team makes great efforts to ensure that Scintilla is released in a timely manner. Complements to the scintillating team. Do remember a tiny spark would spread like wildfire. In turn, your genuine efforts and contributions will never go to waste and you will sow the seeds of change, at least for those who aspire to be at the top of their profession.

Final words - Don't waste your energy worrying. Invest it in believing, creating, trusting, and healing. It is my expectation that the forthcoming edition of Scintilla will receive the same positive response in terms of contributions and valuable recommendations for enhancing the visibility and acceptability of Scintilla. Feel free to write to us if you have any queries or concerns about the newsletter.

Happy heart, happy life
Stay safe, Stay sound

Dr. S. Bharath
Chief Editor

SCINTILLA

CONGRATULATIONS

Succeeding Dr. S. Bharath, Pharmaceutics team is currently working under the eminent leadership of Dr. B.V. Basavaraj from 1st of March 2022. **Dr. B.V. Basavaraj**, M.Pharm., Ph.D., ACCR has more than two decades of academic experience and keenly interested in research concerning Novel Drug Delivery Systems, Nutraceuticals and Natural Products. He is recipient of VGST **KFIST Level 1 grant of 20 lakhs from Govt. of Karnataka in the year 2019.** He is one of the winners of **Exemplary Faculty Awards – FPH** in the category of Teaching in 2020. He has guided many P.G scholars and presently guiding PhD scholars. He has presented research papers in more than 40 national and international conferences, 69 national, 16 international journal publications and authored 2 books. Throughout the years of the journey, he has proved as an enthusiastic, diligent, and conscientious professional. He is also adding efforts to develop the department to ensure it achieves the highest possible standards of excellence in all its activities under his guidance.

Wishing Dr. B.V. Basavaraj, Head of the Department best wishes for future endeavours .

Dr. B. V. Basavaraj
Professor and Head
Dept. of Pharmaceutics, FPH, RUAS

Mr. Tanmoy Gosh
Assistant Professor, Dept. of Pharmaceutics, FPH, RUAS

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DEPARTMENTAL PRIDE

Faculty Development Programme Details

1. Dr. Sindhu Abraham has attended one week Faculty Development Programme on "Advances in Characterization Techniques and Applications: A Material Science Perspective" jointly organized by Department of Biotechnology & Department of Chemistry, Ramaiah Institute of Technology.
2. Dr. Aswathi R Hegde attended a One Week Faculty Development Program (Virtual Mode) on Recent Trends in Pharmaceutical Sciences organized by Staff Welfare Committee, Yenepoya Pharmacy College and Research Centre, and Association of Pharmaceutical Teachers of India (APTI) from 31st January to 06th February 2022
3. Mr. Tanmoy Ghosh attended AICTE Training And Learning (ATAL) Academy online FDP on 'Nanostructured Materials and Their Applications' from 07th February to 11th February 2022 organized by National Institute of Technology Manipur.

Workshop Details

1. Dr. Sindhu Abraham participated in Cloud-based hands-on workshop on Molecular Docking, Pharmacophore Modelling and Machine Learning on march 15 – 16, 2022 organised by Bioinformatics Division, ICMR – National Institute of Cancer Prevention and Research, Noida and Schrodinger Inc.
2. Dr. Sharon C. Furtado participated in Cloud-based hands-on workshop on Molecular Docking, Pharmacophore Modelling and Machine Learning on march 15 – 16, 2022 organised by Bioinformatics Division, ICMR – National Institute of Cancer Prevention and Research, Noida and Schrodinger Inc.
3. Mrs. Shwetha K participated in Cloud-based hands-on workshop on Molecular Docking, Pharmacophore Modelling and Machine Learning on march 15 – 16, 2022 organised by Bioinformatics Division, ICMR – National Institute of Cancer Prevention and Research, Noida and Schrodinger Inc.
4. Mr. Tanmoy Ghosh attended online six hours training workshop on 2D Materials for Biomedical Applications coordinated by LEPABE- Faculty of Engineering of the University of Porto, Portugal & The University of Texas at Austin, USA on 27th and 28th of January 2022.

Oral Presentation

- Dr. Aswathi R Hegde delivered an oral presentation titled "Antioxidant Potential of Naringin Ethosomes: Formulation Development and In Vitro Performance Evaluations" at the national conference on Multi-disciplinary Research in Pharmaceutical Sciences organized by SRM College of Pharmacy, SRMIST, Kattankulathur, Tamil Nadu in association with Publishing Partner Informatics on Feb 9 -11, 2022. (Won First Prize)

Conference Publications

- Hajira Banu B Haroon, Dhrubojyoti Mukherjee, Anbu Jayaraman published paper in conference of "Alzheimer's and Dementia" in association with Alzheimer's Association Journal, on Brain-targeted intranasal formulation of Centella asiatica: A potential strategy for treating Alzheimer's disease.

Online Courses Completed

- Sharon, CF. completed a course on "An Introduction to Ethical Publishing Behaviour" organized by Web of Science Academy on 3rd March 2022

UPCOMING EVENTS

Faculty of Pharmacy
RAMAIAH UNIVERSITY OF APPLIED SCIENCES
FPH
INSTITUTION'S INNOVATION COUNCIL
(Ministry of HRD Initiative)

DEPARTMENT OF PHARMACEUTICS
FACULTY OF PHARMACY

Cordially invite you to attend the Guest

"BUSINESS DEVELOPMENTAL OPPORTUNITIES AFTER MBA IN PHARMA / HEALTH SECTOR"

Ms. SANTWANA ROY
Bioneeds India Private limited
Associate Manager
(Business Development)

Ms. Santwana Roy , B. Pharm ,Pharma MBA , alumni of our college presently associated with Bioneeds India Private limited as associate manager (Business development) would be presenting a guest lecture on the topic " Business development opportunities after MBA in Pharma / Health sector "

Date : 26 th April 2022
Time : 11.00 AM – 12.30 PM
Event Platform: MS Teams
Event Link: https://tinyurl.com/sjbzkhjw

Faculty of Pharmacy
RAMAIAH UNIVERSITY OF APPLIED SCIENCES

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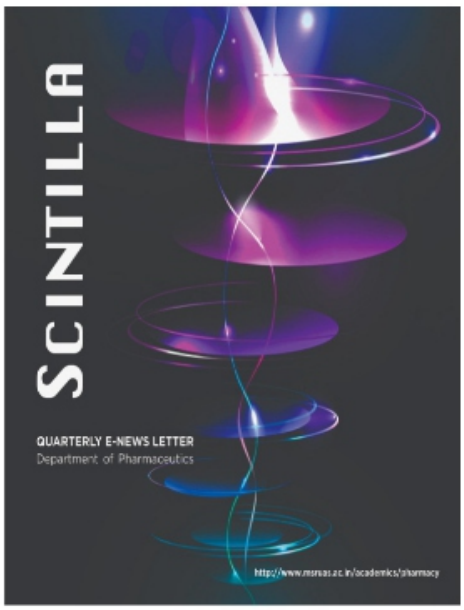

Theme for Next Vol. 2 , 3 rd Issue (Jul-Sep 22)

CURRENT TRENDS IN PHARMACEUTICAL FORMULATION TECHNOLOGY

Inviting :
Best Article (3000 words)

There are surprising prizes to be won !!!
(submit before June 30th, 2022) HURRY !!!!
Submit your entries , queries and/or feedback to
1. Executive Editor, bvbasu@gmail.com
2. Layout Editor , krdarsh18@gmail.com

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RAMAIAH UNIVERSITY OF APPLIED SCIENCES
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SCINTILLA

Chatbots In Healthcare

Dr. Sindhu Abraham
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Dept. of Pharmaceutics,
FPH, RUAS

A chatbot or chatterbot is a software application used to conduct an on-line chat conversation via text or text-to-speech, instead of providing direct contact with a live human agent. Developments in speech recognition and natural language processing have allowed businesses to adopt conversational chatbots in multimodal conversational experiences, including voice, keypad, gesture and image. Today there is a chatbot solution for almost every industry, including marketing, real estate, finance, the government, B2B interactions, and healthcare. According to a survey conducted by a sales sales team of a reputed firm, 86% of customers found it convenient to get answers from a chatbot than fill a website form.

ELIZA was the first chatbot used in healthcare in 1966 imitating a psychotherapist using pattern matching and response selection. However, ELIZA had limited knowledge and communication abilities. Today, chatbots offer diagnosis of multiple symptoms, mental healthcare consultation, nutrition facts and tracking, and more. In 2020, A free WhatsApp-based chatbot service was created in partnership with WHO to assist people in finding verified leads for Covid Resources across India.

Chatbots in healthcare- Do we really need them?

The most valuable features of using chatbots in healthcare include monitoring and tracking of user's behavior, anxiety, weight changes, to encourage developing better habits; maintenance of anonymity regarding sensitive and mental health issues; personalization according to user requirements. Some of the major Chatbot use cases in healthcare include:

1. Provide medical information : Chatbot algorithms are trained on massive healthcare data including disease symptoms, diagnostics, markers, and available treatments. Public datasets are used to continuously train chatbots, such as COVIDx for COVID-19 diagnosis, and Wisconsin Breast Cancer Diagnosis (WBCD).

2. Schedule medical appointments : Chatbots are integrated into the medical facility system to extract information about suitable physicians, available slots, and

clinics and pharmacy working days. Chatbots ask patients about their current health issue, find matching physician and dentists, provide available time slots, and schedule, reschedule, and delete appointments for patients. Chatbots are also integrated into user's device calendars to send reminders and updates about medical appointments.

3. Collect patient data : Chatbots can extract patient information using simple questions about name, address, symptoms, current doctor, and insurance details. Chatbots then store this information in the medical facility system to facilitate patient admission, symptom tracking, doctor-patient communication, and medical record keeping.

4. Handle insurance inquiries : Chatbots can provide insurance services and healthcare resources to patients and plan members. Moreover, integrating RPA or other automation solutions with chatbots allows automating insurance claim processing and healthcare billing.

5. Provide mental health assistance : Chatbots that provide mental health assistance are trained to to deliver cognitive behavioral therapy (CBT) for patients with depression, post- traumatic stress disorder (PTSD), and anxiety, or train autistic patients to improve their social skills and job interview skills. Users can interact with chatbots via text, microphones and cameras.

6. Request prescription refills : Chatbots collect patient information, name, birthday, contact information, current doctor, last visit to the clinic, and prescription information. The chatbot submits a request to the patient's doctor for a final decision and contacts the patient when a refill is available. This allows doctors to process prescription refills in batch or automate them in cases where doctor intervention is not necessary.

