RESEARCH ARTICLE

ISSN 2307-9266 e-ISSN 2413-2241

Scientific and Practical Journal
PHARMACY & PHARMACOLOGY
(ФАРМАЦИЯ И ФАРМАКОЛОГИЯ)

Original drug products approved by the Food and Drug Administration (Center for Drug Evaluation and Research) in 2025

D.V. Kurkin[1,2], N.A. Osadchenko[1], D.A. Galkina[1], D.A. Bakulin[1], Yu.G. Ustyakina[1], S.A. Voskresensky[2], A.R. Makarova[1], O.V. Shatalova[2], A.V. Strygin[2], V.I. Petrov[2], O.V. Marincheva[1], Yu.V. Gorbunova[1], K.N. Koryanova[3,4], E.S. Mishchenko[3], I.S. Gadaev[5], L.I. Shcherbakova[3], I.N. Dyakova[3], E.I. Morkovin[1], A.S. Shuvaeva[1]

[1] Russian University of Medicine,
4 Dolgorukovskaya Str., Moscow, Russia, 127006
[2] Volgograd State Medical University,
1 Pavshikh Bortsov Sq., Volgograd, Russia, 400066
[3] Pyatigorsk Medical and Pharmaceutical Institute – branch of Volgograd State Medical University,
11 Kalinin Ave., Pyatigorsk, Russial, 357532
[4] Russian Medical Academy of Continuous Professional Education,
2/1 Barrikadnaya Str., bldg. 1, Moscow, Russia, 125993
[5] Stavropol State Medical University,
310 Mir Str., Stavropol, Russia, 355017

E-mail: n.a.osadchenko@gmail.com; Strannik986@mail.ru

Received 30 Jan 2026 After peer review 15 May 2026 Accepted 16 June 2026

The annual review of new drugs approved by the FDA is an important tool for analyzing current trends in pharmacology and medicine, reflecting progress in the treatment of complex diseases, including oncological pathologies, orphan diseases, and infectious processes. The article aims to inform medical specialists and pharmacologists about current trends in the development and registration of innovative medicinal products in 2025.

The aim. To summarize and systematize data on the latest medicinal products launched in 2025, and to analyze their mechanisms of action.

Materials and methods. The presented data are taken from open sources and supplemented by the results of individual studies aimed to the investigate new mechanisms and approaches in therapy. The main list of new medicines and introductory information about them are taken from the report of the Food and Drug Administration (FDA) — "Novel Drug Approvals for 2025.

Results. In 2025, the FDA approved 46 drugs, of which 31 were small molecules and 15 were macromolecules. Among the drugs in the first group, 11 (24 % of all new drugs and 35 % of all new small molecules) are used in oncology, 2 are immunotropic, and 2 are for cardiology. The majority (16 drugs) belong to miscellaneous drug groups. Among biologicals, the largest portion consisted of monoclonal antibodies for the treatment of non-oncological diseases — 6 (13 % of all and 40 % of biologicals) and monoclonal antibodies for the treatment of oncological diseases — 5 (11 % of all and 33 % of biologicals). Nucleic acid-based drugs and protein molecules, excluding antibodies, accounted for 3 (7 % of all and 20 % of biologicals) and 1 (2 % of all and 7 % of biologicals) respectively.

For citation: D.V. Kurkin, N.A. Osadchenko, D.A. Galkina, D.A. Bakulin, Yu.G. Ustyakina, S.A. Voskresensky, A.R. Makarova, O.V. Shatalova, A.V. Strygin, V.I. Petrov, O.V. Marincheva, Yu.V. Gorbunova, K.N. Koryanova, E.S. Mishchenko, I.S. Gadaev, L.I. Shcherbakova, I.N. Dyakova, E.I. Morkovin1, A.S. Shuvaeva. Original drug products approved by the Food and Drug Administration (Center for Drug Evaluation and Research) in 2025. *Pharmacy & Pharmacology.* 2026;14(3):248-282. **DOI:** 10.19163/2307-9266-2026-14-3-248-282

Для цитирования: Д.В. Куркин, Н.А. Осадченко, Д.А. Галкина, Д.А. Бакулин, Ю.Г. Устякина, С.А. Воскресенский, А.Р. Макарова, О.В. Шаталова, А.В. Стрыгин, В.И. Петров, О.В. Маринчева, Ю.В. Горбунова, К.Н. Корянова, Е.С. Мищенко, И.Ш. Гадаев, Л.И. Щербакова, И.Н. Дьякова, Е.И. Морковин, А.С. Шуваева. Оригинальные лекарственные препараты, одобренные Управлением по санитарному надзору за качеством пищевых продуктов и медикаментов (Центр оценки и исследований лекарственных средств) в 2025 году. *Фармация и фармакология.* 2026;14(3):248-282. **DOI**: 10.19163/2307-9266-2026-14-3-248-282

Научно-практический журнал
ФАРМАЦИЯ И ФАРМАКОЛОГИЯ
(PHARMACY & PHARMACOLOGY)

ОРИГИНАЛЬНАЯ СТАТЬЯ

DOI: 10.19163/2307-9266-2026-14-3-248-282

Conclusion. The significant proportion of biopharmaceuticals among newly registered drug products in 2025 highlights the dynamic development of the pharmaceutical industry and its focus on personalized medicine and biotechnology. Therapy based on mAbs interacting with receptors, as well as immunotherapy based on newly discovered mechanisms of anti-tumor immunity, occupies a substantial part of the structure of original drugs. The search for new rational antibiotic combinations remains relevant. Small molecules still constitute the largest share of the original drug market, among which drug substances — ligands of new targets and oligonucleotide sequences are emerging. This review is compiled for medical specialists and pharmacologists to familiarize them with current trends in the registration of original drugs and in the therapy of malignant neoplasms, as well as orphan diseases.

Keywords: FDA; original drugs; immunotherapy; small molecules; biopharmaceuticals; drugs for orphan diseases

Abbreviations: DNA — deoxyribonucleic acid; LDL — low-density lipoprotein; MIC — minimum inhibitory concentration; NSCLC — non-small cell lung cancer; RSV — respiratory syncytial virus; CVD — cardiovascular disease; PDE — phosphodiesterase; BCMA — B-cell maturation antigen; EGFR — epidermal growth factor receptor; ER — estrogen receptor; ET — endothelin receptor; Ig — immunoglobulin; HER — human epidermal growth factor receptor; Ki — inhibition constant; PD-1 — programmed cell death protein 1; STAT — signal transducer and activator of transcription; TRPM8 — transient receptor potential cation channel subfamily M member 8.

