



A review on patient-centric drug product design in modern drug delivery systems

Nazemoon Reddy *, J. Shivani, J. Swathi Rathod, K. Arun Kumar and K. Jhansee Rani

Department of Pharmaceutics, Bharat Institute of Pharmacy.

GSC Biological and Pharmaceutical Sciences, 2026, 35(01), 068-074

Publication history: Received on 02 January 2026; revised on 31 March 2026; accepted on 3 April 2026

Article DOI: <https://doi.org/10.30574/gscbps.2026.35.1.0053>

Abstract

Patient-centric drug product design focuses on developing pharmaceutical products that meet the specific needs and preferences of patients. Traditional drug delivery systems often present challenges such as difficulty in administration, non-specific distribution, discomfort or irritation, stability issues, and an increased risk of adverse effects. With more people living with chronic diseases and diverse healthcare needs, designing drugs with the patient in mind has become increasingly important. Patient-centric drug delivery systems aim to overcome these challenges by considering factors such as age, disease condition, route of administration, and overall convenience, making treatment easier, safer, and more effective, ultimately improving healthcare outcomes. This review explores the concept of patient-centric drug product design and its role in modern drug delivery systems, highlighting key aspects such as dosage form design, routes of administration, dosing schedules, and discussing the benefits and challenges of patient-centric approaches. Patient-centric drug product design helps in reducing treatment burden by simplifying drug administration and improving dosing convenience. It also considers patient feedback during formulation development to ensure better acceptability. This approach supports improved medication adherence, especially in long-term therapies. By addressing patient needs, modern drug delivery systems help in achieving consistent therapeutic response. Overall, patient-centric design contributes to safer and more effective healthcare delivery.

Keywords: Patient-centric design; Drug delivery systems; Patient compliance; Pharmaceutical medicine; Personalized medicine

1. Introduction

Modern healthcare is moving towards designing treatments that meet patient needs. Traditional drug delivery systems fail to consider patient requirements this may lead to improper dosing, reduced effectiveness and less response.

Patient-centric drug design focuses on developing pharmaceutical products that are easy and safe to use and acceptable by the patients. It considers the factors such as dosage form, route

of administration, dosing frequency and patient preferences. This improves the patient acceptability and overall quality of life. In conventional drug development, limited attention was given to patient experience, which often resulted in poor adherence to therapy. Factors such as difficulty in swallowing, unpleasant taste, frequent dosing schedules, and fear of injections can negatively affect patient compliance. Patient-centric drug product design addresses these challenges by modifying dosage forms and delivery methods according to patient requirements. It also supports the development of flexible dosing options that can be easily adjusted for individual needs. By improving ease of use and treatment comfort, patient-centric approaches help patients follow their medication regimen more effectively. This ultimately leads to improved therapeutic success and reduced healthcare burden.

* Corresponding author: Nazemoon Reddy

This review highlights the concept of a patient-centric drug delivery system. It discusses benefits, challenges and future directions emphasizing how this strategy is patient-friendly pharmaceutical care.

