



APV FOCUS GROUP DRUG DELIVERY

COMBINING SCIENCE & TECHNOLOGY TO CREATE ADVANCED DRUG DELIVERY SYSTEMS

INTERNATIONAL ASSOCIATION FOR PHARMACEUTICAL TECHNOLOGY

NEWSLETTER

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DRUG DELIVERY EVENTS

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- + [11th World Meeting on Pharmaceutics, Biopharmaceutics and Pharmaceutical Technology](#) [Details](#)
March 19-22, 2018 | Granada, Spain
- + [2nd Edition of Global Conference on Pharmaceutics and Drug Delivery Systems](#) [Details](#)
June 04-06, 2018 | Rome, Italy
- + [Skin Forum 2018 Annual Meeting Skin health and topical formulation - new insights and perspectives](#) [Details](#)
June 20-21, 2018 | Tallinn, Estonia (Course no. 6727)
- + [Controlled Release Society Annual Meeting & Exposition, 2018](#) [Details](#)
July 22-24, 2018 | New York, USA

[Suggest a meeting to be announced!](#)

DRUG DELIVERY PRODUCTS

Provided by Dr. Louise Rosenmayr-Templeton

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SINUVA™ SINUS IMPLANT

Sinuva™ Sinus Implant was approved by the FDA in December 2017 as a treatment for nasal polyps in adults who have previously had ethmoid sinus surgery [1, 2]. The product was developed by Intersect ENT Inc. (CA, USA). It contains 1350 mcg mometasone furoate in a biodegradable implant which releases the anti-inflammatory steroid over a period of 90 days directly at the treatment site.

Nasal polyps affect around 4% of the population and are found on the mucosa of the sinuses and nose [3, 4]. In over 90% of cases polyps are associated with the ethmoid sinuses which are located in the ethmoid bone in the nose between the eyes. Adults are typically affected with nasal polyps being rarely detected in children under 10 years. Although the underlying cause of nasal polyps is, as yet, not understood, they are associated with conditions such as allergy, asthma, infection, cystic fibrosis, and aspirin sensitivity. Symptoms include nasal congestion, obstruction, infections, loss of the sense of smell and facial pain. Initial treatment includes nasal corticosteroids to shrink the polyps followed by oral corticosteroids if nasal treatment is unsuccessful. However, in chronic and severe cases the polyps are surgically removed. Despite this, in the USA alone 635,000 patients still have symptoms following their operation which need to be treated [2]. The Sinuva™ Sinus Implant offers the patient convenience as it removes the need for daily nasal spray administration while delivering the corticosteroid locally in a sustained and chronic manner.

The self-expanding, sterile implant consists of poly-(L-lactide-co-glycolide) and poly-L-lactide-co-ε-caprolactone) coated with mometasone furoate embedded in a bioabsorbable polymer matrix containing poly-(DL-lactide-co-glycolide) and polyethylene glycol. It is supplied inside a crimper and a single-use delivery system. The doctor removes the crimper and delivery system from their packaging using aseptic technique and crimps the implant before loading it into the

delivery system. Using this system the implant is delivered into the ethmoid sinus under endoscopic visualization. The implant enables sustained release of the corticosteroid with the polymers gradually softening with time as they degrade. The implant is removed at day 90 or earlier at the doctor's discretion. It can also be expelled from the nose naturally due to the shrinkage of the polyps coupled with polymer softening or as a result of sneezing or forceful nose blowing.

Approval was based on the safety and efficacy data from two trials Resolve I (6 months duration) and the pivotal Resolve II (90 days duration) involving 400 patients with nasal polyps who had previously had complete, bilateral, ethmoid sinus surgery but continued to have severe symptoms. The results of the multi-centre, 300 patient, single blind RESOLVE II trial which compared the Sinuva™ Sinus Implant to a sham treatment, showed a statistically significant reduction from baseline in bilateral polyp grade ($p=0.007$) and a reduction from baseline Nasal Obstruction/Congestion score ($p=0.007$) following treatment with the drug loaded implant. In addition, there was a statistically significant reduction in the percentage of patients still requiring surgery following treatment and in symptoms associated with nasal polyps. The most common side-effects experienced were bronchitis, nasopharyngitis, otitis media, headache, presyncope (symptoms associated with feeling faint), asthma, and nosebleeds.

The product launch is planned for Q2 2018.