Some innovative medical chatbots:

1. Your.MD : Designed to help patients find the healthcare information they need to stay healthy, MD offers various features and functions. However, what stands apart from all the other features is its symptom checker. Available on the web and as a stand-alone app, it acts as a personal health assistant allowing users to check symptoms, ask a question, or take a health quiz.

2.Sensely :Sensely is not just a chatbot; instead, it offers the platform and pre-built capabilities required to build different types of medical chatbots.

3. NINA (AskNestlé) : Built using Senseforth's conversational AI platform A.ware, NINA is one of India's first AI-powered digital nutritionists. NINA helps young parents create a daily meal plan for their children. Parents can customize the meal plan to address specific nutritional requirements, find innovative recipes to make the fussy eaters happy, set reminders, and even keep a food journal. Parents can interact with Nina on Google Assistant or the website.

4. Ada : This medical chatbot brings together doctors, scientists, and industry pioneers to improve the quality of personal healthcare. Instead of banking only on a repository of information, Ada compares user queries with thousands of similar cases. It then analyzes its findings against the information available in the medical library to craft a much more relevant and contextual response.

5. MAGe : It analyzes comments by visitors/ patients on different platforms like Facebook, Twitter, MouthShut, etc. MAGe also provides detailed analytics and segregates comments on the basis of positive and negative sentiment

filters. It enables different stakeholders to view or download reports for different regions and hospitals.

6. SafedrugBot : SafedrugBot offers guidance to medical practitioners about the usage of drugs by breastfeeding mothers. From understanding the side effects of various drugs to finding safer alternatives, it helps doctors tap into a vast knowledge hub to augment their capabilities. This chatbot is available on Telegram.

7. Woebot : Woebot, provides CBT, mindfulness, and Dialectical Behavior Therapy (CBT).

What is the future of chatbots?

While the industry is already flooded with various healthcare chatbots, people are sceptical regarding its use. This is partly because Conversational AI is still evolving and has a long way to go. As natural language understanding and artificial intelligence technologies evolve, we may witness the emergence of more sophisticated healthcare chatbot solutions.

In the coming few years, healthcare chatbots are expected to serve as 24/7 companions, monitor health status in real-time, and automatically call for assistance in case of an emergency, help manage chronic conditions, mental health issues, and behavioral and psychological disorders, Proactively identify symptoms, crosscheck them against medical history, suggest the next steps, and improve the treatment success rate in cases where early diagnosis can play a critical role. Self-care will be easier as they act as a virtual assistant providing timely medical advice.

FACTS TIME !!

- Pharmacy is as old as medicine itself . The earliest example ever found of pharmaceutical science was in ancient Mesopotamia ,around 2100 BCE. The Papyrus Ebers, a collection of 700 prescriptions and remedies found in Egypt, dates back to around 1500 BCE.
- Pharmacists are the most accessible healthcare professional : >90% of people live within 5 miles of a pharmacist (which may vary from country to country)
- During World War ll , Britain feared that the Germans would consider their country and consequently ,get a hold of their penicillin .As a preventive measure ,researchers smeared pocket linings with penicillin mould to transport to the US !!
- Coca-Cola was invented by a pharmacist, John. S. Pemberton in 1886 for treating aliments .The drink was based on cocaine from coca leaf and caffeinated extracts from a kola nut . Hence the name COCA COLA. The cocaine was removed from the recipes in 1908 and he sold his rights to drink shortly before his death !!
- Humira is the best-selling prescription drug in the world . It is used to treat rheumatoid arthritis and other related diseases made by Abbott Laboratories !!

RECENT ADVANCES IN INJECTABLE FORMULATIONS

Dr. Aswathi R Hegde
Assistant Professor,
Dept of Pharmaceutics,
FPH, RUAS

Overview

World Health Organization (WHO) defines parenterals as sterile preparations that are meant to be administered by injection, infusion or implantation. The term 'parenteral' is derived from the Greek word 'para' meaning outside and 'enteron' meaning intestine. The injectable market is expected to be valued at USD 510.32 million in 2022. This significant growth is driven by rising prevalence of diseases, significant advancement in formulation technology and widespread adoption of self-administered medication and services. Today, traditional needle and syringe-based injections have largely been replaced by needle free injectors. This could be attributed to improved patient experience and acceptability, device usability and the ease of administering injections at the comfort of home.

Conventional parenteral dosage forms

Parenteral administration of drug is one of the most effective routes of administration of drugs with narrow therapeutic index and for patients who are unconscious. Conventional parenteral preparations include solutions, suspensions and emulsions. However, the conventional parenteral preparations are associated with several drawbacks including low drug solubility and drug instability. Over the years, significant advancements in parenteral drug delivery have led to the development of drug-loaded formulations that allow precise targeting of the drug at the site of action along with a sustained or controlled release of the drug.

- Benefits of parenteral controlled drug delivery systems (CDDS)
- Protects the drug from metabolism and premature clearance
- Retains drug at target site for desired period of time
- Delivers drug to appropriate target; keeps drug out of non-target organs
- Compatible, biodegradable and non-antigenic
- Prevents local trauma to tissue each time an injection is made
- Reduces total number of injections throughout the drug delivery – reduced healthcare costs.

The drug delivery technologies for parenteral controlled drug delivery systems can be broadly classified into the following categories:

1. Formulation-based technologies
   - Formulation of poorly water-soluble drugs
   - Nano-carrier mediated targeted drug delivery
   - High concentration protein formulations
   - Sustained release preparations
2. Device-based technologies

1. Formulation-based technologies

Drug delivery technologies can be exploited to reformulate existing molecules or to enable the formulation of drugs with inherent pharmaceutical drawbacks.

Formulation of poorly water-soluble drugs – About 40% of the drugs have been classified as poorly soluble drugs. Several approaches have been explored to overcome this poor solubility of the drugs (Figure 1). Among these, cyclodextrin complexation and use of nanocarrier-based formulations are of particular importance.

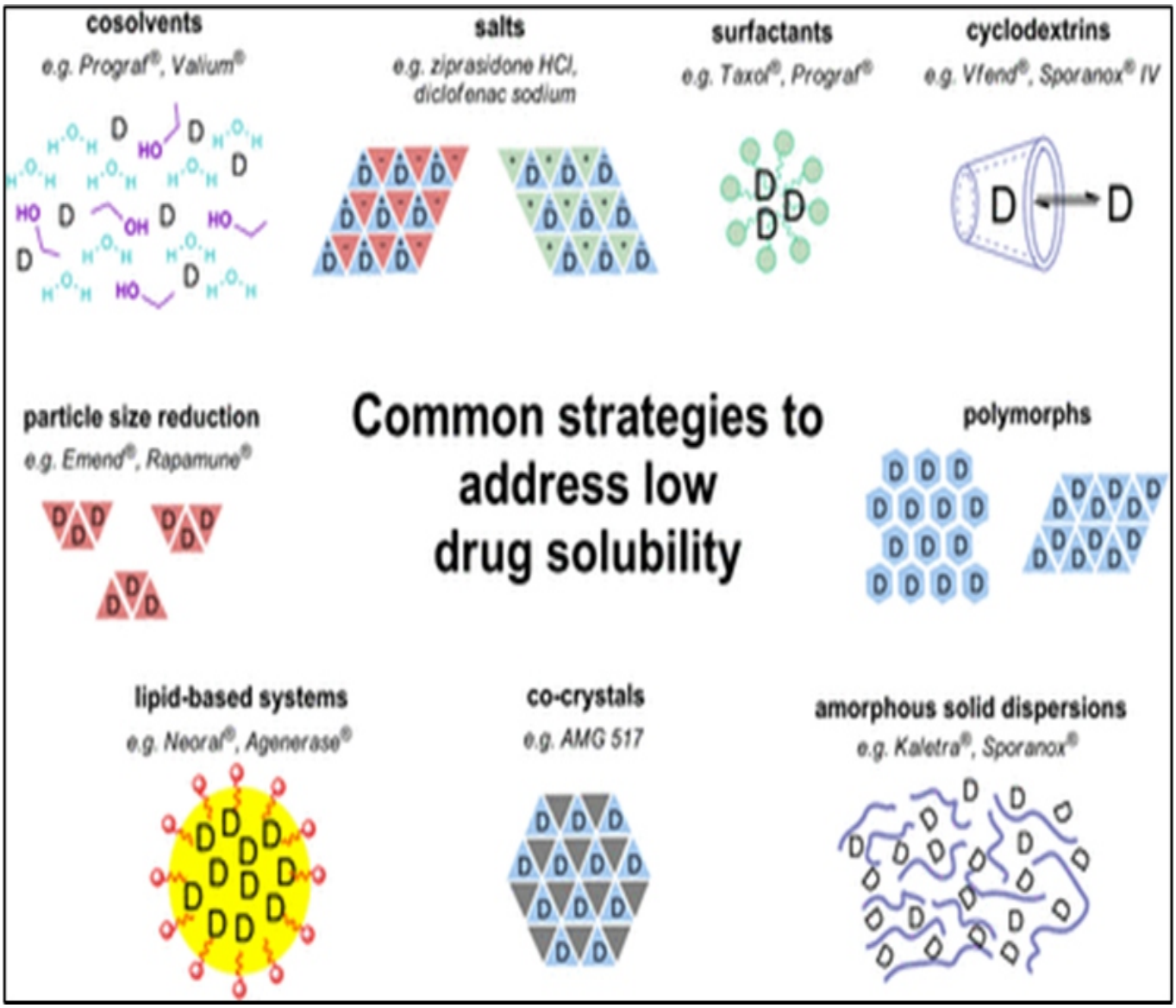

Figure 1. Common strategies to overcome poor solubility of drugs

Cyclodextrin complexes

Cyclodextrins (CDs) are cyclic oligosaccharides of glucose subunits containing a hydrophobic central cavity and hydrophilic outer surface. CDs increase aqueous solubility of poorly water-soluble drugs by formation of inclusion complexes between the host (CD) and guest (drug) molecules. Interaction between drug and cyclodextrin leads to the formation of host-guest complex. The hydrophobic cavity of the host entraps the poorly soluble drugs; when added to aqueous solutions, the polar water molecules get into the cavity of CDs which are immediately replaced by the non-polar drug. For example, itraconazole has poor solubility (~1 ng/mL) with variable absorption. SPORANOX® is marketed as itraconazole-HPβCD complex i.v. infusion, indicated for the treatment of fungal infections like blastomycosis, histoplasmosis, aspergillosis etc.

The drug-CD complex enhances solubility of itraconazole by forming a non-covalent complex and hence increases bioavailability.

