Journal of Advances in Drug Research

ISSN: 2230-7761
www.jadr.co.in

Volume 17, Issue 04 | Received 18.09.2026 | Accepted 19.09.2026 | Online 23.09.2026

TWENTY-FIVE PHARMACEUTICAL DOSAGE FORMS IN PHARMACOLOGY AND CLINICAL PHARMACY: TECHNOLOGICAL DEVELOPMENT, PHARMACOKINETICS, BIOAVAILABILITY, AND CLINICAL APPLICATION

Khafizova Mukharram Nematillaevna
Asia International University
https://orcid.org/0009-0007-3108-2415
hafizovamuharram98@gmail.com

Abstract

Pharmaceutical dosage forms are a fundamental component of modern pharmacology and clinical pharmacy because they determine not only the technological characteristics of a medicinal product but also its pharmacokinetic behavior, bioavailability, onset and duration of action, safety profile, and suitability for individual patients. The purpose of this study was to provide an integrative analysis of twenty-five commonly used pharmaceutical dosage forms with emphasis on their technological preparation, pharmacokinetic properties, bioavailability, and clinical applicability. The study was conducted as a descriptive and comparative review of pharmaceutical and pharmacological literature. Dosage forms were classified according to route of administration, physical state, release characteristics, and therapeutic purpose. The analysis included conventional tablets, enteric-coated tablets, controlled-release tablets, hard and soft gelatin capsules, powders, granules, lozenges, dragees, oral solutions, syrups, suspensions, emulsions, ointments, creams, gels, pastes, rectal suppositories, vaginal pessaries, injectable solutions, injectable suspensions, infusion solutions, inhalation aerosols, transdermal patches, and implants. The findings demonstrate that dosage form selection substantially influences drug absorption, first-pass metabolism, systemic availability, local versus systemic action, duration of effect, dosing frequency, and patient adherence. Oral solid dosage forms remain convenient and widely used, whereas parenteral forms provide the most rapid and complete systemic availability. Topical and mucosal forms are particularly valuable for localized therapy, while modified-release, transdermal, inhalational, and implantable systems offer important advantages in sustained or targeted drug delivery. The appropriate pharmaceutical form should therefore be selected according to the physicochemical characteristics of the drug, therapeutic objective, patient age, disease condition, required onset of action, duration of treatment, and adherence considerations.

Keywords: pharmaceutical dosage forms, drug delivery systems, pharmacokinetics, bioavailability, clinical pharmacy, controlled release, parenteral administration, transdermal delivery, inhalation therapy, implants.

INTRODUCTION

The pharmaceutical dosage form represents the final technological form in which an active pharmaceutical ingredient is administered to a patient. In modern pharmacology and clinical pharmacy, the dosage form cannot be regarded merely as a convenient carrier of an active substance because it directly influences the rate and extent of drug absorption,

Journal of Advances in Drug Research
ISSN: 2230-7761
www.jadr.co.in
Volume 17, Issue 04 Received 18.09.2026 Accepted 19.09.2026 Online 23.09.2026

distribution, metabolism, elimination, local tolerability, systemic exposure, therapeutic response, and risk of adverse effects. The same active ingredient administered in different pharmaceutical forms may demonstrate markedly different pharmacokinetic and clinical characteristics. Oral dosage forms are generally convenient and suitable for long-term treatment; however, their systemic availability may be limited by incomplete gastrointestinal absorption, chemical or enzymatic degradation, and hepatic first-pass metabolism.

Parenteral administration bypasses gastrointestinal absorption and can provide rapid or complete systemic exposure, which is particularly important in emergency medicine, severe infections, critical care, and situations in which oral administration is impossible. Transdermal systems can maintain relatively stable systemic concentrations over prolonged periods and avoid first-pass metabolism, whereas inhalational preparations can deliver drugs rapidly to the respiratory tract and provide high local concentrations with reduced systemic exposure. Topical semi-solid forms, in contrast, are commonly intended to achieve local therapeutic effects with limited systemic absorption. The technological composition of a formulation is therefore closely connected with pharmacokinetic performance. Particle size, excipients, coating materials, viscosity, release systems, drug solubility, formulation pH, stability, sterility, and delivery device characteristics can all alter drug release and absorption. The growing development of modified-release technologies, nanotechnology, polymer-based systems, transdermal preparations, inhalation devices, and implantable dosage forms has further increased the clinical importance of rational dosage-form selection. In addition, contemporary clinical pharmacy emphasizes individualized pharmacotherapy. The choice of dosage form should take into account age, swallowing ability, gastrointestinal function, renal and hepatic status, disease severity, required speed of action, treatment duration, adherence, and individual pharmacokinetic variability. These considerations are especially relevant in pediatrics, geriatrics, emergency care, chronic disease management, and patients requiring long-term pharmacotherapy. The purpose of the present study was to provide an integrative analysis of twenty-five pharmaceutical dosage forms from the perspectives of pharmaceutical technology, pharmacokinetics, bioavailability, and clinical effectiveness.