2. Concept of Patient-Centric Drug Product Design

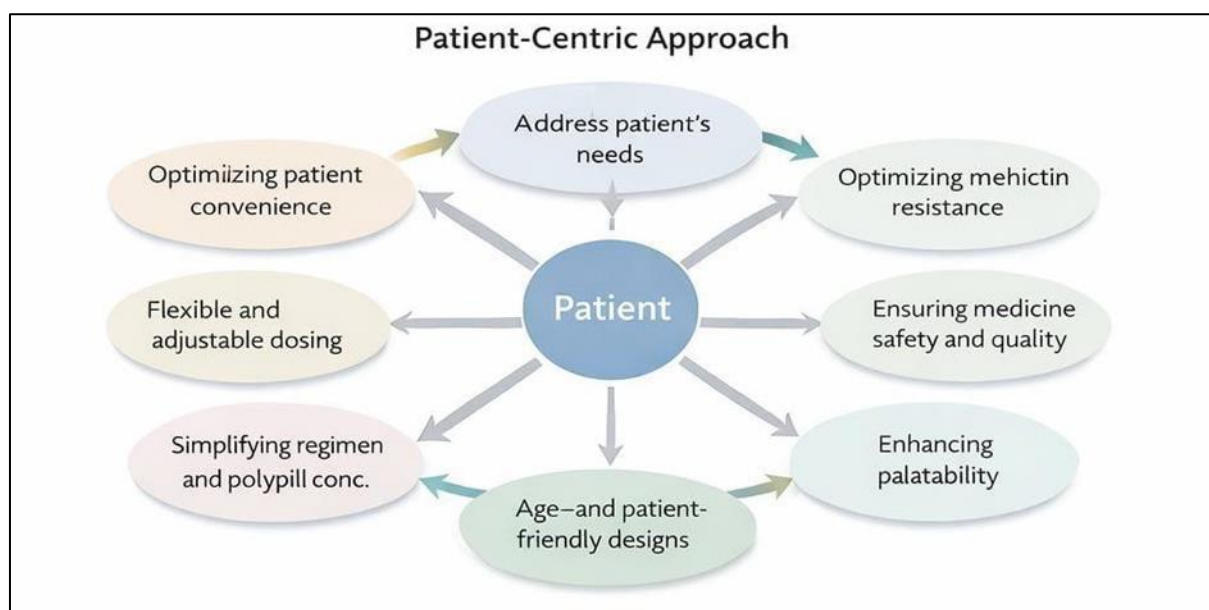
Patient-centric drug product design is an approach that puts the needs, preferences, and convenience of patients at the center of pharmaceutical development. Unlike traditional drug delivery systems, which mainly focus on the chemical or therapeutic aspects of a medicine, patient-centric design considers how the patient will actually use the medicine in real life.

This approach takes into account factors such as dosage form, route of administration, ease of swallowing or applying, taste, packaging, and dosing frequency. The main goal is to make medicines easier, safer, and more acceptable for patients, which in turn improves medication adherence and therapeutic outcomes. Patient-centric design is particularly important for special populations such as children, elderly patients, and people with chronic conditions, who may face challenges with standard dosage forms. By integrating patient preferences and capabilities into the design process, pharmaceutical products become not only more effective but also more user-friendly and supportive of daily life.

Several studies have shown that medicines designed with patient needs in mind lead to higher satisfaction, better adherence, and improved quality of life. This shift in focus is reshaping modern drug delivery and emphasizing the importance of patient-focused pharmaceutical care. Patient-centric drug product design also focuses on giving patients more comfort and flexibility while taking their medicines. Not all patients respond the same way to treatment, so medicines should be available in different strengths and dosage forms to suit individual needs. This is especially helpful for patients who require long-term treatment, as it reduces difficulty and inconvenience during daily medication use.

Another important aspect of this concept is safety and ease of handling. Medicines should be designed in a way that patients can use them correctly without confusion or discomfort. Simple packaging, clear instructions, and easy-to-use delivery devices help in reducing dosing errors and improving confidence in medication use.

Patient-centric design also encourages listening to patient experiences and challenges. When patient feedback is considered during drug development, medicines become more practical and acceptable in real-life situations. By understanding what patients actually need, pharmaceutical scientists can design drug products that support better treatment outcomes and improve overall patient satisfaction.



Source: Adapted from Stegemann S., Expert Opinion on Drug Delivery, 2018.

Figure 1 Concept of patient-centric drug product design

3. Importance of Patient-Centricity in Modern Drug Delivery

Patient-centricity in modern drug delivery is important because it directly affects how well patients can use and benefit from their medicines. Traditional drug delivery systems often do not account for the practical challenges patients face, such as difficulty swallowing tablets, frequent dosing schedules, discomfort during administration, or complex treatment regimens. These challenges can reduce medication adherence, leading to poor therapeutic outcomes and lower patient satisfaction.

By focusing on the patient, drug products can be designed to improve usability, safety, and comfort. For example, oral disintegrating tablets, transdermal patches, and long-acting injectables are developed to simplify treatment and reduce the burden on patients. Patient-centric approaches also consider special populations such as children, elderly patients, and patients with chronic illnesses, ensuring that medicines are accessible and appropriate for everyone.