Nano-carrier based targeted drug delivery systems

Due to their extremely small size (in the nanometer range) and ease of surface engineering, nanocarriers have shown promising potential in the diagnosis and therapy. Nanocarriers are equipped with a high surface-area-to-volume ratio; a high ligand density can be achieved on the surface specifically for targeting multifunctional moleculees.. Modifying the surface of drug-loaded nanocarriers with receptor specific ligands would circumvent non-specificity by enhancing intracellular accumulation ultimately reducing the toxic effects.

Product	Drug	Route of administration	Type of CD	Company (Country)
MitoExtra, Mitozytrex	Mitomycin	i.v. infusion	HP-β-CD	Novartis (Europe)
Abilify	Aripiprazole	i.m. solution	Sulfobutyl-β-CD	Bristol-Myers Squibb (USA)
Caverject Dual	Alprostadil	i.v. solution	α-CD	Pfizer (Europe)
CardioTec	Tc-99 Teboroxime	i.v. solution	γ-CD	Squibb Diagnostics (USA)

Table 1. List of injectable products containing CD complexes

Several nanocarriers like polymeric conjugates, lipid based-carriers such as liposomes and nanostructured lipid carriers, polymeric nanoparticles, dendrimers, carbon nanotubes and gold nanoparticles have been extensively explored as a means of delivering the drug cargo at the desired site of action. A few of these have been described below.

Liposomes – Liposomes are spherical, minute artificial vesicular systems comprising of single or multiple phospholipid layers with a distinct aqueous core. The amphiphilic nature of phospholipids makes it a versatile carrier that can encapsulate hydrophobic and/or hydrophilic drugs. Due to their nano-size and the potential for surface modification, longer circulation time and reduced drug clearance can be envisaged for these lipid-based carriers. The conventional delivery of doxorubicin – an anticancer drug used for the treatment of advanced ovarian cancer, multiple myeloma and HIV-associated Kaposi's sarcoma, is marred with several adverse effects such as reversible nephrotoxicity and cardiotoxicity leading to congestive heart failure and death. Doxil® - pegylated liposomal formulation of doxorubicin hydrochloride has a longer circulation time and minimizes toxicity by accumulating at the target site.

Nanoparticles – nanoparticles (NPs) are colloidal particles, comprising of the therapeutic agent entrapped within a polymeric matrix. NPs are available as polymeric, lipidic and metallic nanoparticles and are biodegradable, nontoxic with high stability. Synthetic polymers like poly(lactic-co-glycolic acid) (PLGA), polylactic acid (PLA), polycaprolactone (PCL) and natural polymers like albumin, gelatin, chitosan, cellulose and starch derivatives have been widely explored for the formulation of drug-loaded Nps.

Paclitaxel (PTX) has low water solubility and is formulated using Cremophor EL and ethanol (Taxol®). However, this causes severe hypersensitivity reactions requiring prolonged infusion times and pretreatment. In addition, PTX is a P-glycoprotein substrate i.e., PTX is pumped out of the cells requiring co-administration of P-gp inhibitors which further leads to toxic side effects. To overcome this, PTX was formulated as albumin-bound NPs (ABRAXANE®), available as a single-dose injection of PTX 100 mg (powder for suspension). Abraxane is a solvent-free, nanoparticle albumin-bound (nab) formulation of PTX. Albumin has high binding affinity to hydrophobic molecules and accumulates in tumors. nab-nanoparticles undergo dissolution to liberate PTX-albumin complexes. Increased drug distribution and deeper penetration into tumor (EPR effect) results in enhanced anti-tumor efficacy (Figure 2).

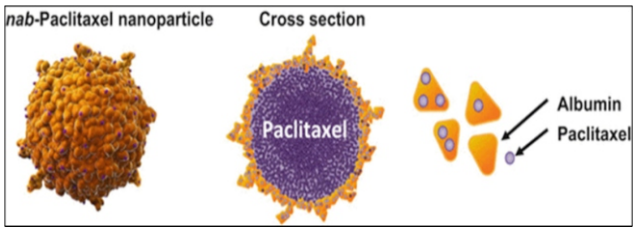

Figure 2. Nanoparticle albumin-bound paclitaxel (ABRAXANE®)

High concentration protein formulations

Monoclonal antibodies are engineered antibodies that can restore, enhance or mimic the immune system's attack on cancer cells. They have longer half-lives (several days) and are stable to proteolytic enzymes; hence can be delivered via subcutaneous route, resulting in lower frequency of administration and self-administration .

Trastuzumab, pertuzumab are mABs used to target HER-2 overexpression. Trastuzumab (Herceptin®) is administered as intravenous infusion for 90 min; requires follow-up doses; frequent visits to clinic. Recently, researchers have developed a novel hydrogel as a carrier for trastuzumab in the body. The hydrogel (96% water and a polymer) is nontoxic, biodegradable and can be injected without causing an inflammatory response. This resulted on increased efficiency of delivery and reduced frequency of administration – from once a week to once every four weeks.

Sustained release formulations

Implants are cylindrical monolithic devices implanted surgically or injected via subcutaneous or intramuscular route. The drug in implant may be dissolved, dispersed or embedded in a matrix of polymer, with the release being controlled by mechanisms of dissolution, diffusion, bioerosion, biodegradation, osmosis etc. Commonly used polymers include biodegradable polymers like poly(lactic-co-glycolic acid) (PLGA), polylactic acid (PLA), Polycaprolactone (PCL). Eligard® - leuprolide acetate for injectable suspension is delivered subcutaneously using a specialized delivery system called ATRIGEL® for controlled release of drug (Figure 3).

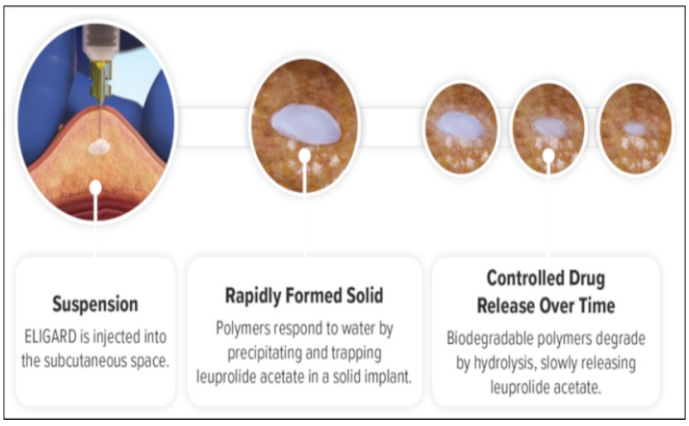

Figure 3. The ATRIGEL® drug delivery system for subcutaneous administration of leuprolide acetate

2. Device based technologies

Device based technologies have led to significant potential for the parenteral delivery of drugs. Injection devices are a suitable means of delivering highly concentrated protein solutions whose administration poses a significant challenge. They are also advantageous for administration of the drugs via the intramuscular route in emergency conditions. Vaccine delivery can be improved through precise device-based intradermal injections. All these advances would enhance the patient compliance and improve the overall outcome of therapy.

Prefilled devices – prefilled devices are a powerful tool to improve parenteral administration of drugs.

- Prefilled syringes – these include a cartridge where the drug is present circumventing the need to load the syringe using a vial/ampoule. Syringes are made of borosilicate and contains a retractable needle, thus generating less space and avoiding risk of injury
- Dual chamber syringes – these are combination products containing the freeze-dried drug and diluent in two separate chambers of the device. Such an arrangement allows reconstitution and administration on demand. Dual chamber syringes are available in 2 different sizes – 5 mg and 12 mg with 2 mL volume.
- Autoinjectors – intended for self-administration – manual or electronic control of activation and dosage for delivery of drugs through the subcutaneous or intramuscular route. Autoinjectors are used when the

· the medication is required immediately but infrequently. NovoLog® FlexPen (Figure 4) is an injectable insulin preparation. The pen is prefilled with 3 mL of 300 units of NovoLog insulin (purely rapid-acting insulin or 70% intermediate-acting insulin + 30% rapid-acting insulin). Dosage can be adjusted in 1-unit increments (up to 60 units of insulin) making it easy and safe for patients to use.

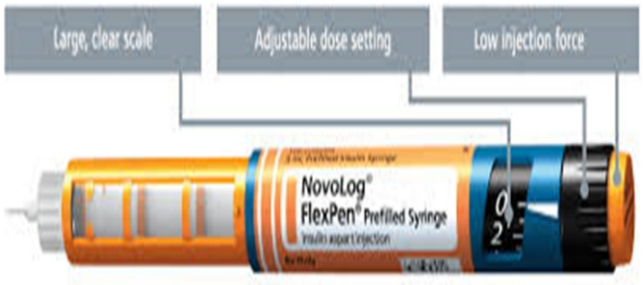

Figure 4. NovoLog® (insulin aspart) FlexPen prefilled syringe

Needle free injections – these are meant to deliver the drugs through the skin using an external source such as shock waves, pressured gas or electrophoresis thereby preventing the use of hypodermic needle. An ultra-fine stream of fluid penetrates through the skin layers which delivers the drug very quickly into the systemic circulation. The total time required to deliver would be less than one-third of a second!

Implants – drug eluting stents have gained significant importance over the years. These implantation devices release drugs at the implantation site and prevent inflammation. Alzet®, an implantable osmotic pump, developed by Alza, USA are infusion devices which are intended to continuously deliver a solution over a given duration at a constant rate. It is composed of 3 layers: the drug reservoir (innermost; containing the solution/ semisolid formulation), surrounded by osmotic sleeve (cylinder containing high concentration of osmotic agent), covered by a semi-permeable membrane. The additional component (flow moderator) is inserted into pump (Figure 5).

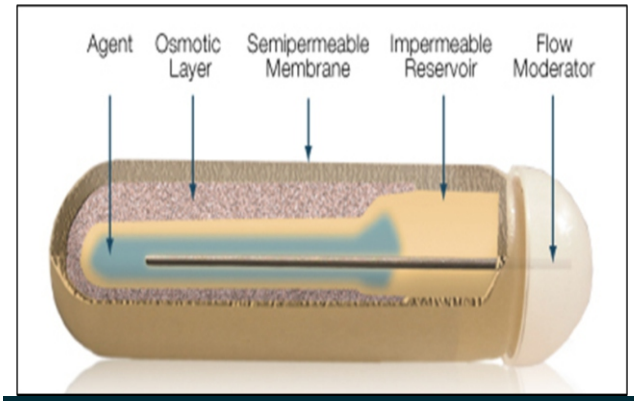

Figure 5. Schematic representation of ALZET® osmotic pump

Product	Pressure source	Route of administration	Company
Biojector 2000	Compressed gas	s.c, i.m	Bioject
Vitajet3	Spring	s.c.	Bioject
Penjet	Compressed gas	s.c, i.m, i.d	Penjet Corporation
Powderject	Spring	i.d	Powderject Pharmaceuticals
Depixol (depot injection)	Compressed gas	i.m	LB Limited

Table 2. List of some marketed needle-free injectors

When the osmotic pump is subcutaneously implanted at the desired site of the body, the water content in the tissue fluid will penetrate through the semipermeable membrane at a controlled rate and dissolve the osmotically active agent. Osmotic pressure (compression of flexible reservoir) is produced in the narrow spacing between the flexible reservoir wall and the rigid semipermeable compartment. The reservoir is gradually reduced in volume and the solution of the active agent is forced to exit through the flow moderator and deliver the drug at a controlled rate. These miniature implantable devices are available with variety of delivery rates (0.25 – 10 ml/h) with duration of delivery ranging from 1 – 4 weeks.