MATERIALS AND METHODS

The study was designed as a descriptive and comparative analytical review of twenty-five pharmaceutical dosage forms commonly used in pharmacology and clinical pharmacy. Information was evaluated from pharmaceutical technology textbooks, pharmacology and biopharmaceutics references, regulatory materials, and publications addressing drug-delivery systems. The dosage forms were analyzed according to four principal domains: technological preparation, pharmacokinetic characteristics, bioavailability, and clinical applicability. Pharmaceutical forms were grouped conceptually into oral solid forms, oral liquid forms, topical and semi-solid preparations, rectal and vaginal preparations, parenteral dosage forms, inhalational systems, transdermal systems, and long-acting implantable delivery systems. Technological assessment included methods such as granulation, compression, coating, encapsulation, dissolution, suspension

Journal of Advances in Drug Research
ISSN: 2230-7761
www.jadr.co.in
Volume 17, Issue 04 Received 18.09.2026 Accepted 19.09.2026 Online 23.09.2026

stabilization, emulsification, sterile manufacturing, matrix and reservoir formation, and controlled-release design.

Pharmacokinetic assessment considered the route of absorption, rate of drug release, first-pass metabolism, systemic exposure, local tissue delivery, and duration of action. Bioavailability was interpreted in relation to the physicochemical and physiological characteristics of each dosage form rather than treated as a fixed property of the formulation category itself. Clinical applicability was assessed according to onset of action, duration, dosing convenience, suitability for local or systemic treatment, patient adherence, and typical therapeutic indications. Because the reviewed sources differed substantially in formulation composition, active ingredients, study design, and patient population, the findings were synthesized qualitatively rather than by pooled statistical analysis.

RESULTS

The integrative analysis demonstrated substantial differences among the twenty-five dosage forms. Conventional tablets are generally produced through direct compression or granulation followed by compression and remain one of the most widely used oral forms because of manufacturing simplicity, dose accuracy, stability, and patient convenience. Their pharmacokinetic performance depends on disintegration, dissolution, gastrointestinal transit, intestinal permeability, and hepatic first-pass metabolism. Enteric-coated tablets contain acid-resistant polymeric coatings designed to delay drug release until the dosage form reaches the intestine. This approach is particularly useful for drugs that are unstable in gastric acid or irritate the gastric mucosa. Controlled-release tablets use matrix, reservoir, osmotic, or related technologies to prolong drug release, reduce fluctuations in plasma concentration, decrease dosing frequency, and improve adherence in chronic therapy. Hard gelatin capsules usually contain powders, granules, pellets, or multiparticulate systems and provide flexible formulation options with relatively rapid shell dissolution. Soft gelatin capsules are particularly suitable for oils, lipophilic drugs, and liquid or semi-solid formulations and may improve dissolution of poorly water-soluble active substances. Oral powders allow rapid dissolution before or after administration and can be useful in patients who have difficulty swallowing solid dosage forms, although accurate dose measurement may be more dependent on packaging and administration technique. Granules improve flow properties and stability and can be administered directly or reconstituted to form solutions or suspensions. Lozenges are designed to dissolve slowly in the oral cavity and are predominantly used for local effects in the mouth and throat, although some active ingredients may also undergo transmucosal absorption.

Dragees are coated solid forms historically used to improve taste, appearance, and stability, although modern film-coated tablets have largely replaced traditional multilayer sugar-coated preparations in many settings. Oral solutions contain the active ingredient already dissolved in a suitable vehicle and therefore eliminate the disintegration and dissolution steps that precede absorption from solid dosage forms. They may provide relatively rapid onset of action but often require careful attention to stability, flavoring, preservatives, and dose measurement. Syrups are concentrated sweetened oral liquids commonly used to improve palatability, particularly in pediatric practice, although sugar content and dental considerations may limit prolonged use in some patients. Oral