Оригинальные лекарственные препараты, одобренные Управлением по санитарному надзору за качеством пищевых продуктов и медикаментов (Центр оценки и исследований лекарственных средств) в 2025 году

Д.В. Куркин[1,2], Н.А. Осадченко[1], Д.А. Галкина[1], Д.А. Бакулин[1], Ю.Г. Устякина[1], С.А. Воскресенский[2], А.Р. Макарова[1], О.В. Шаталова[2], А.В. Стрыгин[2], В.И. Петров[2], О.В. Маринчева[1], Ю.В. Горбунова[1], К.Н. Корянова[3,4], Е.С. Мищенко[3], И.Ш. Гадаев[5], Л.И. Щербакова[3], И.Н. Дьякова[3], Е.И. Морковин[1], А.С. Шуваева[1]

[1] Федеральное государственное бюджетное образовательное учреждение высшего образования «Российский университет медицины» Министерства здравоохранения Российской Федерации, Россия, 127006, г. Москва, ул. Долгоруковская д. 4
[2] Федеральное государственное бюджетное образовательное учреждение высшего образования «Волгоградский государственный медицинский университет» Министерства здравоохранения Российской Федерации, Россия, 400066, г. Волгоград, пл. Павших Борцов, д. 1
[3] Пятигорский медико-фармацевтический институт – филиал федерального государственного бюджетного образовательного учреждения высшего образования «Волгоградский государственный медицинский университет» Министерства здравоохранения Российской Федерации, Россия, 357532, г. Пятигорск, пр-кт Калинина, д. 11
[4] Федеральное государственное бюджетное образовательное учреждение дополнительного профессионального образования «Российская медицинская академия непрерывного профессионального образования» Министерства здравоохранения Российской Федерации, Россия, 125993, г. Москва, ул. Баррикадная, д. 2/1, стр. 1
[5] Федеральное государственное бюджетное образовательное учреждение высшего образования «Ставропольский государственный медицинский университет» Министерства здравоохранения Российской Федерации, Россия, 355017, г. Ставрополь, ул. Мира, д. 310

E-mail: n.a.osadchenko@gmail.com; Strannik986@mail.ru

Получена 30.01.2026 После рецензирования 15.05.2026 Принята к печати 16.06.2026

Ежегодный обзор новых препаратов, одобренных FDA, представляет собой важный инструмент для анализа современных тенденций в фармакологии и медицине, отражая прогресс в лечении сложных заболеваний, включая онкологические патологии, орфанные болезни и инфекционные процессы. Статья направлена на информирование медицинских специалистов и фармакологов о современных тенденциях в разработке и регистрации инновационных лекарственных препаратов в 2025 году.

Цель. Обобщить и систематизировать данные о новейших лекарственных препаратах, вышедших на рынок в 2025 году, а также проанализировать механизмы их действия.

Материалы и методы. Представленные данные взяты из открытых источников и дополнены результатами отдельных исследований, посвящённых изучению новых механизмов и подходов в терапии. Основной список новых лекарственных препаратов и вводная информация о них взяты из отчета Управления по санитарному надзору за качеством пищевых продуктов и медикаментов (FDA) — «Novel Drug Approvals for 2025».

Результаты. В 2025 году FDA одобрено 46 лекарственных препаратов, среди которых 31 — это малые молекулы и 15 — макромолекулы. Среди препаратов из первой группы в онкологии применяют 11 (24% от всех новых препаратов и 35% от всех новых малых молекул), 2 — иммунотропные и 2 для применения в кардиологии. Большая часть (16 препаратов) относится к разрозненным группам препаратов. Среди биопрепаратов большую часть составили моноклональные антитела для лечения неонкологических заболеваний — 6 (13% от всех и 40% от биопрепаратов) и моноклональные антитела для лечения онкологических заболеваний — 5 (11% от всех и 33% от биопрепаратов). Препараты на основе нуклеиновых кислот и белковые молекулы, кроме антител, составили 3 (7% от всех и 20% от биопрепаратов) и 1 (2% от всех и 7% от биопрепаратов) соответственно.

Заключение. Большая доля биопрепаратов среди вновь зарегистрированных лекарственных препаратов в 2025 году подчёркивает динамичное развитие фармацевтической отрасли и ее ориентацию на персонализированную медицину и биотехнологии. Терапия, основанная на mAb, взаимодействующих с рецепторами, а также иммунотерапия, основанная на новых открытых механизмах противоопухолевого иммунитета, занимает весомую часть в структуре оригинальных препаратов. Остаётся актуальным поиск новых рациональных комбинаций антибиотиков. Большую часть рынка оригинальных препаратов все еще составляют малые молекулы, среди которых появляются лекарственные средства — лиганды новых мишеней и олигонуклеотидные последовательности. Обзор составлен для ознакомления медицинских специалистов и фармакологов с современными тенденциями в регистрации оригинальных препаратов и в терапии злокачественных образований, а также орфанных болезней.

Ключевые слова: FDA; оригинальные препараты; иммунотерапия; малые молекулы; биопрепараты; препараты для лечения орфанных болезней

Список сокращений: ДНК — дезоксирибонуклеиновая кислота; ЛПНП — липопротеины низкой плотности; МПК — минимальная подавляющая концентрация; НМРЛ — немелкоклеточный рак лёгкого; РСВ — респираторно-синцитиальный вирус; ССЗ — сердечно-сосудистые заболевания; ФДЭ — фосфодиэстераза; BCMA — антиген созревания В-клеток; EGFR — рецептор эпидермального фактора роста; ER — рецептор к эстрогену; ET — рецептор эндотелина; Ig — иммуноглобулин; HER — рецептор эпидермального фактора роста человека; Ki — константа ингибирования; PD-1 — рецептор программируемой клеточной гибели 1; STAT — сигнальные трансдукторы и активаторы транскрипции; TRPM8 — катионный канал 8, действующий по механизму транзиторного рецепторного потенциала подсемейства меластатина.

INTRODUCTION

Modern pharmacotherapy is one of the key tools for increasing the life expectancy and improving the quality of life of the population, which necessitates the high importance of developing and implementing new drugs. The global pharmaceutical industry is characterized by a high degree of scientific intensity, significant investments, and competitiveness, leading to a constant complication of the processes of creating and registering drugs [1].

The development of original drugs remains a lengthy and resource-intensive process, associated with a high level of risk; however, it is this segment that defines the directions of drug development, forming new therapeutic approaches and expanding treatment options for previously difficult-to-manage diseases. Regulatory activities, which ensure the assessment of the efficacy and safety balance of medicines at all stages of their life cycle, play a significant role in this [2].