Challenges for parenteral drug development

Manufacturing – Compared to conventional dosage forms, drug delivery technologies include several processing steps. This leads to several problems. Since most of the research takes place at the academic level, further scale up to pilot or production scale can be challenging. Maintaining the protein activity during encapsulation into nanocarriers can be quite difficult. Also, the method of sterilization needs careful evaluation with protein-based formulations.

Product performance – consistency of performance is essential in case of device-based systems.

Regulatory aspects – Novel parenteral dosage forms are unique and hence testing guidelines are not fully developed for their evaluation. Also, it is of paramount importance to assess the safety profile of the developed novel parenteral preparations. Hence, it is essential that the regulatory agencies work together with industry and research professionals for the testing of these novel parenteral dosage forms.

Opportunities and future directions

Advanced technologies for devices are being explored, including combination coatings, where multiple polymers are combined to provide a tailored release profile for one or more drugs.

- Improve patient compliance by focusing on the design of appropriate devices
- Formulation characteristics – dose size, viscosity and storage
- Large volume delivery & high viscosity formulations – reduced administration frequency, reduced discomfort & increased convenience.
- Needle-free injections, electronically enabled delivery devices (EEDDs)
- Smart technology – computing dose, automate delivery, reminder regarding therapy, wearable devices

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Biologics in Pharmaceutical Industry: Emerging Trends

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Biologicals are one of the most recent classes of pharmaceutical products. These drugs are derived from living organisms or biological processes and can be used to treat a wide array of diseases. There is a significant difference between biologics and small molecule pharmaceuticals, as biologics are more complex in their production, administration, and regulation.

Figure 1: Complex structure (biologic) and small molecule (aspirin)

The recent class of biologicals for the treatment of diseases includes monoclonal antibodies, recombinant proteins, fusion proteins, therapeutic vaccines, and blood products. These new classes of drugs have been developed to treat a wide range of diseases like cancer, arthritis, and multiple sclerosis. Some examples include Humira (anti-inflammatory), Enbrel (arthritis) and Remicade (irritable bowel syndrome).

Since the 1980s, biologics have been employed to treat a variety of disorders. In 1982, the first biological medication was approved [Genentech and Eli Lilly collaborated to develop a recombinant version of human insulin (Humulin, 1982), which earned FDA clearance as the first recombinant DNA product]. Since Humulin was approved, the FDA has approved 91 recombinant-protein-based new molecular entities (NMEs) as medicines. The worldwide biosimilars industry is estimated to reach a value of US$240 billion by 2030, with India contributing about $35 billion. The biopharma industry appears to be interested in investing in the biosimilar market to enhance healthcare and reduce healthcare costs for illnesses including COVID-19, diabetes, cancer, and autoimmune disorders. The predicted rise of the oncology biosimilar industry may reflect the rising necessity and relevance of monoclonal antibodies such as tocilizumab, sarilumab, and itolizumab for testing on COVID-19 patients. The expiration of patents on several biologics has also aided expansion. According to projections, almost 17 medications will lose their patent protection between 2020 and 2026. Because the patents on popular biologics like Levemir, Humira, and Avastin recently expired, there has been a lot of interest in developing biosimilars for them.Monoclonal antibodies, enzyme modulators, and receptor modulators are the three main kinds of biologics.

Some monoclonal antibodies that have been approved by the FDA are Muromonab, Abciximab, Rituximab, Basiliximab, and Palivizumab. Some enzyme modulators are Dornase alfa, Pegaspargase, Imiglucerase, Alteplase, and Reteplase; some receptor modulators are rhInsulin, Interferon-alpha-2a, Epoetin alfa, Filgrastim, and Sagramostim.

SL. NO	TRADE NAME/PROPER NAME	DISEASE
1	PREHEVBRIO/Hepatitis B Vaccine (Recombinant)	Hepatitis B
2	RETHYMIC/Allogeneic processed thymus tissue–agdc	Congenital athymia.
3	COMIRNATY/COVID-19 Vaccine, mRNA	COVID-19
4	TicoVac/Tick-Borne Encephalitis Vaccine	Tick-borne encephalitis (TBE)
5	RYPLAZIM/plasminogen, human-tvmh	Plasminogen deficiency type 1 (Hypoplasminogenemi).

Table 1: List of few biologicals approved in 2021 (US FDA)

Biologics are classified as (a) soluble cytokines and growth factors that act on lymphoid and non-lymphoid cells; (c) non-soluble cell signalling and adhesion modulators;(d) proteases;and (e) others. Almost two-thirds of biologics had an effect on soluble targets. Cytokines and growth factors were the main targets of receptor modifiers. Monoclonal antibody therapies tended to be cell signalling or adhesion modulators, while enzyme-based biologics primarily targeted proteases. One of the most remarkable breakthroughs was the discovery of the anti-melanoma agent Talimogene laherparepvec (TVEC) in 2015, which was identified as a consequence of a genetic mutation of the herpes virus and has been developed to target exclusively malignant cells and activate the immune system to fight cancer. Using cytoplasmic extract from E. coli, Garamella et al. created a bio-based synthetic tool for batch and semicontinuous synthesis of proteins in mg quantities in 2016. CAR T (Chimeric Antigen Receptor Thymus) cell therapy, in which isolated patient cells are genetically modified to become CAR T cells, is one of the most revolutionary treatmimmunotherapy.ents. CAR T cells that have proliferated are restored to the patient's body and target malignant cells. The therapy is still being tested in a clinical trial to see how safe it is.

Furthermore, antibody-drug conjugates (ADCs), a new form of very powerful therapy are made up of an antibody chemically bound to a cytotoxic small molecule. The anticancer small molecule is transferred and released optimally at the malignant target site, resulting in therapeutic activity without harming healthy cells. This class of medications is just a typical healthcare intersection of chemotherapy and immunotherapy.

Due to their poor oral absorption, biologics require invasive injections. In the gastrointestinal system, biologics are very sensitive to deterioration, and their significantly larger size restricts transit across the epithelium. Finding patient-compliant administration routes and identifying ones that can be employed across a wide dose range are the most significant breakthroughs that can be made via the development of biologic delivery techniques and technologies. As a result, academic and corporate efforts are concentrating on creating innovative biologic delivery systems for systemic absorption.

These techniques focus on changing intravenous delivery to subcutaneous injections or non-invasive routes like transdermal, oral, buccal, nasal, and inhalation to make them more comfortable.

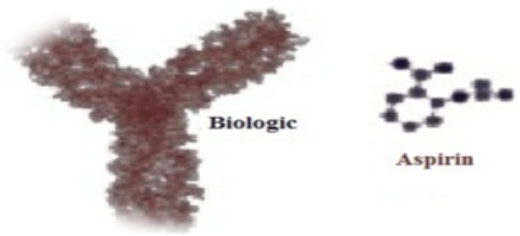

Figure 2: Transition of biologicals from IV to non invasive route

SL. NO	ADMINISTRATION ROUTE	BIOLOGIC	COMPANY	DELIVERY APPROACH	DISEASE
1	Transdermal	Abaloparatide	Radius Health	Microneedle patch	Osteoporosis
2	Oral	Insulin	Oramed	Capsule	Type 1 and t ype 2 Diabetes
3	Inhalation	Human Insulin	Dance Biopharm	Inhaler	Type 1 Diabetes Mellitus
4	Buccal	Insulin	Generex	Buccal spray	Type 1 and type 2 Diabetes
5	Nasal	Desmopressin	Ferring Pharmaceuticals	Nasal spray	Diabetic Insipidus

Figure 2: Transition of biologicals from IV to non inAvasive route

Biologics are often safer than pharmaceuticals and have shorter durations for clinical development and clearance. Biologics are most typically used to treat oncology and autoimmune/inflammatory disorders. They are also used to treat metabolic, cardiovascular, and infectious diseases. Because biologics' structural complexity makes characterization difficult, the clinical consequences in humans are difficult to anticipate. Due to their complicated structures, producing generic equivalents of biologics, known as biosimilars, is extremely challenging.

Growing expertise in biologics, as well as advances in protein engineering, manufacturing improvements, decreased competition from generic manufacturers, and the expiry of important patents, have all contributed to their increased popularity in recent years. In recent years, biologicals have gained popularity because of their ability to treat serious long-term disorders such as cancer and autoimmune diseases more effectively and with fewer side effects than traditional medications.

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The Emerging World of Digital Therapeutics

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"When the history is written on this evolution of healthcare, digital Therapeutics will be a major part of that evolution -Says Ohrenstein.

With healthcare system becoming more advanced and digitalized, patients today are more empowered than before as a result digital health solutions have become the need of the hour. Digital health is a discipline that includes the use of information and technologies regarding health and healthcare.

WHAT IS DIGITAL THERAPEUTICS?

Digital therapeutics is evidence based therapeutics intervention that is driven by high quality software programs to prevent, manage or treat a medical disorder or a disease.According to a recent deloitte record, digital therapeutics will have a disruptive impact on the future of biopharmaceutical companies and the patients they serve.The Digital Therapeutics Alliance (DTA) with the mission of broadening the understanding mainly focuses to combine the features of advanced technology along with design, clinical support, usability and data security of digital therapeutics products and tackles the next frontier in healthcare by shifting the target from treatment to prevention.

APPLICATIONS OF DIGITAL THERAPEUTICS

Digital therapeutics being a software has a wide variety of applications whose methodologies are rooted in cognitive behavioral therapy to boost patient's behavior towards making life style changes such as encouraging the patients to adhere to certain exercise, diet and drug regimens and monitor their health conditions.Digital therapeutics plays a major role in managing and preventing numerous health conditions such as Diabetes, Alzheimer's disease, Heart failure,Asthma,Obesity,Hypertension,Anxiety, Depression and Substance Abuse.Methodologies inculcated in digital therapeutics can be as simple as sending notification to alter the behavior of patients at high risk of obesity or diabetes and as complex as administering an ingestible radio tag that communicates with an external sensor to monitor the efficacy of a given medication.