Journal of Advances in Drug Research
ISSN: 2230-7761
www.jadr.co.in
Volume 17, Issue 04 Received 18.09.2026 Accepted 19.09.2026 Online 23.09.2026

suspensions contain insoluble drug particles dispersed in a liquid phase and require appropriate particle-size control, wetting, flocculation, and stabilization to maintain dose uniformity. They are particularly useful for poorly soluble drugs and for pediatric or geriatric patients. Oral emulsions contain two immiscible phases stabilized by emulsifying agents and may facilitate administration of lipophilic substances. Ointments are semi-solid preparations with occlusive or protective characteristics and are often used for local treatment of dermatological disorders. Drug release depends strongly on the ointment base and physicochemical properties of the active substance. Creams are emulsion-based semi-solid systems that are generally easier to spread and remove than ointments and are widely used for anti-inflammatory, antimicrobial, dermatological, and moisturizing therapy. Gels are polymeric semi-solid systems with high water content and can provide rapid local drug release, cooling effects, and favorable cosmetic acceptability. Pastes contain a relatively high proportion of insoluble solids and are particularly useful when a protective, adsorptive, or barrier effect is required.

Rectal suppositories are formulated to melt, dissolve, or disperse after administration into the rectum and may be used for local or systemic therapy. Rectal administration can partially avoid hepatic first-pass metabolism, although absorption may be variable. Vaginal pessaries and related vaginal dosage forms are primarily designed for local treatment of gynecological infections or other conditions requiring localized drug delivery. Injectable solutions are sterile preparations administered by intravenous, intramuscular, subcutaneous, or other parenteral routes. Intravenous administration provides complete systemic bioavailability and immediate drug availability, whereas intramuscular and subcutaneous absorption depends on local blood flow and formulation characteristics. Injectable suspensions contain dispersed drug particles and may be designed as depot preparations to provide prolonged therapeutic effects.

Infusion solutions are large-volume sterile preparations administered intravenously over a defined period and are essential in fluid replacement, electrolyte correction, parenteral nutrition, and continuous administration of selected medications. Inhalation aerosols and related pulmonary delivery systems allow drugs to reach the respiratory tract rapidly and are particularly important in asthma and chronic obstructive pulmonary disease. Their effectiveness depends not only on the formulation but also on particle size, inhalation technique, airway anatomy, and delivery-device performance. Transdermal patches contain drug within matrix or reservoir systems that deliver the active ingredient continuously through the skin. This route avoids gastrointestinal degradation and first-pass metabolism and can provide relatively stable systemic exposure over prolonged periods. Transdermal therapy is particularly useful for selected analgesics, hormones, cardiovascular drugs, and nicotine replacement. Implantable dosage forms represent long-acting delivery systems designed to release drugs over extended periods. Modern implants may employ biodegradable polymers, reservoir systems, micro- or nanoencapsulation, and advanced manufacturing technologies. They are particularly relevant when prolonged treatment, stable drug exposure, or reduced dosing frequency is clinically desirable. Overall, the analysis demonstrates that no pharmaceutical dosage form is universally superior. The clinical value of each form depends on the therapeutic objective, characteristics of the

Journal of Advances in Drug Research
ISSN: 2230-7761
www.jadr.co.in
Volume 17, Issue 04 Received 18.09.2026 Accepted 19.09.2026 Online 23.09.2026

active ingredient, desired site and speed of action, duration of treatment, and individual patient factors.

DISCUSSION

The results confirm that pharmaceutical dosage form is an important determinant of therapeutic performance rather than a purely technological characteristic of a medicinal product. The formulation influences several sequential processes beginning with drug release and continuing through dissolution, membrane transport, absorption, systemic distribution, metabolism, and elimination. For oral dosage forms, disintegration and dissolution are particularly important prerequisites for absorption. A poorly soluble drug may demonstrate limited systemic exposure even when administered at an appropriate nominal dose, whereas formulation strategies that improve dissolution may enhance pharmacokinetic performance. Nevertheless, bioavailability cannot be assigned solely on the basis of dosage-form category. Statements such as "tablets have moderate bioavailability" or "soft capsules have high bioavailability" are overly general because bioavailability depends primarily on the active pharmaceutical ingredient, formulation composition, physicochemical properties, gastrointestinal physiology, food effects, and patient-specific factors. The same principle applies to controlled-release preparations. Although they may improve adherence by reducing dosing frequency and limiting peak-to-trough fluctuations, their total systemic bioavailability may be similar to, lower than, or occasionally different from that of immediate-release formulations depending on the drug and formulation design. Modified-release systems should therefore be evaluated individually.