The U.S. Food and Drug Administration (FDA), particularly the Center for Drug Evaluation and Research (CDER), remains one of the leading regulatory bodies defining global trends in the development and registration of drugs. Annual reports on the registration of new drugs allow for a systematic analysis of changes in the structure of pharmacotherapy, including distribution by drug classes, mechanisms of action, and therapeutic areas.

In 2025, the trend towards an increased share of targeted drugs aimed at specific molecular targets, as well as the expanded use of biotechnological approaches, is expected to continue. Alongside monoclonal antibodies, the importance of nucleic acid-based drugs, including small interfering RNAs and antisense oligonucleotides, is growing, reflecting the development of precision medicine and targeted delivery technologies [3]. Simultaneously, there is active implementation of new small molecules with original mechanisms of action, including in areas beyond oncology, such as cardiometabolic, immune, and rare genetic diseases [4].

The analysis of medicines registered in 2025 is of interest from the perspective of assessing current pharmacotherapy development trends, identifying priority therapeutic areas, and characterizing innovative treatment approaches.

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

THE AIM to systematize and analyze current trends in the development and registration of new medicines in 2025, with a particular focus on innovative mechanisms of action.

MATERIALS AND METHODS

Data on medicine indications and mechanisms of action were taken from the Summary of Product Characteristics (SmPC) published by the FDA and supplemented with descriptions presented on the Drugs.com website. Structural formulas of drugs were obtained from the PubChem resource. In cases where PubChem did not contain the required formula, the molecular structure was taken from the Drugs.com website or from the package insert of the medicinal product with that active substance. The ChemDraw Program was used to standardize the appearance of the formulas.

To update literary data, a search for publications on preclinical and clinical studies of drugs or their active substances, as well as publications on fundamental research, was conducted in the validated bibliographic database of the U.S. National Library of Medicine (PubMed), on the ResearchGate and Google Scholar websites, as well as in Russian scientific online libraries eLibrary.ru and CyberLeninka. Search queries included combinations of keywords with pharmacological properties (e.g., arimoclomol in Niemann-Pick disease, etc.). When searching for data on medicinal products, articles published no earlier than 2016 were used. No publication date restriction was imposed when describing studies of fundamental mechanisms.

The work also includes data from CDER's "Advancing Health Through Innovation" reports[1,2,3,4,5] for the periods from 2021 to 2025.

RESULTS

In 2025, the FDA approved 46 medicines. Table 1 presents the trade name, manufacturer, INN, dosage form, class, and indications for use of the medicines approved in 2025.

In 2025, the FDA approved 46 medicines, 31 of which were small molecules and only 15 were macromolecule-based drugs (biologics; Fig. 2). Among small molecules, a large number of agents used in oncology were registered — 11 (24 % of all new medicines and 35 % of all new small molecules), as well as 2 immunotropic drugs and 2 cardiotropic drugs. The majority (16 agents) belong to miscellaneous drug groups. Among biologics, the largest proportion consisted of monoclonal antibodies for the treatment of non-oncological diseases — 6 (13 % of all and 40 % of biologics) drugs, and monoclonal antibodies for the treatment of oncological diseases — 5 (11 % of all and 33 % of biologics). Nucleic acid-based drugs and protein molecules other than antibodies accounted for 3 (7 % of all and 20 % of biologics) and 1 (2 % of all and 7 % of biologics) respectively.

The dynamics of CDER FDA registrations over the past 9 years are presented in Figure 1.

The ratio of the quantities of drugs depending on their share in different market segments is presented in Table 2.

Below are descriptions of original drugs registered by the FDA in 2025. Structural formulas of the molecules are presented in Figure 3.

Small Molecules

Oncology Drugs

Treosulfan[6] (GRAFAPEX, solution for intravenous administration) is intended for co-administration with fludarabine as a conditioning regimen for allogeneic hematopoietic stem cell transplantation in adult patients and children from 1 year of age with acute myeloid leukemia or myelodysplastic syndrome. Treosulfan is an alkylating agent. It is hypothesized that DNA alkylation causes the cytotoxic effect of treosulfan [5]. In vivo, treosulfan demonstrated immunosuppressive and antitumor activity in a mouse leukemia model [6].

Taletrectinib[7] (IBTROZI™, capsules for oral use) is a kinase inhibitor intended for the treatment of adult patients with locally advanced or metastatic non-small cell lung cancer (NSCLC; ROS-1 positive). Taletrectinib is a ROS1 tyrosine kinase inhibitor, acting, among other things, on its mutant forms. ROS1 domain-containing chimeric proteins can induce tumor growth due to the enhancement of downstream signaling pathways [7]. Taletrectinib inhibited the growth of cancer cells expressing ROS1 chimeric proteins and mutations. Antitumor effects of taletrectinib were observed *in vivo* in a mouse model of ROS1-positive NSCLC [7].

[1] CDER. Advancing Health Through Innovation: New Drug Therapy Approvals 2021. Available from: https://www.fda.gov/media/155227/download?attachment
[2] CDER. Advancing Health Through Innovation: New Drug Therapy Approvals 2022. Available from: https://www.fda.gov/media/164429/download?attachment
[3] CDER. Advancing Health Through Innovation: New Drug Therapy Approvals 2023. Available from: https://www.fda.gov/media/175253/download?attachment
[4] CDER. Advancing Health Through Innovation: New Drug Therapy Approvals 2024. Available from: https://www.fda.gov/media/184967/download?attachment
[5] CDER. Advancing Health Through Innovation: New Drug Therapy Approvals 2025. Available from: https://www.fda.gov/media/190705/download?attachment

[6] Drugs.com. Treosulfan. Available from: https://go.drugbank.com/drugs/DB11678
[7] Drugs.com. Taletrectinib. Available from: https://go.drugbank.com/drugs/DB18711

RESEARCH ARTICLE
ISSN 2307-9266 e-ISSN 2413-2241

Table 1 — Medicinal products registered by the FDA in 2025[8]