IMPACT OF COVID-19, AN ACCELERATOR FOR Dtx.

The DTx industry experienced a major boost in 2020 when COVID-19 pandemic hit. DTx offers chronic patients the opportunity not only to have their healthcare needs fulfilled, but also to avoid the risk of exposure to COVID-19 from in-patients hospital visits. COVID-19 shone a light on the need for innovative treatment option. Companies that took advantage of this opportunity include,

- Akili Interactive labs, which released EndeavorRx, a game-based digital therapeutic to improve the attention span of children with attention deficit hyperactivity disorder (ADHD).
- Orexo's marketing of GAIA Ag's RCT-proven digital therapeutics for alcohol misuse and mild-to-severe depression.

FDA APPROVED DIGITAL THERAPEUTICS IN THE PRESENT ERA

- OMADA HEALTH and INSULA delivers digital therapeutic Behavioral intervention for diabetes.
- BIOFOURMIS augments personalized therapies to help patients with Chronic condition.
- HAPPIFY HEALTH has launched ENSEMBLE to help People treat the symptoms of anxiety and depression.

OPTIMISATION OF PRICING : The ultimate test of digital therapy is the amount the customer pays for it. Payers will typically value a therapy if given a proof to be reducing the complications and are effective and that it reduces the healthcare costs. At present MYIA LABS, has strived to reduce emergency hospital visits caused by coronary heart diseases and Pear therapeutics which aims at moving care from the clinic to a cheaper setting.

LOOKING AHEAD : In the present scenario, digital therapeutics is not at a conceptual stage but is well within the production and delivery stages.Indian pharmaceutical companies are aiming to simplify the management of cardiac disorders using AI-driven Dtx. DTx companies are looking forward to diversify by adding new indications for chronic kidney diseases and focuses on developing solutions for gastrointestinal disease such as Irritable Bowel Syndrome, Inflammatory Bowel Diseases etc. Several partnerships between pharmaceutical companies and Digital Therapeutics have already been established, Boeahringer Ingelheim partnered with Click Therapeutics to develop a digital therapy for patients with Schizophrenia.Sanofi partnered with Happify Health to build a digital therapy to help multiple sclerosis patients to manage their mental health.

CONCLUSION: When it comes to innovations, it's not just the present that matters, but also the future.DTx is expected to significantly influence healthcare delivery and its consumption across the globe. The rising number of pharmaceutical companies is taking a thoughtful approach to DTx. However rigorous testing is required through randomized trials to achieve reliable evidence on the safety and efficacy of DTx .Although the efforts of Dtx

Vocal Biomarkers – Reshaping healthcare diagnostics

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Research into digital biomarkers is an area of rapid growth in digital medicine. Speech offers rich insights into cognition and function and is affected by many psychiatric and neurodegenerative diseases. By requiring the coordination of various cognitive and motor processes, even a short sample of speech may provide a sensitive snapshot of cognition and functioning relevant to many disease areas. Speech can be collected with widely available technology, such as smartphones, thereby facilitating remote and frequent monitoring, which can reduce measurement error. With advances in natural language-processing and machine-learning techniques, speech can be automatically and objectively analyzed, producing high-dimensional data. Speech-based biomarkers could facilitate more efficient clinical research and more sensitive monitoring of disease progression and response to treatment. What is more futuristic than having a conversation with an AI that in return can tell a lot about the state of your mental health and even whether or not you have COVID?

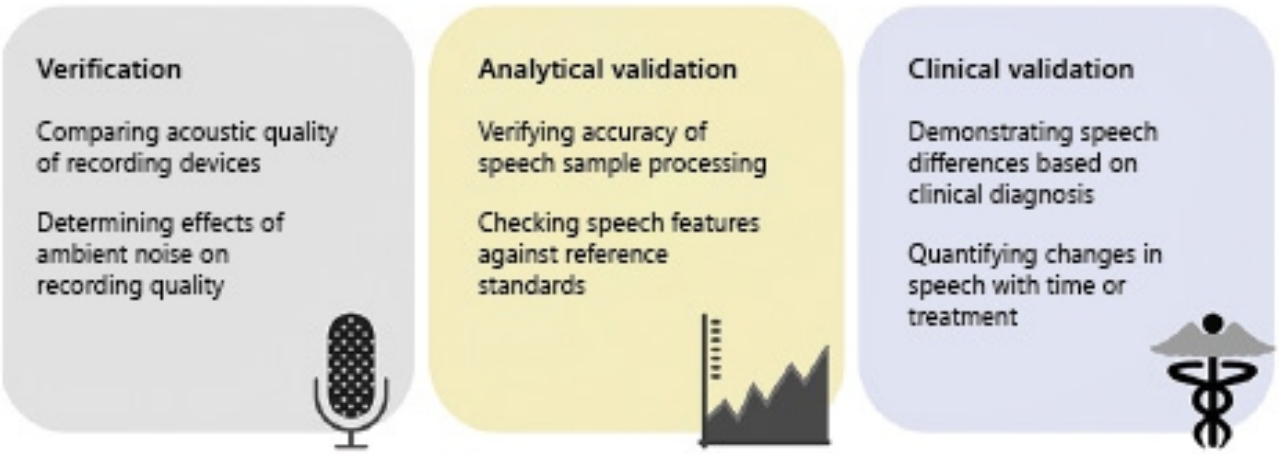
Voice text startups are blooming, leveraging machine learning to detect vocal biomarkers that are red flags for certain conditions. By the characteristics of your voice, these algorithms can be accurate, fast and cost-effective solutions compared to conventional check-up methods. This could essentially be the difference between life and death. For example, an US based start-up SONAPHI is focusing on a voice-based screening app that will look for vocal features related to the presence of COVID-19.

How these technologies work?

1) A person's voice is recorded and then transferred into a spectrogram (an image) alongside medical data of that person.
2) Machine learning algorithms analyze the voice samples and detect in the recording patterns specific to certain symptoms or illnesses. These patterns appear as small changes in the spectrogram, identified with the help of computer vision methods.

How are these speech-based technologies evaluated?

Digital Medicine (DiMe) society has proposed a framework and common vocabulary for the evaluation of these digital biomarkers. The components of evaluation of these speech-based biomarkers includes: verification, analytical validation, and clinical validation. (Fig 1)



Verification describes the process of validating the hardware and sensors involved in recording a digital measurement. For speech-based measures, verification primarily involves evaluating the recording devices and determining the conditions required for adequate recording quality. Analytical validation involves checking that the measurements obtained via a digital biomarker are accurately measuring the intended phenomena. For speech-based biomarkers, this requires verifying that any property or metric extracted from a speech sample, which we refer to as a feature, measures the associated aspects of speech accurately. Clinical validation is the process of evaluating if a digital biomarker provides meaningful clinical information. For example, a digital biomarker could be used for disease diagnosis, measuring disease or symptom severity, monitoring change in disease/symptoms over time, predicting disease onset, or measuring the response to treatment or therapy.As a noninvasive method of remotely detecting new cases of various diseases, voice biomarkers can be a key to unlock disease diagnoses for earlier adequate interventions and improved health outcomes for patients. The pandemic has highlighted how many limitations patients have regarding access and affordability of health care and how much telemedicine can alleviate over-burdened hospitals. As finances start to pour into voice tech, accurate diagnosis for some conditions can be as easy as a patient speaking into a smart phone.

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Magnetic Bacteria as a means of drug targeting

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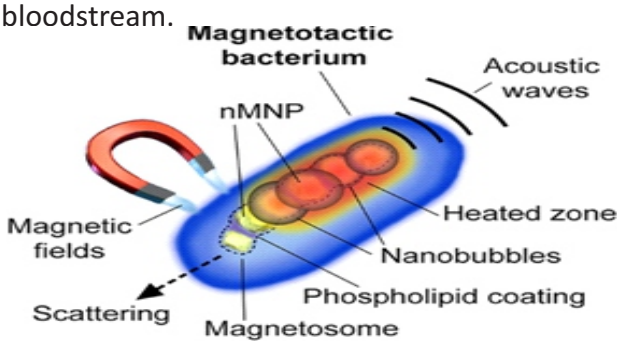
One of the fundamentals of cancer treatment, and several other therapies, is targeted medication delivery, which may allow for improved treatment efficiency. Magnetic drug targeting is a promising method of drug delivery that can be realised when vehicle has a strong magnetic force. Magnetic-targeted drug carriers are made using a core of iron oxides with a biocompatible polymer coating for drug delivery.

Magnetotactic bacteria produce magnetosomes, which are iron oxide nanoparticles wrapped with biological material. Due to their unique properties such as paramagnetism, nanotechnology, narrow-size distribution, and being confined to the membrane, bacterial magnetosomes (BMs) generated by magnetotactic bacteria aroused interest as choices for targeting drug carriers. The magnetosomes are used as a compass by these bacteria to navigate in the direction of the earth's magnetic field. The presence of a magnetosome chain within the MTB cell allows it to passively orient itself by the geomagnetic field.

Bacterial magnetosomes are enclosed by a lipoprotein membrane and made of magnetite Fe3 O4 and greigite Fe3 S4.

MTB's magnetite crystals are 30–120 nm in length and give the cell a permanent magnetic dipole moment. The MTB were used in a recent study in weak rotating magnetic fields in liquid. When in a swarm, the bacteria's movement in reaction to magnetic fields allowed them to regulate the flow of the liquids they were in. This generates a similar effect to that of micropumps, allowing microorganisms to transfer active chemicals present in the liquid with high precision using a magnetic field. As a result, active treatments could be delivered directly to tumour locations via the bloodstream.