OZEMPIC®

In February 2018 the European Commission granted marketing authorization for Ozempic® (semaglutide), a human glucagon-like peptide 1 (GLP-1) receptor agonist developed by Novo Nordisk (Bagsvaerd, Denmark) for the treatment of Type 2 diabetes [5, 6]. It is indicated as monotherapy when metformin is contraindicated, and as an adjunct to other therapies.

Ozempic® is administered once weekly by sub-cutaneous injection and is available in a multi-dose pre-filled pen capable of delivering 0.25 mg, 0.5 mg and 1 mg semaglutide. The starting dose is 0.25 mg once weekly for 4 weeks, followed by 0.5 mg once weekly. After at least 4 weeks the dose can be increased to 1 mg if required to achieve glycemic control. The peptide consists of a backbone of 37 peptide residues and is produced by yeast fermentation. The lysine residue at position 26 is modified by a C18 fatty diacid bound through a hydrophilic spacer. Albumin binding is the main reason for the long half-life of semaglutide which results in decreased renal clearance and reduced metabolic degradation. In addition, the molecule is stabilized to attack by the enzyme, dipeptidyl-peptidase 4 (DPP-4), through modification at position 8.

Ozempic® contains 2mg semaglutide in a 1.5ml sterile solution (1.34 mg/ml). The other ingredients are disodium phosphate dihydrate, propylene glycol, phenol and water for injections. The injection has a pH of approximately 7.4, adjusted with NaOH or HCL if required.

Approval was based on six phase 3a trials known as the SUSTAIN program involving over 7,000 adults with type 2 diabetes including patients with high risk of heart disease and those with kidney disease. These studies evaluated Ozempic® as a monotherapy or co-administered with metformin, metformin and sulfonyleureas, metformin and/or thiazolidinedione, and basal insulin in comparison to placebo, sitagliptin, exenatide extended-release (ER), and insulin glargine. The results showed that for up to 2 years treatment with semaglutide resulted in prolonged, statistically significant and clinically relevant reductions in HbA1c and body weight compared to comparator treatment, (placebo or active control treatment). The main side-effects experienced in clinical trials were gastrointestinal and self-limiting. However, an increased risk of diabetic retinopathy complications was observed. Like other GLP-1 agonists the medicine carries a warning due to its association with the development of thyroid C-cell cancer in rodents.

Ozempic® enters a growing but very competitive market for the treatment of Type 2 diabetes. However, its ability to reduce HbA1c levels and body weight to a more significant extent than its competitors including the market leader, Eli Lilly's Trulicity™ (dulaglutide), will increase its chances of success [7]. Novo Nordisk hope to gain approval for Ozempic® for the treatment of obesity and an oral formulation of the peptide is currently in Phase 3 [8].

Ozempic® was also approved by the US FDA on 5 December 2017 [9].

References and Further Information

- [1] Entry for Sinuva™ Sinus Implant on Drugs@FDA
<https://www.accessdata.fda.gov/scripts/cder/daf/index.cfm?event=BasicSearch.process>
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- [7] Semaglutide demonstrated significant reductions in blood sugar and weight compared with dulaglutide; results published in The Lancet Diabetes & Endocrinology. https://www.novonordisk.com/content/Denmark/HQ/www-novonordisk-com/en_gb/home/media/news-details.2165323.html
- [8] Novo Nordisk website <https://www.novonordisk.com/>
- [9] Entry for Ozempic on Drugs@FDA. https://www.accessdata.fda.gov/drugsatfda_docs/label/2017/209637lbl.pdf

DRUG DELIVERY COMPANIES

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Provided by Dr. Florian Unger/Dr. Karsten Cremer/Dr. Dieter Becker

DELSITECH LTD (Turku, Finland)

DelSiTech has an advanced proprietary drug delivery technology, Silica Matrix, for parenteral administration of injectable depot and implant dosage forms. The drug delivery technology is based on biodegradable amorphous silica (SiO₂) matrix into which the active agent is embedded using the sol-gel encapsulation technique. The matrix can be designed to biodegrade at the required rate to ensure a tightly controlled release of the active substance by non-enzymatic hydrolytic surface erosion of the matrix, providing a better therapeutic effect in situ and causing lower systemic and local adverse effects than alternative delivery systems. As such, the technology is different from other reported silica based systems like mesoporous silica technology. The technology was originally discovered and developed by researchers at the University of Turku and Åbo Akademi University in Turku, Finland, and is fully owned and patented by DelSiTech. The DelSiTech silica-based drug delivery technology has several advantages over other alternative delivery technologies. One of the main benefits of DelSiTech's Silica Matrix is its superior safety; silica is a natural, endogenous component of the body and it is fully biocompatible and non-toxic. The local irritation is minimal as silica does not lower the tissue pH when dissolved, and there is no risk of sudden burst release event at accidental break-down of the dosage form.