Registration Date	Trade Name	Manufacturer	INN	Dosage Form	Class	Indication
17 Jan 2025	Datroway	Daiichi Sankyo, Inc.	Datopotamab deruxtecan-dlnk	Solution for intravenous administration	Monoclonal antibody	For the treatment of unresectable or metastatic HR-positive, HER2-negative breast cancer in patients who have previously received hormonal therapy and chemotherapy for unresectable or metastatic disease.
21 Jan 2025	Grafapex	Medac GmbH	Treosulfan	Solution for intravenous administration	Alkylating agent	For use in combination with fludarabine as a conditioning regimen for allogeneic hematopoietic stem cell transplantation in acute myeloid leukemia and myelodysplastic syndrome.
30 Jan 2025	Journavx	Vertex Pharmaceuticals Incorporated	Suzetrigine	Tablets for oral use	Sodium channel blocker	For the treatment of moderate to severe acute pain.
11 Feb 2025	Gomekli	SpringWorks Therapeutics, Inc.	Mirdametinib	Capsules for oral use and tablets for oral suspension	Kinase inhibitor	For the treatment of neurofibromatosis type 1 in patients with symptomatic plexiform neurofibromas that cannot be completely removed.
14 Feb 2025	Romvimza	Deciphera Pharmaceuticals, LLC	Vimseltinib	Capsules for oral use	Kinase inhibitor	For the treatment of symptomatic giant cell tumor of the synovial sheath of tendons, surgical removal of which could potentially lead to worsening functional limitations or severe morbidity.
25 March 2025	Blujepa	GlaxoSmithKline	Gepotidacin	Tablets for oral use	Bacterial topoisomerase II inhibitor	For the treatment of uncomplicated urinary tract infections.
28 March 2025	Qfitlia	Genzyme Corporation	Fitusiran	Solution for subcutaneous injection	Small interfering RNA	For the prevention or reduction of bleeding episodes in patients with hemophilia A or B.
02 Apr 2025	Vanrafia	Novartis Pharmaceuticals Corporation	Atrasentan	Tablets for oral use	Endothelin receptor antagonist	For the reduction of proteinuria in adults with primary immunoglobulin A nephropathy at risk of rapid disease progression.
23 Apr 2025	penpulimab-kcqx	Akeso Biopharma Co., Ltd.	Penpulimab-kcqx	Solution for intravenous administration	Monoclonal antibody	In combination with cisplatin or carboplatin and gemcitabine for the treatment of adult patients with recurrent or metastatic non-keratinizing nasopharyngeal carcinoma, or as monotherapy during or after platinum-based chemotherapy and at least one prior line of therapy.
29 Apr 2025	Imaavy	Janssen Biotech, Inc.	Nipocalimab	Solution for intravenous administration	Monoclonal antibody	For the treatment of myasthenia gravis.

[8] FDA. Novel Drug Approvals. Available from: https://www.fda.gov/drugs/novel-drug-approvals-fda/novel-drug-approvals-2025

Scientific and Practical Journal
PHARMACY & PHARMACOLOGY
(ФАРМАЦИЯ И ФАРМАКОЛОГИЯ)

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

Registration Date	Trade Name	Manufacturer	INN	Dosage Form	Class	Indication
08 May 2025	Avmapki Fakzynja Co-Pack	Verastem, Inc.	Avutometinib and Defactinib	Separate tablets for oral use	Kinase inhibitors	For the treatment of recurrent low-grade serous ovarian cancer with *KRAS* gene mutation after prior systemic therapy.
14 May 2025	Emrelis	AbbVie Inc.	Telisotuzumab vedotin-tllv	Solution for intravenous infusion	Monoclonal antibody	For the treatment of locally advanced or metastatic NSCLC with high c-Met protein expression after prior systemic therapy.
28 May 2025	Tryptyr	Alcon Laboratories, Inc.	Acoltremon	Ophthalmic solution	TRPM8 thermoreceptor agonist	For the treatment of the signs and symptoms of dry eye disease.
09 June 2025	Enflonsia	Merck Sharp & Dohme LLC	Clesrovimab-cfor	Solution for intramuscular injection	Monoclonal antibody	For the prevention of respiratory syncytial virus (RSV) lower respiratory tract disease in newborns and infants born during or entering their first RSV season.
11 June 2025	Ibtrozi	Nuvation Bio Inc.	Taletrectinib	Capsules for oral use	Kinase inhibitor	For the treatment of locally advanced or metastatic ROS1-positive NSCLC.
16 June 2025	Andembry	CSL Behring LLC	Garadacimab-gxii	Solution for subcutaneous injection	Monoclonal antibody	For the prevention of hereditary angioedema attacks.
02 July 2025	Lynozyfic	Regeneron Pharmaceuticals, Inc.	Linvoseltammab-gcpt	Solution for intravenous infusion	Monoclonal antibody	For the treatment of relapsed or refractory multiple myeloma after at least four prior lines of therapy, including a proteasome inhibitor, an immunomodulatory agent, and an anti-CD38 monoclonal antibody.
02 July 2025	Zegfrovy	Dizal (Jiangsu) Pharmaceutical Co., Ltd.	Sunvozertinib	Tablets for oral use	Kinase inhibitor	For the treatment of locally advanced or metastatic NSCLC with EGFR exon 20 insertion mutations, as detected by an FDA-approved test, that has progressed on or after platinum-based chemotherapy.
03 July 2025	Ekterly	KalVista Pharmaceuticals, Inc.	Sebetralstat	Tablets for oral use	Kallikrein inhibitor	For the treatment of acute attacks of hereditary angioedema
23 July 2025	Anzupgo	LEO Laboratories Ltd.	Delgocitinib	Cream for topical application	Janus kinase inhibitor	For the treatment of moderate to severe chronic hand eczema when topical corticosteroids are not suitable or provide insufficient effect.
28 July 2025	Sephience	Allphamed PHARBIL Arzneimittel GmbH	Sepiapterin	Powder for oral use	Phenylalanine hydroxylase activator	For the treatment of hyperphenylalaninemia in patients with sepiapterin-responsive phenylketonuria, in conjunction with a phenylalanine-restricted diet.
31 July 2025	Vizz	LENZ Therapeutics, Inc.	Aceclidine	Ophthalmic solution	Cholinergic receptor agonist	For the treatment of presbyopia
06 Aug 2025	Modeyso	Jazz Pharmaceuticals, Inc.	Dordaviron	Capsules for oral use	Protease activator	For the treatment of H3 K27M-mutant diffuse midline glioma with disease progression after prior therapy.