Enteric coating provides a clear example of how technology can modify the site rather than necessarily the total extent of absorption. These coatings protect acid-sensitive drugs or reduce gastric exposure but may delay onset of action because release does not begin until the dosage form reaches the higher-pH environment of the intestine. Oral liquid formulations eliminate tablet disintegration and may therefore provide faster drug availability, but they present different technological challenges, including chemical stability, microbial contamination, taste masking, and accurate dose measurement. Their value is particularly high in pediatric and geriatric patients or in individuals with dysphagia. Topical formulations illustrate the importance of distinguishing local effectiveness from systemic bioavailability. Ointments, creams, gels, and pastes are commonly designed to retain active ingredients within the skin or superficial tissues. Low systemic exposure may therefore represent a therapeutic advantage rather than a limitation. Similar principles apply to lozenges, vaginal dosage forms, and certain rectal formulations when the intended effect is local.

Parenteral administration remains essential when rapid systemic exposure is required or gastrointestinal absorption is unreliable. Intravenous administration provides complete bioavailability by definition because the drug enters the systemic circulation directly. However, parenteral therapy also involves disadvantages including invasiveness, pain, the need for sterile production, risk of infection, administration errors, and requirements for trained personnel. Intramuscular or subcutaneous depot formulations can extend the duration of action but cannot be assumed to provide the same pharmacokinetic

Journal of Advances in Drug Research
ISSN: 2230-7761
www.jadr.co.in
Volume 17, Issue 04 Received 18.09.2026 Accepted 19.09.2026 Online 23.09.2026

profile as intravenous administration. Inhalational therapy demonstrates the importance of targeted delivery. A relatively small drug dose may produce substantial therapeutic effects in the lungs while reducing systemic exposure. Nevertheless, clinical effectiveness is highly dependent on correct inhaler technique, which emphasizes the role of pharmacists and healthcare professionals in patient education. Transdermal systems offer the important advantages of avoiding gastrointestinal degradation and hepatic first-pass metabolism while providing sustained exposure. Their application, however, is restricted mainly to drugs with physicochemical properties suitable for transport across the skin barrier. Implantable systems and advanced long-acting delivery technologies represent an important direction in pharmaceutical development because they can maintain therapeutic concentrations for weeks, months, or longer. However, these systems require careful evaluation of biocompatibility, dose control, retrieval or biodegradation, manufacturing complexity, and long-term safety. The analysis also emphasizes the clinical pharmacy principle that dosage-form selection should be individualized. Pediatric patients may benefit from liquids, dispersible formulations, or appropriately designed powders, whereas older adults with swallowing difficulties may require alternatives to conventional tablets. Patients with poor adherence may benefit from once-daily modified-release formulations, transdermal patches, depot injections, or implants when clinically appropriate.

In emergency conditions, rapidly acting intravenous, inhalational, or other immediately available dosage forms may be preferable. For chronic dermatological or mucosal disorders, localized delivery can achieve effective tissue concentrations while limiting systemic exposure. The choice of formulation must therefore integrate pharmaceutical technology with clinical decision-making. Another important consideration is medication safety. Some dosage forms must not be crushed, opened, divided, or altered because disruption of enteric coatings or controlled-release systems can change the site or rate of drug release and potentially increase toxicity. Pharmacists play an important role in counseling patients and healthcare professionals regarding these formulation-specific risks. In the context of pharmaceutical development, the increasing use of personalized medicine also creates opportunities for individualized dosage forms. Three-dimensional printing, polymeric delivery systems, microencapsulation, and nanotechnology may enable more flexible dosing and targeted release in the future. However, advanced technologies should not automatically be considered clinically superior to conventional formulations. Their value must be demonstrated through reproducible improvements in pharmacokinetics, therapeutic effectiveness, safety, adherence, or another clinically meaningful outcome.

The present review has several limitations. It provides a qualitative integrative comparison rather than a systematic review or meta-analysis, and the twenty-five dosage forms encompass broad categories containing numerous individual formulations with different pharmacokinetic properties. Therefore, the conclusions should be interpreted as general pharmaceutical and clinical principles rather than fixed quantitative characteristics of every product within each category. Future studies may benefit from comparing specific formulations of the same active pharmaceutical ingredient using standardized pharmacokinetic indicators such as maximum plasma concentration, time to maximum concentration, area under the concentration–time curve, elimination half-life, and absolute

Journal of Advances in Drug Research
ISSN: 2230-7761
www.jadr.co.in
Volume 17, Issue 04 | Received 18.09.2026 | Accepted 19.09.2026 | Online 23.09.2026

or relative bioavailability. Such comparisons would allow more precise evaluation of how technological modifications translate into clinically meaningful differences.