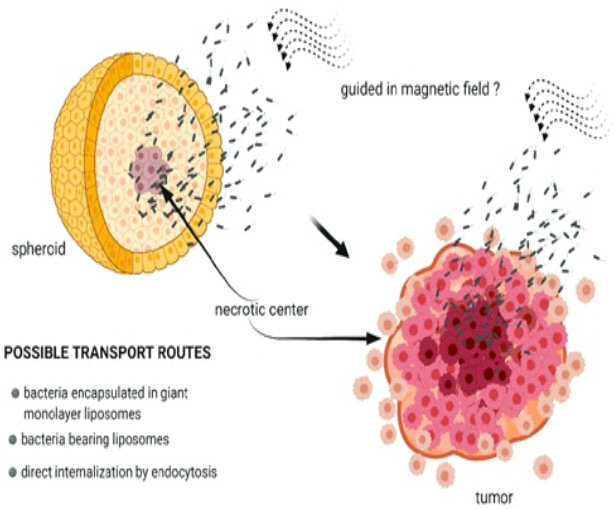


As proven in a model system based on a microfluidic chip, MRI can be utilised to build bacterial or hybrid medical nanorobotic system that can controllably travel through the human circulatory system. Magnetosomes with an artifical modified membrane can specifically bind to monoclonal antibodies and be used for magnetic cell separation, as well as the development of new electrochemical sensors that can detect bacterial pathogens and toxicants & immunomagnetic analyzation for anthropogenic pollutants

FOUR GROUPS OF DRUGS LOADED ONTO BMs

Protein drugs	Nuclei acid drugs	Radioactive isotopes	Chemotherapeutic drugs
Insulin, growth hormone, and erythropoietin; monoclonal antibodies such as Remicade, Rituxan, and Erbitux	BMs were reported for DNA/RNA extraction, Delivery of ganglioside, Capture of oligonucleotides and antibodies; Hepatitis B antigen detection	Radioactive isotopes such as 99mTc, 131I, 123I, and 111In can be linked with suitable chelates, radioactive-labeled molecules such as nucleic acids and proteins	BMs can be linked to Doxorubicin, epirubicin, daunorubicin, idarubicin, pirarubicin, mitomycin, bleomycin, and peplomycin by crosslinking agents such as aliphatic binary aldehyde, diisocyanates, diisothiocyanates.

Few protein medications on the market fail because they are easily digested or disrupted as they pass through biological barriers. When it comes to solid tumours, therapeutic anticancer antibodies have a low curative efficacy. This disadvantage can be solved by loading antibodies onto BMs and using magnets to keep them in solid tumours. Secondly, nucleic acids operate as medications by attaching to produced proteins and hybridising to messenger RNA, causing translation to be altered or causing target RNA to be degraded. Furthermore, because BMs can be labelled with radioactive isotopes, they can be used for internal radiation or brachytherapy of solid tumours due to their targeted drug delivery. Many chemotherapy medicines containing carboxyls or phosphate groups can also be connected to the amino groups of BMs via EDC. The multifunctional magnetosomes can be employed as molecular probes for MRI-guided tumour identification and as medication carriers for tumour treatment and radioimmunotherapy when paired with magnetic hyperthermia.



Although the majority of these research are still in the proof-of-concept stage, and each study only looked at one sort of magnetosome application, the data suggest that developing multifunctional magnetosomes for clinical use will be quite simple. Magnetosomes, for example, can be coupled with radioactive isotope-labeled antibodies and identify carcinoembryonic antigens after being premodified with anticancer medicines.

ANN in Pharmaceutical Formulations

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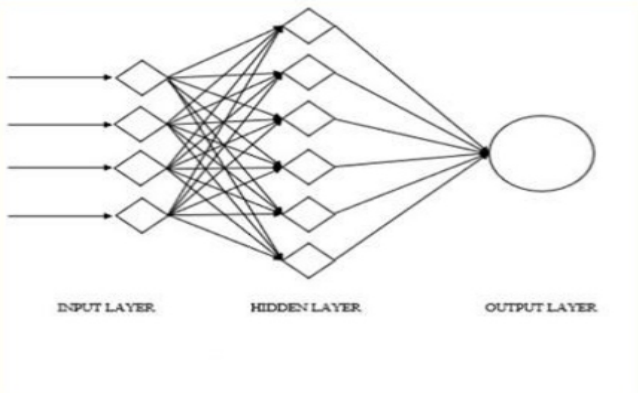
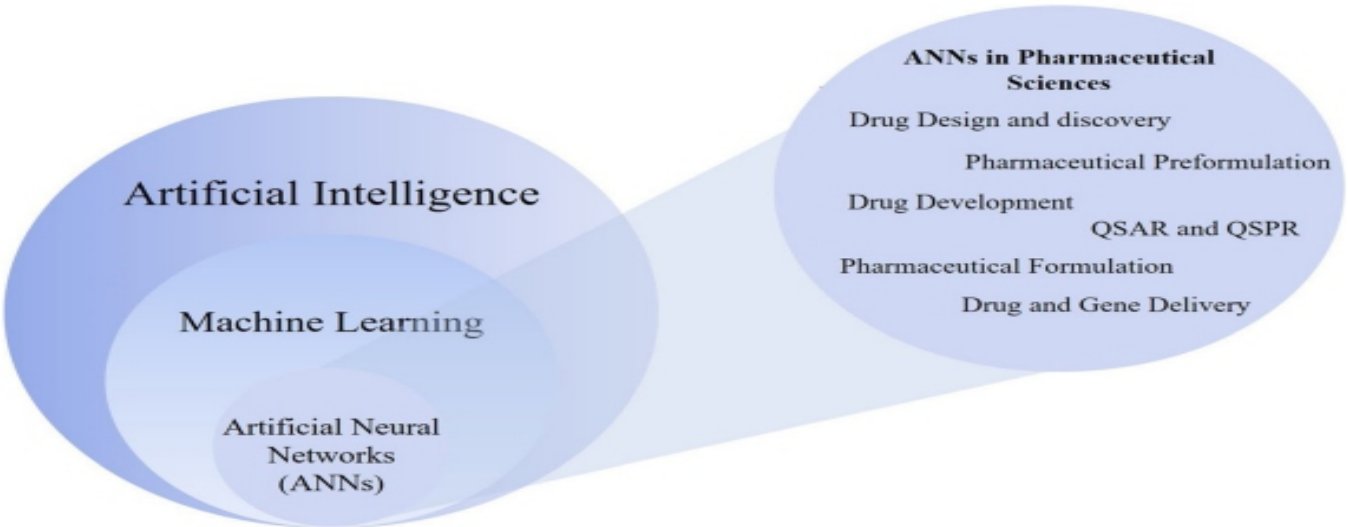
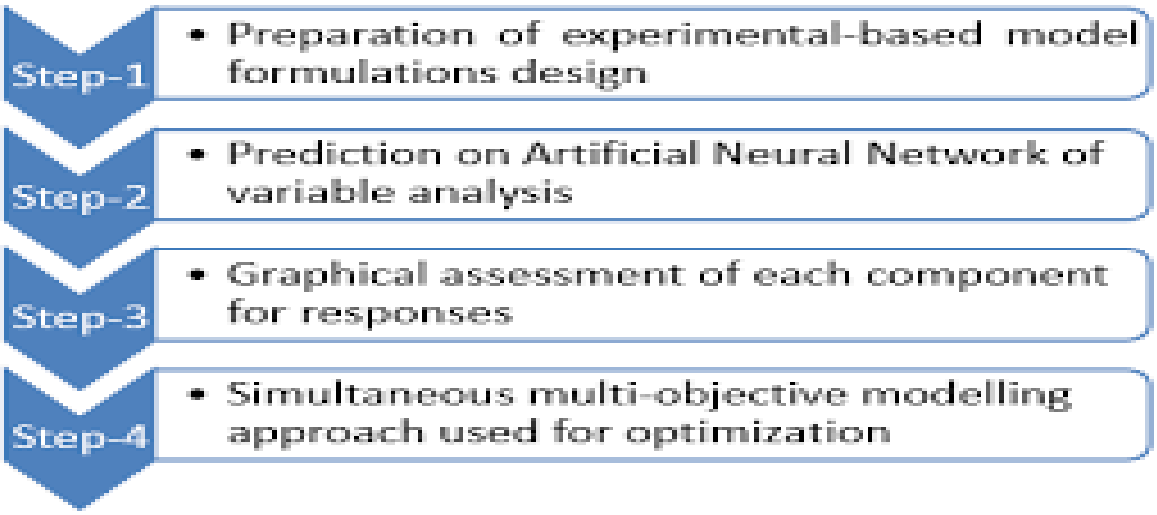
INTRODUCTION

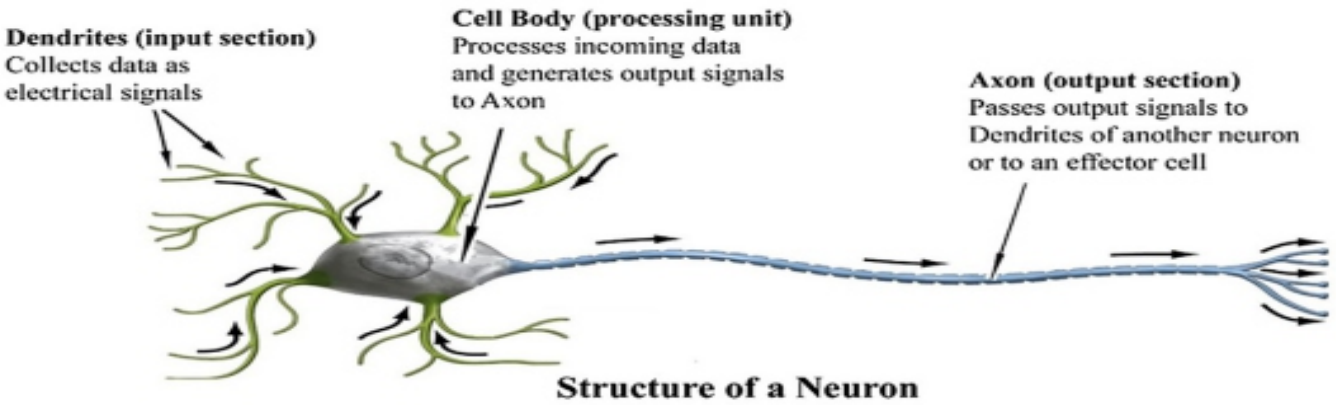
An Artificial Neural Network (ANN) is a computer software that simulates neuron activity in the human brain. ANNs are computer models inspired by biology that imitate the brain's ability to learn. Our brains are made up of billions of neurons, which are little processing units. An huge number of synapses link one neuron to another, making these neurons completely interconnected. Artificial neurons, or processing elements (Pes), are connected by coefficients in the same way as human neurons are (weights).

The input, hidden, and output layers are the three fundamental structural components of a conventional ANN. The input layer, which corresponds to the dendrites of a biological neuron and conveys information to the next layer, is the first layer of an artificial neuron. The next layer is the concealed layer, which is the intermediate layer between the input and output layers. Through specific coefficients, the hidden layer joins these two layers (weights). A number of neurons make up each buried layer (also called nodes). A trial-and-error approach is usually used to determine the number of neurons in the hidden layer of ANNs.