ISSN 2307-9266 e-ISSN 2413-2241

Scientific and Practical Journal
PHARMACY & PHARMACOLOGY
(ФАРМАЦИЯ И ФАРМАКОЛОГИЯ)

Registration Date	Trade Name	Manufacturer	INN	Dosage Form	Class	Indication
08 Aug 2025	Hernexeos	Boehringer Ingelheim Pharmaceuticals, Inc.	Zongertinib	Tablets for oral use	Kinase inhibitor	For the treatment of adult patients with unresectable or metastatic non-squamous NSCLC whose tumors have activating mutations in the HER2 tyrosine kinase domain, as detected by an FDA-approved test, and who have received prior systemic therapy
12 Aug 2025	Brinsupri	Insmed Incorporated	Brensocatib	Tablets for oral use	DPP-1 inhibitor	For the treatment of non-cystic fibrosis bronchiectasis.
21 Aug 2025	Dawnzera	Ionis Pharmaceuticals, Inc.	Donidalorsen	Solution for subcutaneous injection	Antisense oligonucleotide targeting prekallikrein	For the prevention of hereditary angioedema attacks
29 Aug 2025	Wayrilz	Genzyme Corporation	Rilzabrutinib	Tablets for oral use	Kinase inhibitor	For the treatment of persistent or chronic immune thrombocytopenia that is not adequately responsive to immunoglobulins, anti-D therapy, or corticosteroids.
19 Sep 2025	Keytruda Qlex	Merck Sharp & Dohme LLC	Pembrolizumab and hyaluronidase alfa-zzbi	Solution for subcutaneous injection	Monoclonal antibody	For the treatment of solid tumors in adults and pediatric patients (12 years of age and older) who have previously received intravenous pembrolizumab.
19 Sep 2025	Forzinity	Stealth BioTherapeutics Inc.	Elamipretide	Solution for subcutaneous injection	Mitochondrial cardiolipin-binding agent	For improvement of muscle strength in patients with Barth syndrome weighing at least 30 kg.
25 Sep 2025	Inluriyo	Eli Lilly and Company	Imlunestrant	Tablets for oral use	Estrogen receptor antagonist	For the treatment of estrogen receptor-positive, HER2-negative, ESR1-mutated advanced or metastatic breast cancer with disease progression after at least one endocrine therapy.
25 Sep 2025	Palsonify	Crinetics Pharmaceuticals, Inc.	Paltusotine	Tablets for oral use	Somatostatin receptor agonist	For the treatment of acromegaly in adults who have had an inadequate response to surgery and/or for whom surgery is not an option.
30 Sep 2025	Rhapsido	Novartis Pharmaceuticals Corporation	Remibrutinib	Tablets for oral use	Kinase inhibitor	For the treatment of chronic spontaneous urticaria in adults who have persistent symptoms despite treatment with H1-type antihistamines.
07 Oct 2025	Jascayd	Boehringer Ingelheim Pharmaceuticals, Inc.	Nerandilast	Tablets for oral use	PDE4 inhibitor	For the treatment of idiopathic pulmonary fibrosis
24 Oct 2025	Lynkuet	Bayer HealthCare Pharmaceuticals Inc.	Elinzanetant	Capsules for oral use	Neurokinin 1 and 3 receptor antagonist	For the treatment of moderate to severe vasomotor symptoms associated with menopause.
03 Nov 2025	Kygevvi	UCB, Inc.	Doxecitin and Doxiribitine	Powder for oral solution	Pyrimidine nucleosides	For the treatment of thymidine kinase 2 deficiency in patients whose symptoms begin at age 12 years or younger.

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

Registration Date	Trade Name	Manufacturer	INN	Dosage Form	Class	Indication
13 Nov 2025	Komzifti	Kura Oncology, Inc.	Ziftomenib	Capsules for oral use	Menin inhibitor	For the treatment of adult patients with relapsed or refractory acute myeloid leukemia with a susceptible NPM1 mutation who lack satisfactory alternative treatment options.
18 Nov 2025	Redemplo	Arrowhead Pharmaceuticals, Inc.	Plozasiran	Solution for subcutaneous injection	Small interfering RNA targeting apolipoprotein C-III	For lowering triglyceride levels in adults with familial chylomicronemia syndrome.
19 Nov 2025	Hyrnuo	Bayer HealthCare Pharmaceuticals Inc.	Sevabertinib	Tablets for oral use	Kinase inhibitor	For the treatment of locally advanced or metastatic non-squamous NSCLC whose tumors have activating mutations in the HER2 tyrosine kinase domain, in patients who have received systemic therapy.
25 Nov 2025	Voyxact	Otsuka Pharmaceutical Company, Ltd.	Sibeprenlimab-szsi	Solution for subcutaneous injection	Monoclonal antibody	For reducing proteinuria in adult patients with primary immunoglobulin A nephropathy at risk of disease progression.
12.12.2025	Lerochol	LIB Therapeutics Inc.	Lerodalcibe-liga	Solution for subcutaneous injection	Proprotein convertase subtilisin/kexin type 9 inhibitor	Lowering of low-density lipoprotein cholesterol levels in adults with hypercholesterolemia, including heterozygous familial hypercholesterolemia, as an adjunct to diet and exercise.
12.12.2025	Nuzolvence	Innoviva Specialty Therapeutics, Inc.	Zoliflodacin	Granules for oral suspension	Type II topoisomerase inhibitor (Spiropyrimidine trione)	For the treatment of uncomplicated urogenital gonorrhea caused by Neisseria gonorrhoeae.
12.12.2025	Cardamyst	Milestone Pharmaceuticals	Etripamil	Nasal spray	Calcium channel blocker	For the treatment of episodes of paroxysmal supraventricular tachycardia
16.12.2025	Exdensur	GlaxoSmithKline	Depemokimab-ulaa	Solution for subcutaneous injection	Monoclonal antibody	For the treatment of severe eosinophilic asthma as add-on maintenance therapy.
19.12.2025	Myqorzo	Cytokinetics	Aficamten	Tablets for oral use	Cardiac myosin inhibitor	For the treatment of symptomatic obstructive hypertrophic cardiomyopathy.
23.12.2025	Yartemlea	Omeros Corporation	Narsoplimab-wuug	Solution for intravenous infusion	Monoclonal antibody	For the treatment of thrombotic microangiopathy associated with hematopoietic stem cell transplantation.
30.12.2025	Nereus	Vanda Pharmaceuticals Inc.	Tradipitant	Capsules for oral use	Substance P/neurokinin-1 receptor antagonist	For the treatment of vomiting due to motion sickness.

Note: HER, human epidermal growth factor receptor; IL, interleukin; DPP-1, dipeptidyl peptidase 1; INN, International Nonproprietary Name; NSCLC, non-small cell lung cancer; RNA, ribonucleic acid; PDE4, phosphodiesterase 4.