Patient-centric approaches are especially important in chronic diseases where medicines must be taken for long periods. Drug delivery systems that reduce dosing frequency and discomfort make it easier for patients to continue their treatment without interruption. This leads to better disease control and reduced complications over time.

Modern drug delivery systems also benefit from patient centricity by improving safety and reducing medication errors. Easy-to-use dosage forms, clear instructions, and suitable packaging help patients understand and use their medicines correctly. This is particularly important for elderly patients and those with limited physical or cognitive abilities.

Overall, incorporating patient needs into drug design not only enhances treatment effectiveness but also supports better healthcare outcomes, higher adherence, and improved quality of life. Modern drug delivery systems that prioritize patient-centricity represent a shift toward more compassionate and effective pharmaceutical care.

4. Patient-Centric approaches in Drug designing

4.1. Oral drug delivery systems

Oral drug delivery is the most common route of administration, but traditional tablets and capsules can be difficult for some patients to swallow. Patient-centric oral systems include orally disintegrating tablets, chewable tablets, and smaller-sized tablets to improve ease of use. Taste-masked formulations and flavored syrups are also developed to increase acceptability, particularly for children and elderly patients. Flexible dosing options, such as liquid formulations or sprinkle capsules, help patients take their medications correctly and consistently.

Modern oral drug delivery systems also focus on improving drug bioavailability and reducing dosing frequency. Modified-release and sustained-release formulations help maintain consistent drug levels in the body and reduce the need for frequent dosing. This reduces treatment burden and improves adherence to therapy.

Additionally, patient-centric oral drug delivery systems aim to minimize side effects and gastrointestinal irritation. By optimizing formulation and release characteristics, drugs can be delivered more safely and effectively. Overall, oral drug delivery remains a key area where patient-centric design significantly enhances treatment success and patient satisfaction.

4.2. Transdermal drug delivery systems

Transdermal patches provide an alternative for patients who have difficulty swallowing oral medications or require steady drug levels over time. These systems are designed to be easy to apply and remove, comfortable to wear, and minimize skin irritation. Transdermal delivery also reduces the need for frequent dosing, which can improve adherence and convenience for patients managing chronic conditions.

Patient-centric transdermal systems such as patches are easy to apply and remove, improving patient comfort and acceptance. These systems provide controlled and sustained release of drugs, which helps in maintaining steady drug levels in the body. Reduced dosing frequency improves patient compliance, particularly in chronic conditions like cardiovascular and hormonal disorders.

Transdermal drug delivery also improves safety by reducing the risk of overdose and minimizing first-pass metabolism. Clear instructions, proper patch size, and skin-friendly adhesives further enhance ease of use. Overall, transdermal drug delivery systems represent an important patient-centric approach in modern drug delivery by offering a safe, convenient, and effective alternative to conventional dosage forms.

4.3. Long-Acting Injectable and Implantable systems

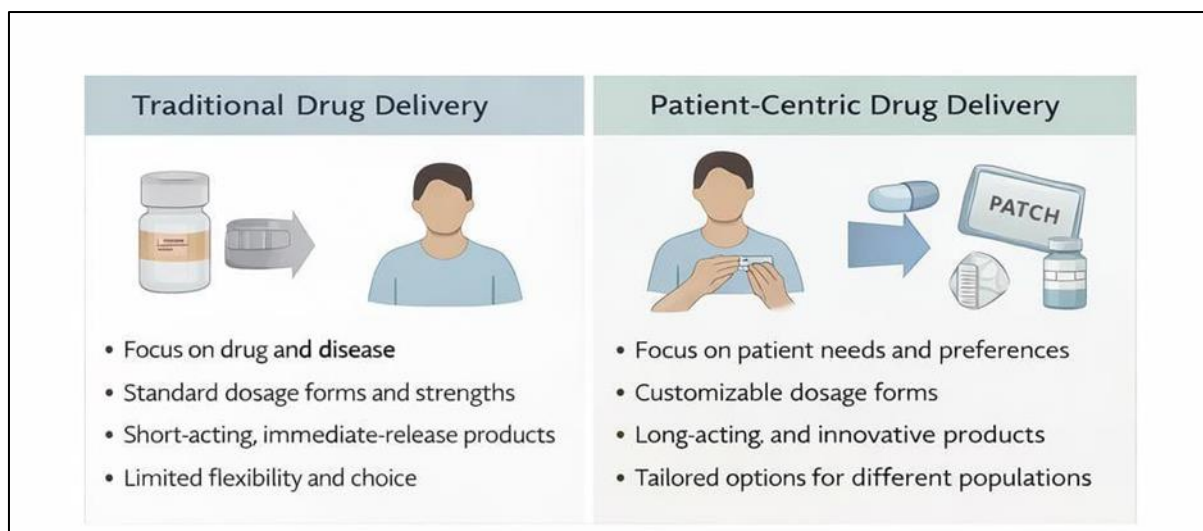
Long-acting injectables and implantable devices are increasingly used for chronic conditions, where frequent dosing may be challenging. These systems provide sustained drug release over weeks or months, reducing the burden of daily medication. By minimizing dosing frequency and simplifying treatment, patient-centric injectables improve adherence and treatment outcomes while supporting patient comfort and convenience.