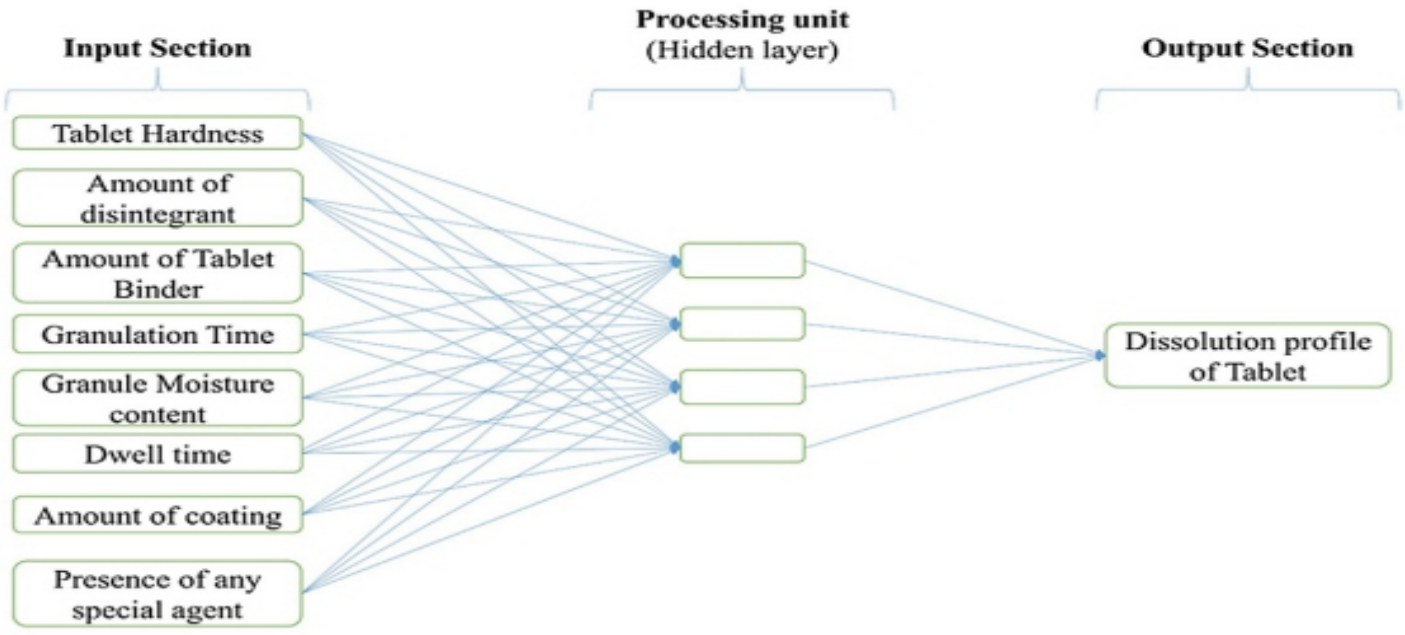








Structure of a Neuron

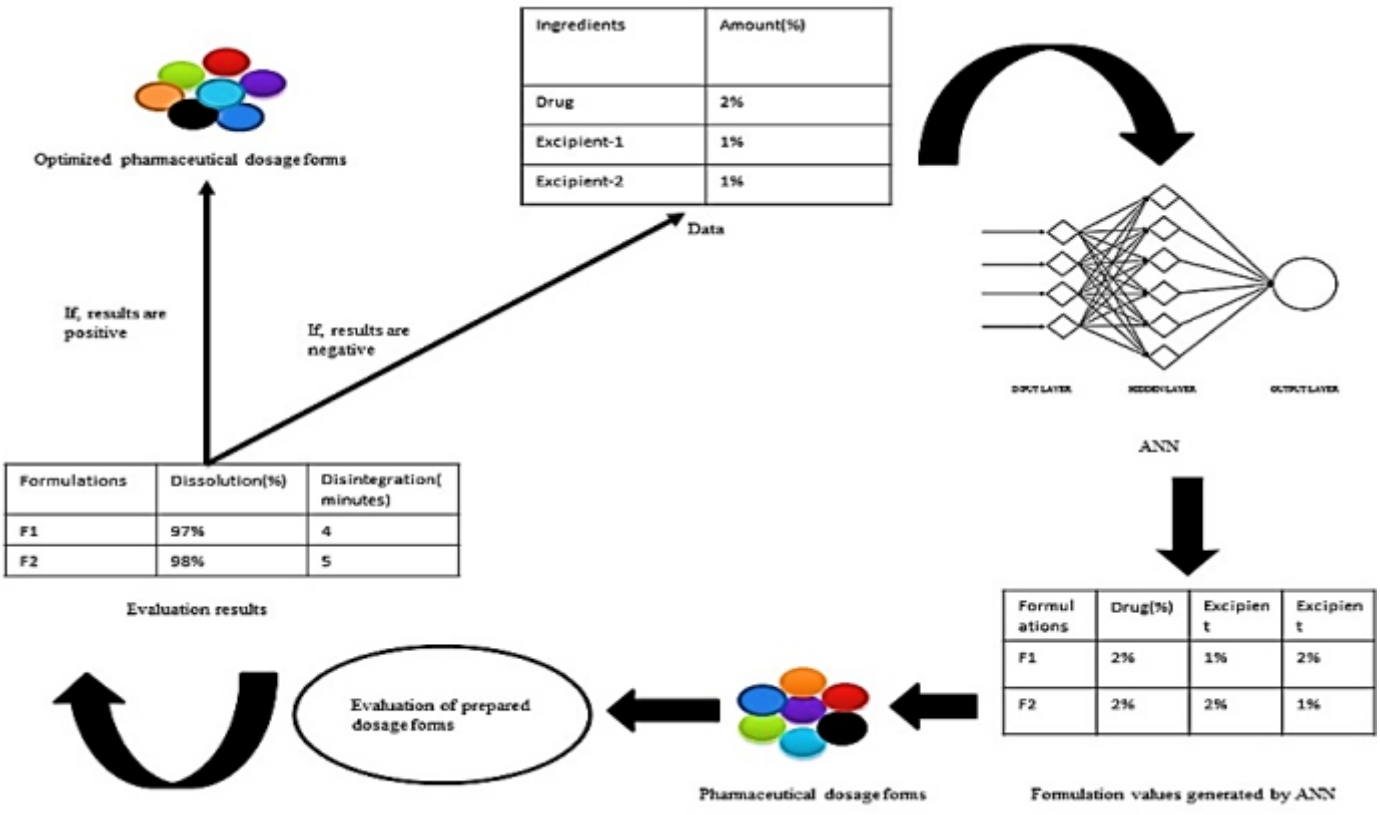


Structure of a Artificial Neural Network

Pre-formulation Stage

Pre-formulation is the stage of drug development where the physicochemical qualities of a drug material are evaluated, such as solubility, stability, interaction with excipients, and, ultimately, bioavailability. The physicochemical parameters of a drug substance must be determined. The water solubility of a novel medicinal ingredient is an important initial stage in the pre-formulation process. Any medicine that has to be absorbed must be water soluble in some way. Surfactants, complexation, salt creation, hydrotropes, and cocrystal formation are some of the solubilization procedures used to increase medicinal ingredient aqueous solubilities.

The use of several computational methodologies, such as molecular dynamics simulations and machine learning techniques, to forecast the water solubility of medicinal compounds has piqued attention. A machine learning application based on artificial neural networks (ANNs) was created to predict the solubility enhancing impact of different hydrotrope compoundsLogP, melting point, and hydrogen bonding capacity were among the physicochemical parameters studied. The effective usage of ANNs in other solubility applications in many research domains, as well as their reported utility in predicting solubility increases for medicinal compounds, are promising for future study of their prospective uses in pharmaceutical pre-formulation research.The prediction of four pharmacokinetic parameters, namely oral bioavailability (BA), plasma protein binding rate (PPBR), apparent volume of distribution at steady-state (Vdss), and elimination half-life (HL), was produced using an integrated transfer learning and multitask learning



technique. For 1104 authorised medicinal compounds, eight molecular descriptors were employed. Molecular weight, hydrogen bond donor count, hydrogen bond acceptor count, rotatable bond count, topological polar surface area, heavy atom count, complexity, and covalently bound unit count were someof the descriptors used. When compared to other traditional machine learning approaches such as partial least-squares regression (PLSR), SVM, ANNs, RF, and KNN, the generated model performed well and had strong generalisation ability. Transfer learning has shown to be a potential machine learning method for future investigation in pre-formulation investigations.

Formulation Stage

The formulation of pure drug ingredients into drug products for patient administration is another stage of drugdevelopment. ANNs have sparked a lot of interest in this field, and they've quickly become the most prominent machine learning technique for predicting pharmaceutical formulations. The use of machine learning methods, notably ANNs, to optimise formulations (including the optimization of components and/or operating conditions) has shown tremendous promise for future applications that often demand quick and efficient manufacture. In the construction of in silico prediction models in pharmaceutical formulation, non-traditional machine learning approaches have recently beenused. In pharmaceutical formulation research, LightGBM has lately demonstrated a high prospective prediction capacity when compared to traditional machine learning approaches.LightGBM, RF, and DL were compared for the prediction of complexation free energy between cyclodextrins (Cds) and guest molecules with a dataset consisting of 3000 data points. Over 30 numerous descriptors related to the guest molecule, CD, and experimental conditions have been implemented in designing the machine learning models. LightGBM showed better prediction performance compared to the other models including RF and DL. LightGBM method was implemented for prediction of complexation performance of 341 drugs/phospholipid complex formulations described by over 40 molecular descriptors related to the properties of the drugs, solvents, and experimental conditions. Compared with other conventional machine learning techniques such as SVM and DT, lightGBM model showed the best predictive performance for predicting drug/phospholipid complexation

CONCLUSION

The ANN model as well as the notion of how ANN may be utilised to assist create regulated drug delivery paths have been elucidated. Overall, the employment of ANN in the research of dosage forms processes provides a modern function due to its unique features, such as non-linear processing capabilities to represent poorly understood structures. In the pharmaceutical sector, applications of ANN Model processes that have more capability than traditional mathematical models have become more essential. The breadth of current applications, which range from fundamental chemical property explanations through behaviour, anatomy, and epidemiology, demonstrates ANNs' actual capacity to recognise and foresee consequences. Because neural networks are

described with scientific models and implemented via standard computer use, ANNs do not require special hardware.In the realms of illness diagnosis, evaluation, and simulation, the use of ANN to therapeutic decision creation has proven very successful. When compared to marginal to predictable modelling approaches, ANNs are a very new technology. The use of a fake neural network in the creation of sustained-release medications has been expanding at a rapid ratedue to the same intriguing prospects. Because of this versatility, ANNs may be employed in practically any sector of earning that involves the analysis of voluminous, parameter, and numerous findings; as a result, ANN implementations are predicted to expand into a variety of fields. As user-friendly and successful ANN software systems are built, the usage of ANN in the production and design of sustained release medication delivery systems will undoubtedly grow in the future. ANN implementations are also illustrated in terms of count, varied continuous release delivery, and ANN implementations.