DelSiTech's Silica Matrix provides a large range of applications in delivery of therapeutic agents. Many different silica-based formulations encapsulating various sized small molecules, ranging from practically water-insoluble drugs to highly-water soluble hydrophilic compounds have been developed so far. The release time has varied from a few days to several months, even up to a year. Also, heat and/or organic solvent sensitive molecules can be encapsulated as the manufacturing process can be performed at low temperatures in aqueous solutions. DelSiTech also successfully developed long acting formulations of small and large peptides and proteins (incl. mABs) in a range of therapeutic indications. The release rate is strictly controlled by silica biodegradation and the biological activity of the encapsulated molecules was well preserved in all cases. Furthermore, complex carbohydrates, such as heparins, and nucleic acid therapeutics (e.g. siRNA) can be administered with the technology. Administration of viral vectors, e.g. in gene therapy, in a controlled fashion for longer time periods using Silica Matrix has been shown. Silica encapsulation also offers other unforeseen benefits to virus-based therapeutic products, such as the possibility to store final products at 4°C or even at room temperature instead of -20°C to -80°C.

Silica Matrix can be used in a broad number of human therapeutic indications including oncology, metabolic disorders, gene therapy and ocular disease. For example, molecules can be delivered intravitreally using a thin needle (27-30G) for 6 months or more release by being encapsulated inside silica microparticles or silica microimplants. In addition, Silica Matrix based eye drops can be developed that release over 1-2 days to overcome the constant need for topical re-application. Ocular drug delivery is a major part of DelSiTech's business and an in-house developed intravitreal dissolution model helps to predict the in vitro/in vivo correlation. The company is also active in animal health developing novel medical products for companion and production animals.

Fact sheet:

Founded:	2001
Location:	Turku, Finland
Ownership:	Private
Employees:	>15
Key technology:	DelSiTech™ Silica Matrix DelSiTech's Silica Matrix is an advanced delivery technology for parenteral and local administration of injectable depot and implant dosage forms. The proprietary technology is based on silica (SiO ₂) matrix into which the molecule of interest is embedded using a process called sol-gel. The resulting Matrix is nanoporous, biocompatible and it can be designed to biodegrade by matrix dissolution at the desired rate to ensure a tightly controlled release of the active substance over periods of days up to many months or a year.
Products:	DelSiTech's lead internal pipeline product is 1308, a 3 month subcutaneous depot of the hepatitis B (HBV) antiviral entecavir. This will be the first long acting HBV product to enter the clinic

	and will overcome the issues of compliance seen in the treatment of this disease. DelSiTech's second product is for ophthalmology; a long-acting small molecule for intravitreal delivery
Development status:	1308 will enter Phase I in H1 2018. DelSiTech's ophthalmology programme is in preclinical testing
Partnerships:	Collaboration and licensing agreement with Bayer AG for ophthalmology Licensing agreement with Solani Therapeutics Ltd in Animal Health Collaboration with MedImmune, Inc. on antibody delivery Collaboration agreement with C-Tri Co., Ltd for development of long acting oncology peptide product
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DRUG DELIVERY PEOPLE

Provided by Dr. Lea Ann Dailey

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This time we would like to introduce **PROF. DR. DAGMAR FISCHER** as our featured Drug Delivery Scientist. Prof. Fischer studied pharmacy at the Julius Maximilian University in Würzburg, Germany, followed by a PhD on the topic of non-viral gene delivery at the Philipps University of Marburg, Germany. She remained in Marburg until 2004 whilst pursuing her habilitation, after which she accepted a position as Head of Preclinical Research and Development at Antisense Pharma GmbH. In 2008 she returned to academia as Professor of Pharmaceutical Technology and Biopharmacy at the Friedrich Schiller University in Jena, Germany. Whilst in Jena she has held the post of Dean of Studies from 2013-2016, in addition to taking leading roles in several scientific and professional societies, including general secretary of the German Pharmaceutical Society (DPHG), deputy director of the Jena Center for Soft Matter, past president of the Controlled Release Society German Local Chapter as well as an APV Education and Science focus group member.