These drug delivery systems improve patient compliance by providing sustained and controlled drug release with a single administration. Long-acting injectables are commonly used in chronic conditions such as psychiatric disorders, hormonal therapies, and infectious diseases, where consistent drug levels are essential for effective treatment. Implants offer similar benefits by continuously delivering drugs without the need for repeated injections.

Patient comfort and convenience are important considerations in the design of long-acting injectables and implants. Advances in formulation technology have helped reduce injection pain and improve biocompatibility of implant materials. Although initial administration requires medical assistance, the overall treatment burden is reduced, leading to improved patient satisfaction and better therapeutic outcomes.

4.4. Advantages of Patient-Centric Drug Delivery Systems

- Improves medication adherence by making medicines easier and more convenient to take
- Leads to better therapeutic outcomes through consistent and correct use of medicines
- Enhances patient comfort and satisfaction by considering taste, dosage form, and administration route
- Reduces the risk of adverse effects by minimizing errors in drug administration
- Supports a positive treatment experience and encourages long-term engagement with therapy
- Contributes to improved quality of life for patients
- Simplifies treatment regimens for patients with chronic diseases
- Increases patient confidence and trust in their therapy
- Provides flexibility for different patient populations, including children and elderly
- Encourages pharmaceutical innovation focused on patient needs
- Provide sustained and controlled drug release over a long period
- Maintain stable drug concentration in the body
- Reduce dosing frequency and treatment burden
- Improve patient compliance and adherence to therapy
- Minimize chances of missed doses and treatment failure
- Useful in chronic and long-term disease management
- Reduce fluctuations in plasma drug levels
- Lower risk of relapse in certain diseases
- Reduce frequent hospital visits and healthcare burden
- Provide discreet and convenient treatment options



Source: Adapted from Stegemann S., Expert Opinion on Drug Delivery, 2018.

Figure 2 Comparison between traditional and patient-centric drug delivery systems

5. Challenges in Patient-Centric Drug Delivery System

- Developing patient-friendly formulations can be costly and time-consuming regulatory requirements for new formulations may be complex and slow down approval
- Manufacturing patient-centric products can be challenging, especially for special populations
- Balancing effectiveness, safety, and patient convenience is difficult
- Ensuring the product is suitable for children, elderly, and patients with chronic conditions
- Limited availability of technology for certain advanced drug delivery systems
- Need for extensive patient testing and feedback to validate usability
- Potential increase in production and storage costs
- Difficulty in maintaining stability and shelf-life in specialized formulations
- Challenges in educating patients and healthcare providers about new dosage forms
- Requires trained healthcare professionals for administration
- Risk of pain, discomfort, or infection at the injection or implant site
- Difficulty in dose adjustment once administered
- Removal of implant may require minor surgical procedure
- Possibility of local irritation or allergic reactions
- Limited patient acceptance due to fear of injections or implants
- Complex regulatory approval process
- Not suitable for all drugs or all patient populations