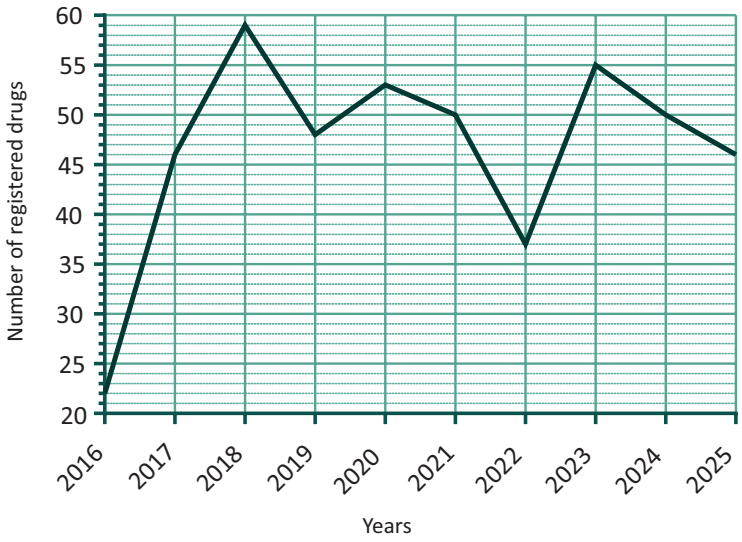


Figure 1 — Number of CDER-Approved Drugs Over the Last 9 Years.

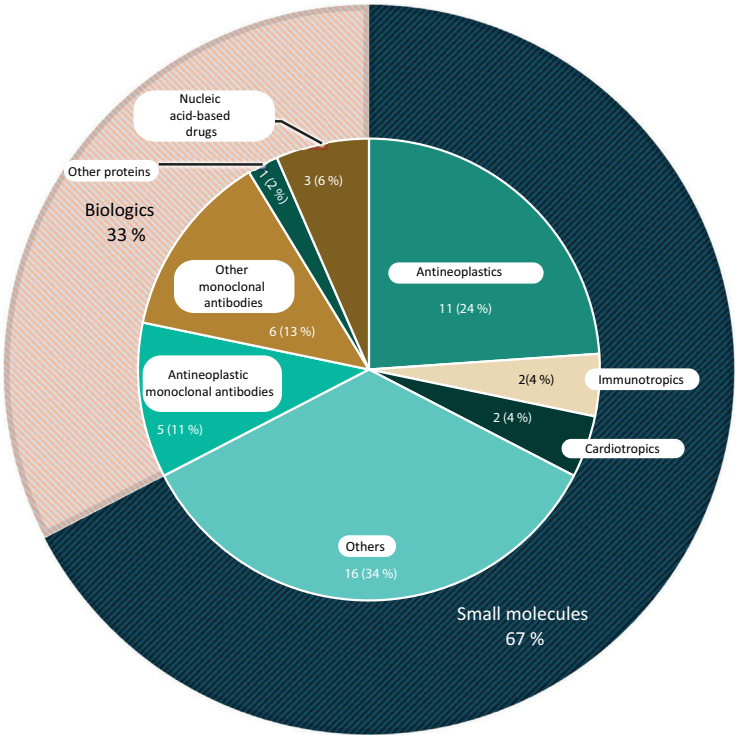


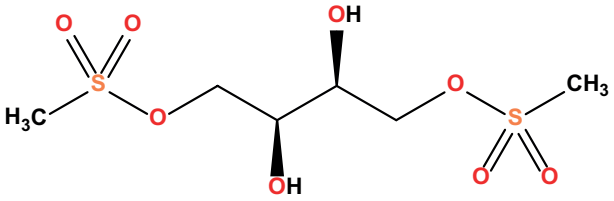
Figure 2 — Distribution of FDA-approved drugs in 2025 by category based on the nature of the medicines.

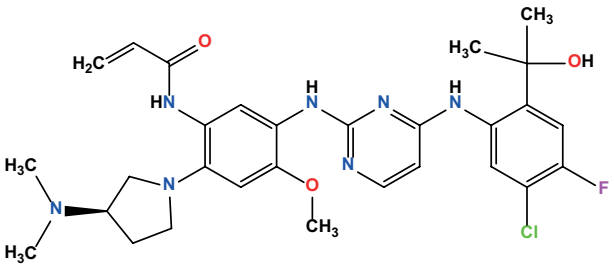
Table 2 — Original drugs from 2021 to 2025 by market segments, abs. (%)

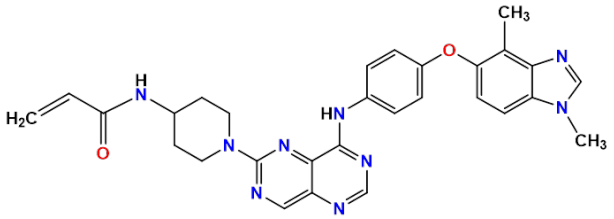
Year	2021	2022	2023	2024	2025
First in class	27 (54 %)	20 (54 %)	20 (36 %)	24 (48 %)	20 (43 %)
Breakthrough Therapy	14 (28 %)	13 (35 %)	9 (16 %)	18 (36 %)	15 (33 %)
Orphan Disease Drugs	26 (52 %)	20 (54 %)	28 (51 %)	26 (52 %)	23 (50 %)
Prescription Segment Drugs	49 (98 %)	36 (97 %)	49 (89 %)	47 (94 %)	44 (96 %)
First U.S. Approved Drugs	38 (76 %)	25 (68 %)	35 (64 %)	34 (68 %)	32 (70 %)
Fast Track Development Drugs	18 (36 %)	12 (32 %)	25 (45 %)	22 (44 %)	18 (39 %)
Accelerated Approval Drugs	14 (28 %)	6 (16 %)	9 (16 %)	7 (14 %)	11 (24 %)
Priority Review Drugs	34 (68 %)	21 (57 %)	31 (56 %)	28 (56 %)	21 (46 %)
First Cycle Approval Drugs	43 (86 %)	28 (76 %)	46 (84 %)	37 (74 %)	39 (85 %)

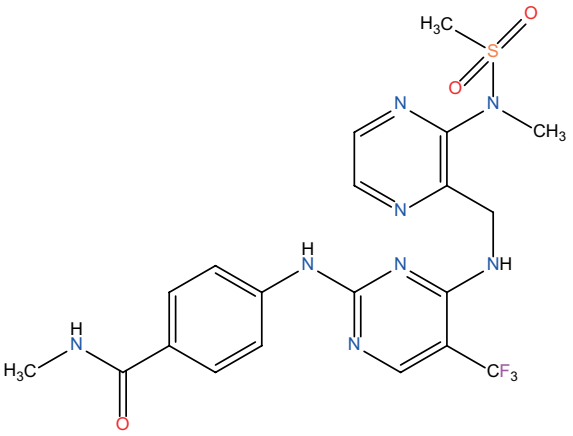
ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