During her career, Prof. Fischer has become one of the leading experts in nanotechnology for healthcare and cosmetic applications. Her research interests are centred on the applications of new polymeric biomaterials across a wide range of products. Her interests extend from basic science covering material science, nanotoxicology, exploring alternative methods to animal testing, and preclinical drug development to applications ranging from gene therapy, inflammation, infections and imaging technologies. Her current projects include the development of bacterial nanocellulose as a drug delivery system, understanding biological elimination pathways of complex diagnostic nanoparticles (NanoBel), and modulation of the "silent" aging-associated inflammatory processes through the use of natural products and innovative carrier systems (InflammAging).

FEATURED ARTICLE

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DEVELOPMENT OF PEDIATRIC MEDICINES

By Pascale Clement, Ph.D. (Director, Project Management), William Wei Lim Chin, Ph.D. (Technical Specialist, Science & Technology), and Uwe Hanenberg, Ph.D. (Director, Product Development, Science & Technology)
All: Catalent Pharma Solutions

Introduction

The task of developing medicines for the various pediatric age groupings (preterm newborn, term newborn, infants and toddlers, children (2 to 11 years) and adolescents) can be challenging. Physiological changes happen from birth through to adolescence, leading to differences in pharmacokinetics (PK) and pharmacodynamics (PD). This can require different formulations, different dosage forms and strengths, or different routes of administration to ensure the proper treatment of children of all age groups. The following Q&A will help you to get good overview before getting started on the development of a pediatric medicine.

Q1 - What are the special challenges in the development of oral dosage form for pediatric use?

The biggest challenge in pediatric oral solid formulation development is to develop flexible dosage forms that allow the dose to be measured and easily administered, and which are preferably formulated with taste-masking properties for better acceptance of the drug formulation by children. There are some limitations of the various dosage forms and their possible adverse impact on patient safety, acceptability as well as swallowability. For example, oral solid dosage forms are associated with limited dose flexibility and risk of aspiration or choking, depending on the size and shape of the tablet or capsule. Oral liquids present challenges in terms of physical, chemical, and microbiological stability. Both oral solids and liquids have to be palatable and are likely to require taste-masking. The measurement and administration of

oral liquid and oral solid dosage forms can lead to improper dosing and potentially toxicity concerns. Special attention must also be given to the use of appropriate excipients for children from different age groups to avoid excipient toxicity.

Q2 - What are the specifics that need to be considered for the development of pediatric medicines?

The following specifics need to be considered when developing medicines for children:

- Pediatric medication may need a different drug delivery technology compared to adult medication with the same API.
- Not all excipients suitable for adults can be used in pediatric formulations.
- Selected excipients should be reduced to the minimum needed
- Minimal dosing frequency
- Swallowability needs to be considered
- Risk of choking needs to be considered
- Acceptance of treatment needs to be a strong focus (influenced by age, culture, health status, behavior, social background, route of administration, taste of medication, duration of treatment, convenience of administration)

Q3 - Which oral dose form is most accepted by children?

The preference towards dosage forms primarily differed based on age and prior use. Initial findings revealed that minitables and syrups were found to be the most acceptable formulations to toddlers and infants. Granules and multi-particulates incorporating taste masking technologies may also be appropriate dosage forms for infants. It is also reported that children across ages have preference for chewable and orodispersible preparations when compared with multi-particulates such as sprinkles.

Q4 – How is the pharma industry addressing the requirement of age dependent dosing of oral dose forms?

Industry is addressing the need for easy, reliable, flexible dosing of paediatric oral dose forms by using the following:

- Dosing mini-tablets using counting devices
- Powders for reconstitution; solution to be dosed by volume (e.g. powder in a bottle, powder in a stick pack)
- Liquids/syrups to be dosed by volume
- Conventional solid formulations in different dosage strength → different formulations may be required

Q5 - With all the challenges in developing a suitable formulation for pediatric use, what are the most promising technologies, which are available today?

There is no single technology that fits perfectly for paediatric drug development. Technologies that offer options for age appropriate formulation would be desirable. Therefore, technologies that produce small oral dosage forms like mini-tablets or pellets, mini-softgels, chewables or orally dispersible tablets stand a promising chance for better compliance in a paediatric population.