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MYTHBURSTER

PUZZLE PUNCH

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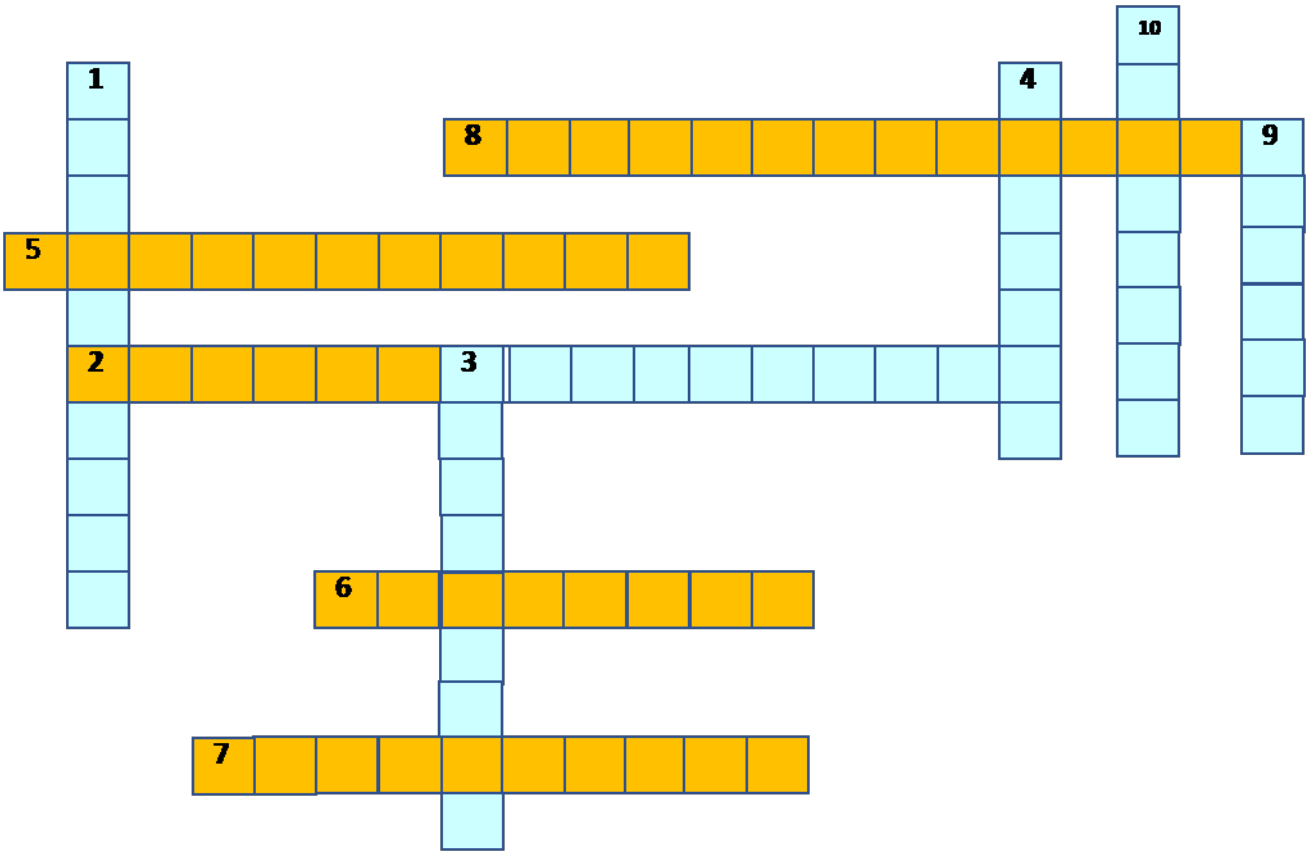

Across

2. Study of time course of a drug with in body and incorporate ADME processes
5. Common suppository base used in Pharmaceutics
6. Highly protein bound anticoagulant
7. _____ -450 enzyme system is responsible for metabolism
8. Biochemical similarity of 2 drugs sharing same API and desired outcomes

Down

1. Pharmacokinetic process, movement of drug from site of administration to site of measurement
3. Hypothetical volume of body fluid containing drug from which drug is cleared completely in a specific period of time
4. A carbohydrate, that is filtered and completely absorbed in the renal tubules
9. Sweet alcoholic oral preparations containing 1 or more drugs
10. Oily greasy preparations for external use

(Submit your answers to the editorial team - prizes to be won)
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ALMA MATER SLICE

Alumni speech report – 24.03.2022 , Thursday

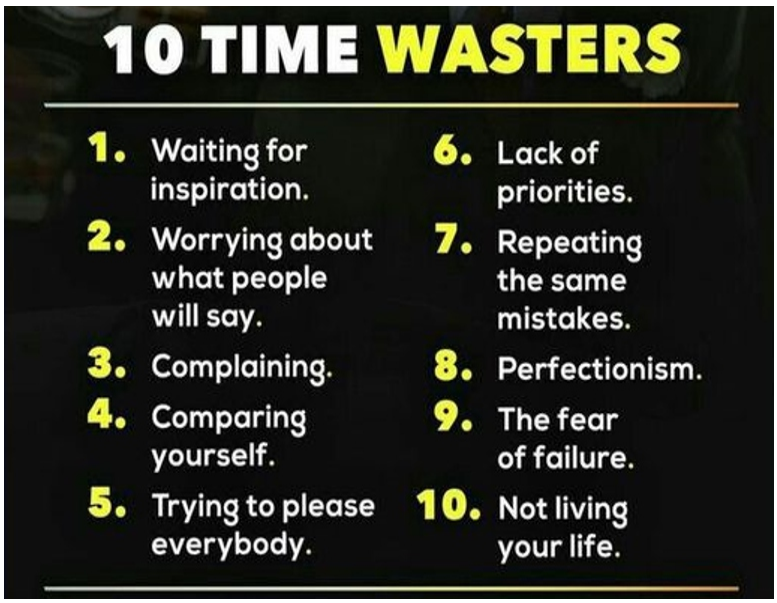
"A career in industries mostly focussed on Applied research" –

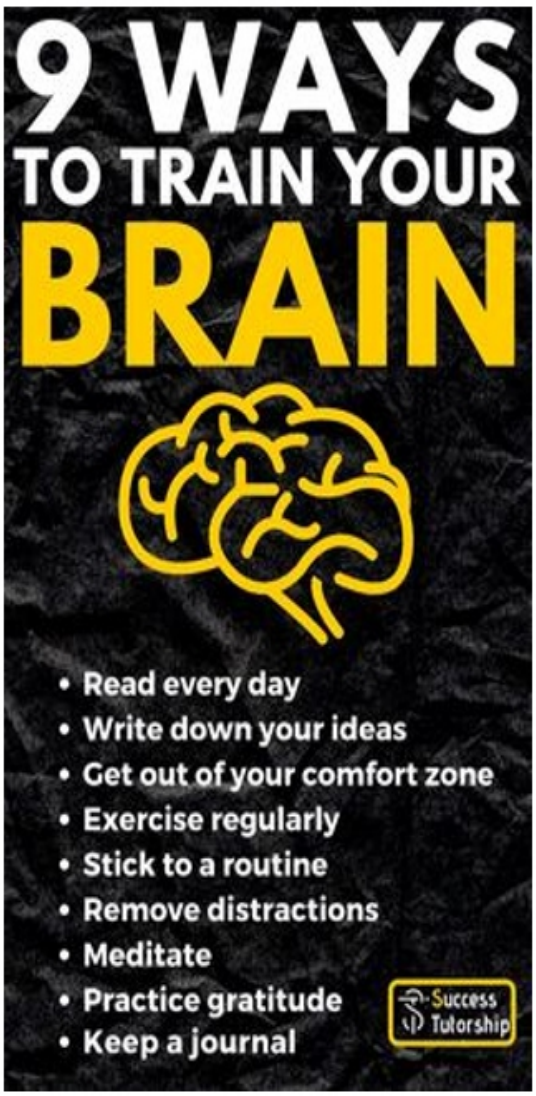
- Merely means that, Academia is highly research and discovery focussed whereas, industry work allows researchers to feel a sense of immediate impact.

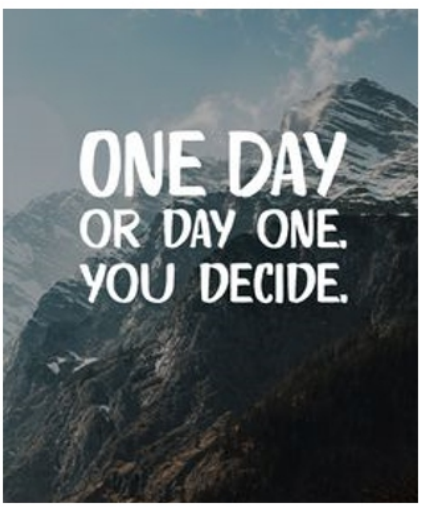
Mr. Manoj Kulakarni
Alumni 2011-13
M Pharm
Dept. of pharmaceutics

On the occasion of Interim presentation event, organized by the Department of Pharmaceutics, the students of M. Pharm had the opportunity to interact and learn from the practical experiences of Mr. Manoj Kulkarni, alumni of RUAS (2013). Mr. Manoj pursued his Bachelors from 2007-2011, Masters from 2011-2013 in the Department of Pharmaceutics. His research was focused on "Mucoadhesive inserts of Cinnarizine – A Novel Drug Delivery System" (Cinnarizine nasal insert for the motion sickness), was granted a patent in 2021. His experiences helped us understand the ethics, acumen and methodologies required for conducting good research. Mr. Manoj, kick started his career in formulation and development with 'Group pharmaceuticals'. Later, took an opportunity with Strides as Formulation, Research and development scientist. Mr. Manoj expressed excitement over his new position as a data analyst in Hyderabad. Learning about his academic credentialsthough online certificate programs and offline modes of educations inspired us to pursue our interests.His industry experiences made us aware of the corporate expectation for freshers and the interpersonal and management skills required to take the business world head-on. We learnt about the importance of documentation, such as maintain log books, descripting the true results and the literature survey. We understood that researching the echelons in an organization requires one to identify with the values, vision and mission statements of a company. Professionalism and smart work are a prerequisite to success, said Mr. Manoj. He expressed his gratitude to Dr. S Bharath and all the faculty members for helping and guiding him throughout, an indication to us, of his grounded-ness. We, the M Pharms, are grateful to Dr. B V Basavaraj, HOD - Department of pharmaceutics, for organizing and making this session with Mr. Manoj a grand success. This learning, instilled a sense of pride and belongness to Ramaiah University, and respect the guidance of our mentors who continually help us in reaching greater heights.

BLISSFULL MIND







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