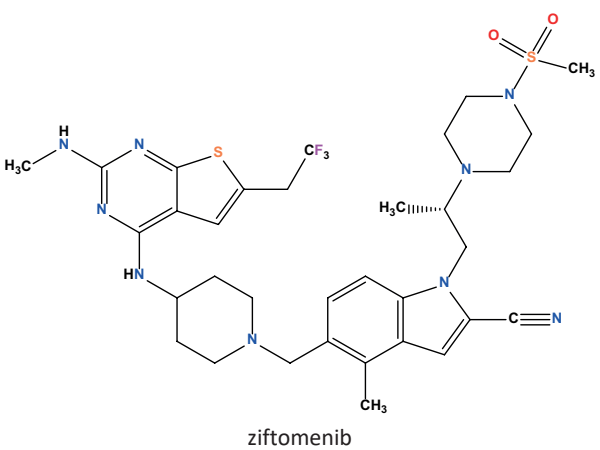
SMALL MOLECULES
Oncology Drugs

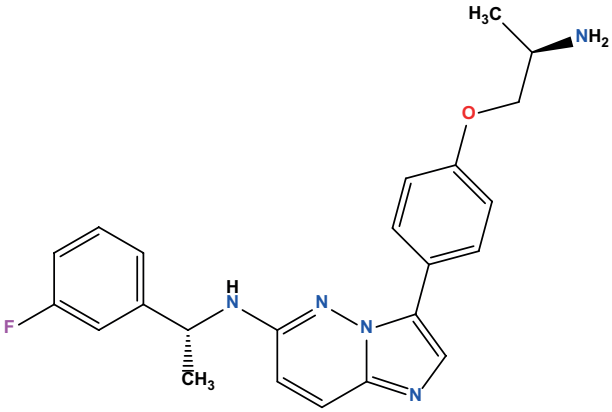

treosulfan

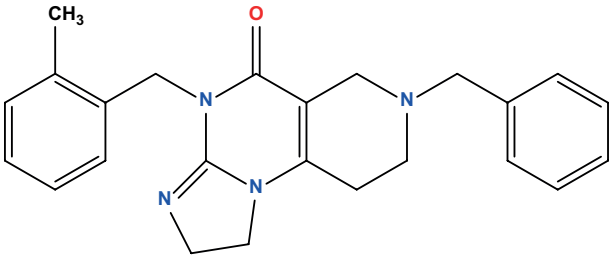

sunvortinib

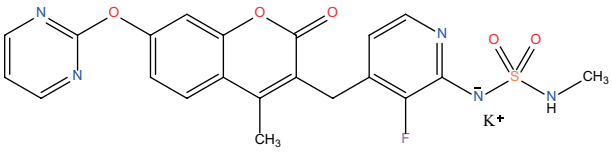

zongertinib

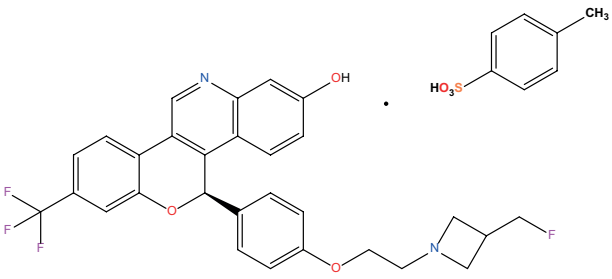

defactinib

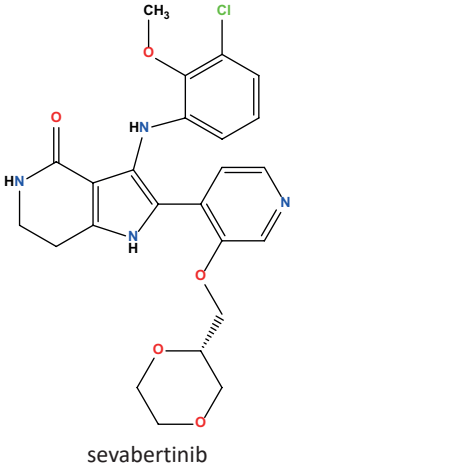

ziftomenib

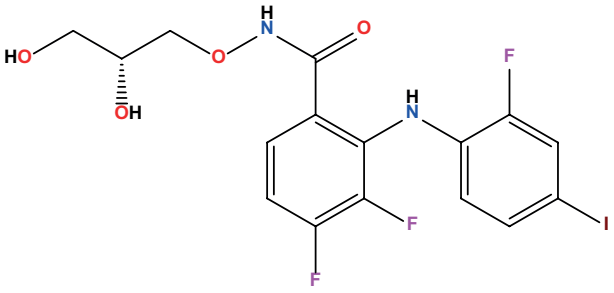

taletrectinib


dordaviron

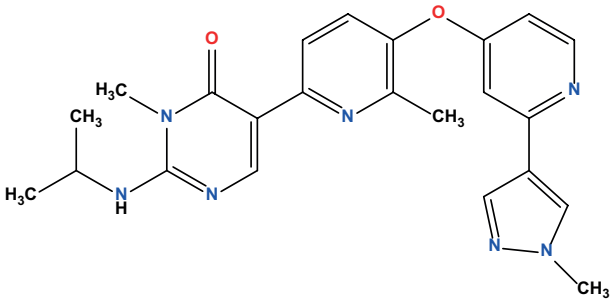

avutometinib


imlunestrant


sevabertinib

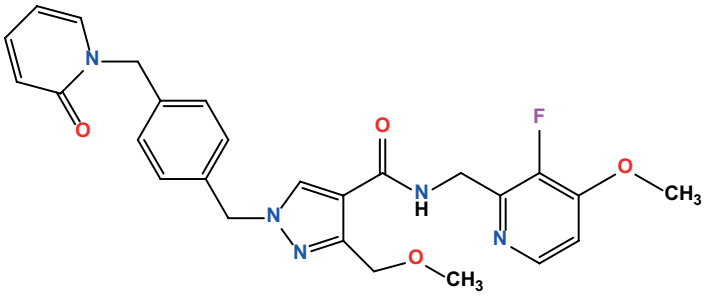


mirdametinib

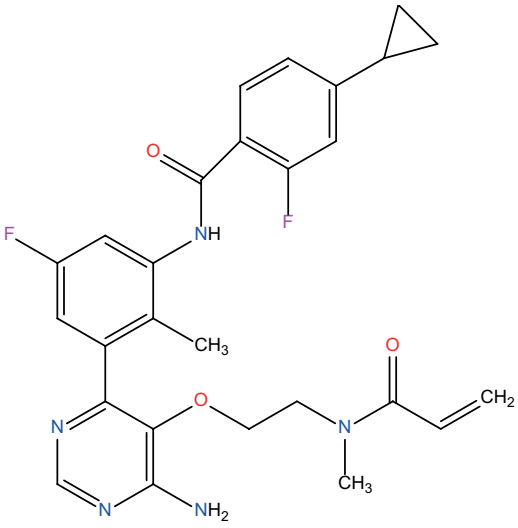


vimseltinib

Immunotropic Drugs