Q6 - Is there a concern for food effects in pediatric patients?

The potential drug-food or vehicle interaction in children adds further to the complexity. It is quite common for medication to be mixed with or dissolved in food or liquids to improve delivery and palatability. The quantity and the composition of food required to generate a food effect in children is not clearly understood now. Additionally, it is possible that mixing oral dosage forms with foods and drinks could have an impact on the physicochemical stability of the drug and/or formulation.

Q7 - What are the PK/PD differences between adults and children?

The differences in PK/PD are caused by the physical, metabolic and physiological processes inherent to growth of children. Gastric pH (first three years, especially first weeks), intestinal fluid volume and composition, immaturity of bile and pancreatic fluid secretion, and intestinal transit time can all have a significant impact on drug exposure. Differences related to total body water, plasma-protein binding, metabolic enzymes, first pass effect, glomerular filtration, renal secretion and renal absorption lead to differences in clearance between adults and children. A further significant difference between children and adults can be the permeation of the drug through the epithelial layer of the gastrointestinal tract, which has often a smaller value in children compared to adults – the permeability of APIs can, but must not, be lower. In some cases, (e.g. Dolansetron, Ketoprofen or Voriconazole) this leads to a switch in the BCS class from 1 (adult) to 3 (children) or from 2 (adult) to 4 (children) with associated impact on formulation and bioavailability enhancement requirements for the paediatric formulations.

Q8 – Do regulatory authorities reflect the specific needs of pediatric medicines in their regulations?

The needs of pediatric medicine are reflected in the current drug regulatory environment. In the US, the Best Pharmaceuticals for Children Act and Pediatric Research Equity Act, which were previously subjected to reauthorization every 5 years, were made permanent under the Food and Drug Administration Safety and Innovation Act in 2012. In the European Union, Paediatric Regulation came into effect in 2007 and since then, no new drug can be registered in the EU without a detailed Paediatric Investigation Plans being approved by the EMA's Paediatric Committee.

Q9 - What are the known consortiums in the pediatric drug development field?

Many initiatives within industry, regulators and academia have been spurred with respect to the development of medicines for pediatric age groups and to improve the availability of information on the use of medicines in children. For example, the European Pediatric Formulation Initiative (EuPFI), a group composed of pediatric formulation experts from industry, academia, and clinical pharmacy, was founded with the aim to raise awareness of pediatric formulation issues and provide recommendations for formulation development plans [1]. Another network, the European Network of Pediatric Research (Enpr-EMA) [2] was established by the European Medicines Agency to encourage collaboration between academic and industry members from within and outside the European Union.

The content of the article was published in a podcast entitled [Pediatric Drug Delivery - Challenges and Solutions](#) by Pharmaceutical Technology on March 22, 2017.

References and Further Reading

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- [2] European Network of Paediatric Research website http://www.ema.europa.eu/ema/index.jsp?curl=pages/partners_and_networks/general/general_content_000303.jsp
- [3] Lopez, F.L., Ernest T.B., Tuleu, C. and Orlu Gul, M. Formulation approaches to pediatric oral drug delivery: benefits and limitations of current platforms. *Expert Opin Drug Deliv.* (2015), 12(11): 1727–1740.
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- [5] Batchelor, H. K., Fokati, N. and Klein S. Paediatric oral biopharmaceutics: Key considerations and current challenges. *Adv. Drug Deliv. Rev.* (2014) 73:102-26.

DRUG DELIVERY LITERATURE

Provided by Dr. Carsten Timpe

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RECENTLY PUBLISHED LITERATURE REVIEWS IN THE FIELD OF DRUG DELIVERY

STRUCTURAL MODIFICATIONS OF DS FOR SOLUBILITY ENHANCEMENT (AMORPHOUS DRUG DELIVERY SYSTEMS, COCRYSTALS, POLYMORPHISM)

Pharmaceutical cocrystals: walking the talk, Bolla G, Nangia A.. *Chem Commun(Camb)*. 2016 Jun 28;52(54):8342-60

In this feature review, some prominent examples of drug cocrystals are highlighted which exhibit variable hardness/softness and elasticity/plasticity depending on cofomer selection, improvement of solubility and permeability in the same cocrystal, increase of the melting point for solid formulation, enhanced color performance, photostability and hydration stability, and a longer half-life