CONCLUSION

Pharmaceutical dosage forms have a decisive influence on the clinical performance of medicines because they determine how an active pharmaceutical ingredient is released, reaches its site of absorption or action, and produces its therapeutic effect. The analysis of twenty-five dosage forms demonstrates that the technological method of formulation is closely related to pharmacokinetics, bioavailability, safety, dosing convenience, and patient adherence. Conventional oral solid forms remain essential because of stability, manufacturing efficiency, and ease of administration, whereas liquid oral formulations provide important advantages in patients who cannot easily swallow tablets or capsules. Topical and mucosal preparations are particularly valuable when local therapy is required and limited systemic exposure is desirable. Parenteral dosage forms are indispensable for rapid systemic treatment and for drugs that cannot be effectively administered orally. Inhalational formulations allow targeted pulmonary delivery, while transdermal systems can provide sustained systemic exposure without gastrointestinal absorption or hepatic first-pass metabolism. Controlled-release formulations, depot injections, and implants offer advantages in long-term therapy by reducing dosing frequency and improving adherence in appropriately selected patients. However, the therapeutic value of a dosage form should not be judged solely by assumptions regarding “high” or “low” bioavailability. The actual pharmacokinetic profile depends on the characteristics of the active pharmaceutical ingredient, formulation design, route of administration, physiological conditions, and individual patient factors. Rational dosage-form selection therefore requires integration of pharmaceutical technology, pharmacokinetics, clinical pharmacology, and patient-centered clinical pharmacy. Such an approach can improve therapeutic effectiveness, reduce preventable adverse effects, and support individualized pharmacotherapy.

REFERENCES

1. Allen LV, Popovich NG, Ansel HC. *Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems*. 10th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
2. European Medicines Agency. *List of Pharmaceutical Dosage Forms*. 2023.
3. Brunton LL, Hilal-Dandan R, Knollmann BC, eds. *Goodman & Gilman’s The Pharmacological Basis of Therapeutics*. 13th ed. New York: McGraw-Hill; 2018.
4. Janczura M, et al. The development of innovative dosage forms of fixed-dose combinations. *Pharmaceutics*. 2022.
5. Mahato RI, Narang AS. *Pharmaceutical Dosage Forms and Drug Delivery*. 3rd ed. Boca Raton: CRC Press; 2018.
6. Nematilloyevna KM. The easy ways of learning medical plants (phytonyms) in the Department of Pharmaceutical Terminology. *JournalNX*. 7(06):274–277.
7. Nematilloyevna XM. Farmatsevtik terminologiyada ma’noli qismlar. *Modern Education and Development*. 2024;16(9):232–243.

Journal of Advances in Drug Research

ISSN: 2230-7761
www.jadr.co.in

Volume 17, Issue 04 | Received 18.09.2026 | Accepted 19.09.2026 | Online 23.09.2026

8. Obidov OO, Musayeva NA, Ismatova ShSh. *Umumiy farmakologiya va retseptura: o‘quv qo‘llanma*. Tashkent: Ilm-Ziyo; 2013.
9. Adejare A, ed. *Remington: The Science and Practice of Pharmacy*. 23rd ed. Philadelphia: Elsevier; 2021.
10. Xaydarov VR, Tadjieva AD, Usubbaev AM, et al. *Farmatsevtik texnologiya (tayyor dori turlari texnologiyasi)*. Tashkent: Ibn Sino; 2022.
11. Khafizova M. Простые способы изучения лекарственных растений (фитонимов) в разделе фармацевтической терминологии. *Central Asian Journal of Education and Innovation*. 2023;2(11 Part 2):193–198.
12. Khafizova M. Studing medicinal plants (phytonyms) in the section of pharmaceutical terminology. *Central Asian Journal of Multidisciplinary Research and Management Studies*. 2024;1(2):4–7.
13. Khafizova M. The use of segments of frequency in the names of medicines in pharmaceutical terminology. *Modern Science and Research*. 2025;4(2):708–714.
14. Shargel L, Yu ABC, Wu-Pong S, et al. *Applied Biopharmaceutics & Pharmacokinetics*. 8th ed. New York: McGraw-Hill; 2022.
15. Ministry of Health of the Republic of Uzbekistan. Law on Medicinal Products and Pharmaceutical Activities, No. 415-I, 25 April 1997, as amended.