6. Future perspectives of Patient-Centric Drug Delivery Systems

- Increasing focus on personalized and precision medicine
- Use of technology such as digital health tools and smart devices for monitoring
- Development of long-acting injectables and implantable systems for better adherence
- Integration of patient feedback and real-world data into drug design
- Application of artificial intelligence to optimize formulation and dosing
- Greater involvement of patients in decision-making and product development
- Expansion of drug delivery options for special populations
- Innovations in dosage forms that improve convenience and safety
- Focus on cost-effective solutions while maintaining patient-centered benefits
- Shift towards standard practice of patient-centric design in pharmaceutical care
- Use of advanced materials to improve safety and biocompatibility
- Integration of digital health technologies to monitor drug delivery and adherence
- Improved long-acting formulations with better dose control

- Development of biodegradable implants to avoid surgical removal
- Enhanced patient involvement and feedback during drug development
- Simplification of drug delivery devices for better ease of use
- Wider application of patient-centric approaches in chronic disease management

7. Conclusion

Patient-centric drug product design has emerged as an important approach in modern drug delivery systems by focusing on patient needs, preferences, and real-world use of medicines. Unlike traditional drug delivery systems, this approach considers factors such as age, disease condition, route of administration, dosing frequency, and ease of use to improve treatment outcomes. By enhancing patient comfort, adherence, and safety, patient-centric drug delivery helps in achieving better therapeutic effectiveness, especially in chronic diseases and long-term therapies. Although challenges such as formulation complexity, cost, and regulatory considerations still exist, continuous advancements in pharmaceutical technology and patient involvement in drug development are addressing these limitations. Overall, patient-centric drug product design represents a promising strategy for improving healthcare quality and ensuring more effective and acceptable drug therapies in the future.

Patient centricity also encourages the use of innovative technologies, personalized therapy, and patient feedback during drug development. These strategies help reduce treatment burden, minimize medication errors, and enhance overall patient satisfaction. Looking ahead, patient-centric approaches are expected to play an even bigger role in healthcare, making treatments more effective, acceptable, and aligned with real-world patient needs.

Overall, patient-centric drug delivery represents the future of pharmaceutical development, bridging the gap between drug formulation and patient well-being, and ensuring that medicines truly serve those who need them.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

References

- [1] Menditto E, Orlando V, De Rosa G, Minghetti P, Musazzi UM, Cahir C, et al. Patient centric pharmaceutical drug product design—the impact on medication adherence.
- [2] *Pharmaceutics*.2020;12(1):44. <https://www.mdpi.com/1999-4923/12/1/44>
- [3] Stegemann S. Patient centric drug product design in modern drug delivery as an opportunity to increase safety and effectiveness.
- [4] *Expert Opin Drug Deliv*.2018;15(4):619–27.<https://pubmed.ncbi.nlm.nih.gov/29719161/>
- [5] Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications.
- [6] *BrJ Clin Pharmacol*.2012;73(4):691–705.<https://pubmed.ncbi.nlm.nih.gov/22958337/>
- [7] Smart design of patient-centric long-acting products: from preclinical to marketed pipeline trends and opportunities.
- [8] *PubMed*.<https://pubmed.ncbi.nlm.nih.gov/35877189/>
- [9] Patient centricity driving formulation innovation: improvements in patient care facilitated by novel therapeutics and drug delivery technologies.
- [10] *PubMed*.<https://pubmed.ncbi.nlm.nih.gov/34990203/>
- [11] Shariff Z, Kirby D, Missaghi S, Rajabi-Siahboomi A, Maidment I. Patient-centric medicine design: key characteristics of oral solid dosage forms that improve adherence and acceptance in older people.
- [12] *Pharmaceutics*.2020;12(10):905. <https://www.mdpi.com/1999-4923/12/10/905>

- [13] Future perspectives for patient-centric pharmaceutical drug product design with regard to solid oral dosage forms.
- [14] JPharmInnov.2019;15:318–24.<https://link.springer.com/article/10.1007/s12247-019-09407-2>
- [15] Development and evaluation of a patient-centric approach for accurate medication capture. PubMed.
- [16] <https://pubmed.ncbi.nlm.nih.gov/41113505/>