PEPTIDE, PROTEIN-BASED DRUG DELIVERY

Peptide-Drug Conjugate: A Novel Drug Design Approach, Ma L, Wang C, He Z, Cheng B, Zheng L, Huang K. *Curr Med Chem*. 2017;24(31):3373-3396

In this review, the principles of design, synthesis approaches and the latest advances of Peptide-drug conjugates (PDCs) are summarized

CANCER THERAPY

Supramolecular Delivery Systems for Non-Platinum Metal-Based Anticancer Drugs, Ringhieri P, Morelli G, Accardo A., *Crit Rev Ther Drug Carrier Syst*.2017;34(2):149-183

The present review reports on the state of the art of these new, nonplatinum, anticancer metallodrugs delivered by nanosized vehicles. The development and drug delivery selection of complexes of ruthenium, gold, cobalt, copper, gallium, and others that show promising antitumor efficacy is reported

DERMAL AND TRANSDERMAL DRUG DELIVERY

Bioresponsive transcutaneous patches, Yu J, Zhang Y, Kahkoska AR, Gu Z.. *Curr Opin Biotechnol*. 2017 Dec;48:28-32.

This review surveys the recent advances in the development and use of bioresponsive transcutaneous patches for on-demand smart and precise drug delivery, exploiting different physiological signals including pH, serum glucose levels, and enzyme activity. The clinical potential of these devices, including challenges and opportunities, is also discussed.

GENE DRUG DELIVERY, GENE THERAPY, siRNAs

Nanoengineered strategies for siRNA delivery: from target assessment to cancer therapeutic efficacy, Mishra DK, Balekar N, Mishra PK.. *Drug Deliv. Transl Res*. 2017 Apr;7(2):346-358

This review focuses on gene-silencing mechanisms, challenges to siRNA delivery, design and delivery of nanocarrier systems, ongoing clinical trials, and translational prospects for siRNA-mediated cancer therapeutics.

NANOSYSTEM-BASED DRUG DELIVERY

Update on Nanotechnology-based Drug Delivery Systems in Cancer Treatment, Ho BN, Pfeffer CM, Singh ATK. *Anticancer Res.* 2017 Nov;37(11):5975-5981.

Review on the recent advances in nanotechnology-based approaches in cancer treatment.

Nano-Delivery in Pediatric Tumors: Looking Back, Moving Forward. Colletti M, Paolo VD, Galardi A, Milano GM, Mastronuzzi A, Locatelli F, Di Giannatale A. *Anticancer Agents Med Chem.* 2017;17(10):1328-1343

In this review, recent advances in the treatment of pediatric tumors through nanodelivery system with particular attention to neuroblastoma, soft-tissues/bone sarcomas and pediatric brain tumors are described. Furthermore the potential role of exosomes as an effective option of nanodelivery is explored providing insights into their characteristics in pediatric tumors and their use in adult clinical trials.

OCULAR DRUG DELIVERY

Drug delivery to the eye: what benefits do nanocarriers offer?, Joseph RR, Venkatraman SS. *Nanomedicine (Lond).* 2017 Mar;12(6):683-702

This review summarizes the recent advances in sustained ocular therapy, both to the anterior and posterior segments, which have been made possible, thanks to nanotechnology. Also the distribution and fate of these nanocarriers themselves, postadministration, as well as clearance from ocular tissues are discussed.

Pharmacokinetic aspects of retinal drug delivery, Del Amo EM, Rimpelä AK, Heikkinen E, Kari OK, Ramsay E, La-junen T, Schmitt M, Pelkonen L, Bhattacharya M, Richardson D, Subrizi A, Turunen T, Reinisalo M, Itkonen J, Toropainen E, Casteleijn M, Kidron H, Antopolsky M, Vellonen KS, Rupunen M, Urtti A.. *Prog Retin , Eye Res.* 2017 Mar;57:134-185

Drug delivery to the posterior eye segment is an important challenge in ophthalmology, because many diseases affect the retina and choroid leading to impaired vision or blindness. This article does not include an extensive review of drug delivery technologies, because they have already been reviewed several times recently. Instead, it is the aim to provide a systematic and quantitative view on the pharmacokinetic factors in drug delivery to the posterior eye segment.

