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Medicinal Chemistry and Therapeutics

Editorial

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Current Trends in Medicinal Chemistry and Its Future

Medicinal chemistry is a multidisciplinary area in chemistry that connects chemistry, applied chemistry, pharmacy, and relevant areas. It also directed to discovery, development, and refinement of therapies for plants and animals. In modern science, it is presently a fast and demanding interdisciplinary research area (Patrick, 2023). It mainly aims to improve our lives through synthesizing, characterizing, and developing new drugs as well as modifying existing bioactive moieties to combat various diseases and disorders (Toenjes & Gustafson, 2018).

In general, medicinal chemistry discusses the design, chemical synthesis, and development of new formulations with the help of organic chemistry, pharmacology, and biological perspectives. Traditionally, medicinal chemistry started its journey from plant products to manage various ailments in humans. Sumerian civilization used hundreds of medicinal plants (over 250 plants), including opium on clay tablets in 3000 BC (around 5000 years ago). Many records have been identified in Babylon, Egypt, China, ancient Greece, Rome, and India about the use of medicinal plants and their derivatives in human diseases. Hippocrates and Galen also described the therapeutic value of plants (Jampilek, 2019; Patrick, 2023). However, the information regarding the usage of plants was gathered into 'Materia Medica' and pharmacopoeias during the Middle Ages. The seventeenth and eighteenth centuries are the golden age for the discovery of several useful medicinal plants (Farrant, 2020). Salicylic acid, discovered from willow bark in 1870 with an analgesic effect, was a breakthrough in medicinal chemistry. Currently, we have more than 120 important drugs that are derived from medicinal plants and are used worldwide. And now our medical library is rich with thousands of bioactive compounds.

Lipinski's rule of five (Pfizer's rule of five, rule of thumb, or the rule of five (RO5)) evaluates drug likeness based on the observation that most orally administered drugs are relatively small and moderately lipophilic molecules. This rule describes molecular properties important for a drug's ADME (absorption, distribution, metabolism, and excretion) in a human body (Lipinski, 2016). In the past, synthesis and modifications of bioactive compounds as well as small molecular weight compounds were highly discussed. However, in the modern era, there is more concern about simpler-to-assemble, higher molecular weight compounds and targeted degradation derivatives, which are of great interest, which is pushing us to think about the fate of RO5 in the near future (Eyube, 2024).

Modern medicinal chemistry believes that a specific disease needs a specific treatment (Eyube, 2024). Although viral infections are yet to be managed with targeted molecules, which we normally rely on preventive vaccinations for, many bacterial infection cases have been solved by current antibiotic therapies. To date, various strategies have been followed in the case of cancer, metabolic and neurological diseases and disorders, and so on. Simpler-to-assemble, higher molecular weight compounds, such as PROteolysis Targeting Chimeras (PROTACs), have been identified as promising candidates in cancer, infectious diseases, etc. (Zhao et al., 2023) Another practical example is antisense oligonucleotides that are increasing interest for the treatment of infectious diseases (Watts, 2018).

Nano-based drug synthesis and utilization is another interesting sector of modern medicinal chemistry (Mattioli et al., 2024). On the other hand, pro-drug development, modulator synthesis, enzymatic preparation, targeting protein–protein druggable cavities, and so on are some other important strategies of modern medicinal chemistry (Vanden Eynde et al., 2019). Modern medicinal chemistry has an advanced focus on solubility modification, bioavailability enhancement, and toxicity management in the host.

One potential limitation for the medicinal chemistry has been identified since its starting point is the slowest process to discover a new drug candidate (Partridge et al., 2020). However, combinatorial synthesis and diversity-oriented synthesis are known key technologies to solve this issue (Kennedy et al., 2008; Collins et al., 2016). Therefore, the generation of structurally diverse hit compounds is possible in a short period of time for the biological assays. Moreover, virtual screening, either structure-, ligand-, or fragment-based techniques, has been discovered as some potential new ways for the discovery of new active molecules (Zhou et al., 2021). Additionally, activity-directed synthesis is another emerging approach that allows crude reaction mixtures to be directly screened for checking biological activity (Karageorgis et al., 2020). Therefore, current approaches in medicinal chemistry are not centered on the generation of academic knowledge; their consequential approaches and advantages are also directed towards the industrial production of new therapeutic molecules.

The COVID-19 situation also proves that medicinal scientists played pivotal roles through collaboration and sharing research data (Ghosh et al., 2020); is it possible to handle the upcoming challenges? In short, medicinal chemistry is a multidisciplinary subject that accommodates knowledge, skills, techniques, and approaches with advanced technologies to do for the human beings and other animals and resolve existing and upcoming challenges worldwide.

Editorial Note

Not peer reviewed.

Conflict of Interest

The author declared that they have no conflict of interest.

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https://doi.org/10.71193/jmct.20250003
Journal Home Page: Journal of Medicinal Chemistry and Therapeutics

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Journal of Medicinal Chemistry and Therapeutics

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Received: 5 March 2025

Published: 20 March 2025