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Special Issue: Advances in Drug Delivery Systems

Editorial

The 'What, Why, Where and How' of Delivering a Drug

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Drug delivery is an important aspect in drug development as, without an effective targeted and suitable delivery system, the drug would not be useful. Numerous parameters are considered towards designing successful drug delivery systems. For example, it would require understanding the properties of the drug being delivered (what), its purpose (why), and the knowledge of the target organ or tissue the drug is being delivered to (where). These in turn will help determine the type of delivery system that should be used (how). These and other factors are interdependent on each other and the optimization of all usually leads to a successful delivery system for patients.

As such the field of drug delivery can then encompass several sub-topics ranging from delivery routes to delivery materials and this special issue in TIPS covers some of these. The issue starts with two Spotlights by Angsantikul and Mitragotri [1] and Minko [2]. While Angsantikul and Mitragotri [1] highlight a recent article by Mann *et al.* [3] describing the work towards generating an ultrafast-acting insulin by adding polyacrylamide-based excipients, Minko [2] highlights the work from Saraswat *et al.* [4] to develop a nanoformulation for delivery of a selective bromodomain-containing protein 4 (BRD4) protein degrader, ARV in pancreatic cancer. A Forum article by Caprifico *et al.* [5] then briefly discusses the use of fluorescein isothiocyanate tagged chitosan nanoparticles as a tracking tool to monitor the fate of the drug-loaded nanoparticles.

These short articles are followed by an Opinion piece by Mao *et al.* [6] proposing that bioactive molecules that maintain the blood-testis barrier can be utilized to transport drugs across it and other blood-tissue barriers. A Review by Huang and colleagues [7] discusses recent developments in nano targeted drug delivery systems-based modulation of tumor-associated macrophage in cancer immunotherapy. This is followed by a Review by Lam and colleagues [8] that reviews the recent development in pulmonary delivery systems for RNA therapeutics and provides insights on the gap in knowledge in the field, that will help advance the field. This and another Review by Dammes and Peer [9] that discusses the advances in RNA therapeutics and its delivery strategies in the recent years, are particularly timely in the context of the COVID-19 pandemic where 2 of the vaccine candidates that are currently in phase III clinical trials utilize the RNA platform¹.

The collection is rounded off by two other Reviews by Guo *et al.* [10] and Goswami *et al.* [11]. While Guo *et al.* [10] present an overview of cancer nanomedicines in four emerging oncology-associated fields of gene therapy, immunotherapy, extracellular vesicle therapy, and machine learning assisted therapy, Goswami *et al.* [11] discuss different endosomal escape strategies and focus on cell membrane fusion as a strategy to deliver protein therapeutics directly into the cell cytoplasm for efficient drug delivery.

I hope that you, the readers of TIPS, will find the content of this special issue enjoyable. I will end by highlighting that even under "normal" circumstances, a special issue in a journal reflects the hard work and collaboration between authors and reviewers in the field who come together via

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the journal platform to ensure that the best content is generated for the associated scientific community. This special issue is significantly special for TIPS given that it came together in the middle of a global pandemic which has upset lives across the world and resulted in thousands of fatalities. I am therefore immensely thankful to the authors and the reviewers who contributed their time towards this collection in a period of such upheaval. Finally, I would also like to thank the entire production team of TIPS who continue to race against time to ensure timely production of all articles at the journal in such trying times.

As always, I look forward to hearing from you and can be reached at kmukherjee@cell.com, tips@cell.com or [@TrendsinPharma](https://twitter.com/TrendsinPharma).

Resource

<https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines>

References

1. Angsantikul, P. and Mitragotri, S. (2020) Amphiphilic polyacrylamide excipients lead to a record-breaking fast-acting insulin. *Trends Pharmacol. Sci.* 41, 681–684
2. Minko, T. (2020) Nanoformulation of BRD4-degrading PROTAC: Improving druggability to target the 'undruggable' MYC in pancreatic cancer. *Trends Pharmacol. Sci.* 41, 684–686
3. Mann, J.L. *et al.* (2020) An ultrafast insulin formulation enabled by high-throughput screening of engineered polymeric excipients. *Sci. Transl. Med.* 12, eaba6676
4. Saraswat, A. *et al.* (2020) Nanoformulation of PROteolysis TARgeting Chimera targeting 'undruggable' c-Myc for the treatment of pancreatic cancer. *Nanomedicine (Lond.)* 15, 1761–1777
5. Caprifico, A. *et al.* (2020) Fluorescein isothiocyanate chitosan nanoparticles in oral drug delivery studies. *Trends Pharmacol. Sci.* 41, 686–689
6. Mao, B. *et al.* (2020) Modulating the blood–testis barrier towards increasing Drug delivery. *Trends Pharmacol. Sci.* 41, 690–700
7. Yang, Y. *et al.* (2020) Tackling TAMs for cancer immunotherapy: It's nano time! *Trends Pharmacol. Sci.* 41, 701–714
8. Chow, M.Y.T. *et al.* (2020) Inhaled RNA therapy: from promise to reality. *Trends Pharmacol. Sci.* 41, 715–729
9. Dammes, N. and Peer, D. (2020) Paving the road for RNA therapeutics. *Trends Pharmacol. Sci.* 41, 755–775
10. Guo, P. *et al.* (2020) Cancer nanomedicines in an evolving oncology landscape. *Trends Pharmacol. Sci.* 41, 730–742
11. Goswami, R. *et al.* (2020) Accessing intracellular targets through nanocarrier-mediated cytosolic protein delivery. *Trends Pharmacol. Sci.* 41, 743–754