ORAL DRUG DELIVERY

Novel strategies in the oral delivery of antidiabetic peptide drugs - Insulin, GLP 1 and its analogs, Ismail R, Csóka I. . *Eur J Pharm Biopharm.* 2017 Jun;115:257-267

This review focuses on currently developed strategies to improve oral bioavailability of these peptide based drugs: evaluating their advantages and limitations in addition to discussing future perspectives on oral peptides delivery

Challenges in oral drug delivery of antiretrovirals and the innovative strategies to overcome them, Sosnik A, Augustine R. *Adv Drug Deliv Rev.* 2016 Aug 1;103:105-20.

The present review highlights various innovative research strategies adopted to overcome the limitations of the present treatment regimens and to enhance the efficacy of the oral antiretroviral therapy in HIV

Safety concerns over the use of intestinal permeation enhancers: A mini-review. McCartney F, Gleeson JP, Brayden DJ.. *Tissue Barriers.* 2016 Apr 12;4(2)

Intestinal permeation enhancers (PEs) are key components in ~12 oral peptide formulations in clinical trials for a range of molecules, primarily insulin and glucagon-like-peptide 1 (GLP-1) analogs. The review discusses as to whether PEs can cause irreversible epithelial damage and tight junction openings sufficient to permit co-absorption of payloads with bystander pathogens, lipopolysaccharides and its fragment, or exo- and endotoxins that may be associated with sepsis, inflammation and autoimmune conditions.

PULMONARY DRUG DELIVERY

Magnetic nanoparticles-based drug and gene delivery systems for the treatment of pulmonary diseases, El-Sherbiny IM, Elbaz NM, Sedki M, Elgammal A, Yacoub MH.. *Nanomedicine (Lond).* 2017 Feb;12(4):387-402.

This review provides an overview on the unique properties of magnetic nanoparticles (MNPs) and magnetic-mediated hyperthermia with emphasis on the recent biomedical applications of MNPs in treatment of both lung cancer and cystic fibrosis.

ALTERNATIVE APPLICATION ROUTES (E.G. INTRATHECAL, BRAIN DELIVERY ETC.)

Nanomedicines for the Treatment of CNS Diseases. Reynolds JL, Mahato RI. *J. Neuroimmune Pharmacol.* 2017 Mar;12(1):1-5

In this thematic issue, several reviews and original research are presented that address "Nanomedicines for CNS Diseases."

The APV Drug Delivery Focus Group (APV DD) is a section of the APV (Arbeitsgemeinschaft für Pharmazeutische Verfahrenstechnik e.V. / International Association for Pharmaceutical Technology), a major European society for those sharing a professional interest in pharmaceutical sciences. The Focus Group was established in 2003 in response to the increasing importance of drug delivery within modern pharmaceuticals.

[Read more.](#) [Contact us.](#)

COMBINING SCIENCE AND TECHNOLOGY TO CREATE ADVANCED DRUG DELIVERY SYSTEMS

OUR MISSION STATEMENT:

Modern drug delivery research and development is a truly multidisciplinary approach and must combine all relevant scientific, technical, medical and regulatory aspects required for the design, preparation, testing, manufacturing and registration of drug delivery systems and their components. It is the mission of the APV Drug Delivery Working Group to foster and promote all aspects of research and development required to transform drug molecules into safe, applicable and acceptable drug delivery systems, which provide therapeutic benefit, convenience to the patient and improve patient compliance.

Our mission includes in particular the following tasks:

- Thoroughly understanding the physical-chemical and biopharmaceutical properties of the drug substance to be delivered and the components of the drug delivery system
- Understanding the biological barriers and the interactions of the drug molecule and its delivery system with the biological environment and the biological target including PK/PD and PK/safety relationships
- Research on excipients, materials and technologies required for the design, preparation and manufacturing of drug delivery systems for a selected route of administration
- Development and understanding of methods for in vitro and in vivo evaluation of drug delivery systems and their components
- Knowledge of regulatory requirements for clinical testing, manufacturing and registration of drug delivery systems

All disciplines relevant to the above mentioned areas of drug delivery R&D are invited to contribute to the APV Drug Delivery Group:

Pharmaceutics, Biopharmaceutics, Analytics, Biology, Physical Chemistry, Biochemistry, Physics, Engineering Sciences, Nano Technology, Material Sciences, Polymer Science, Toxicology, Drug Safety, Clinical Research, Drug Regulatory Affairs, etc.

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