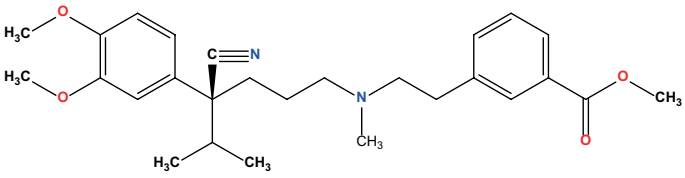


sebetralstat

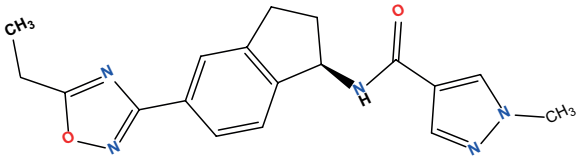


remibrutinib

Cardiotropic Drugs

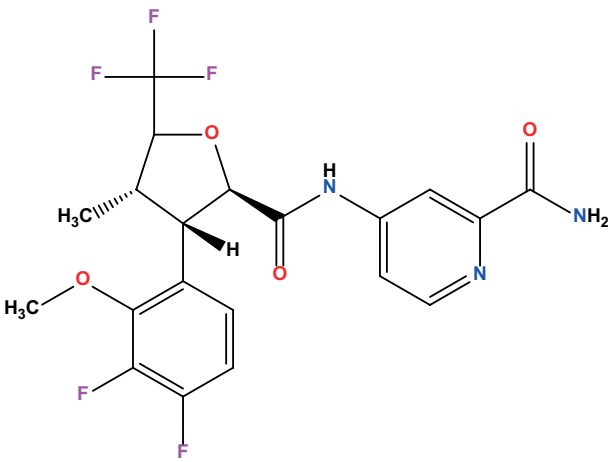


etripamil

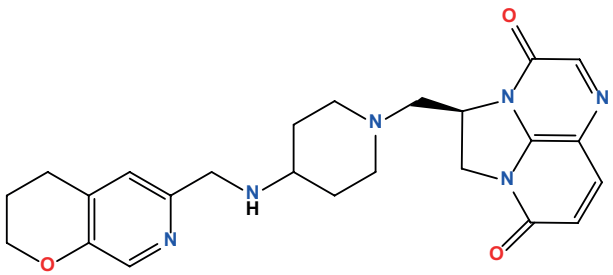


aficamten

Other drugs for various pathologies

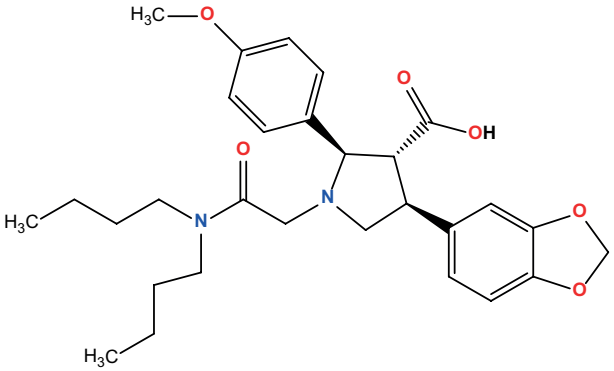


suzeltidine

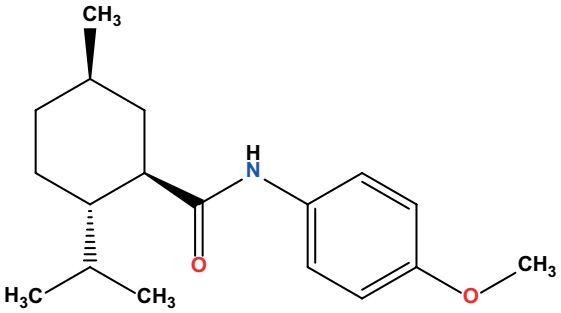


gepotidacin

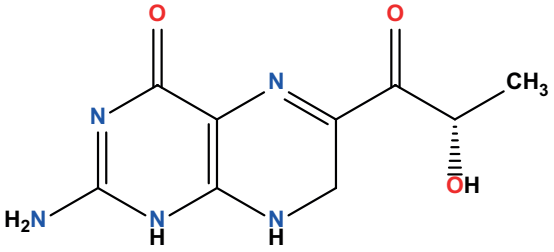
ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282



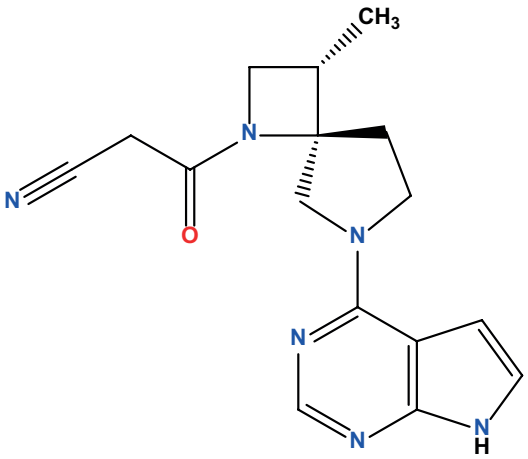
atrasentan



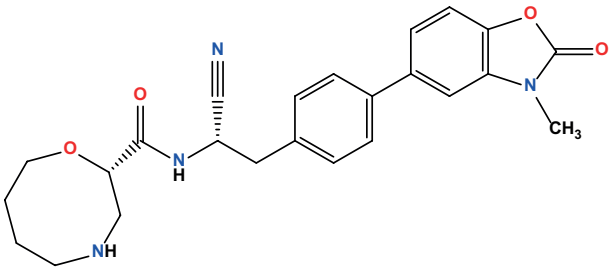
acoltemon



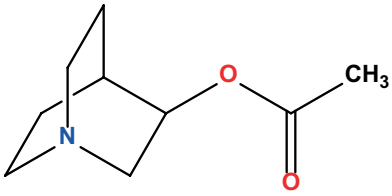
sepiapterin



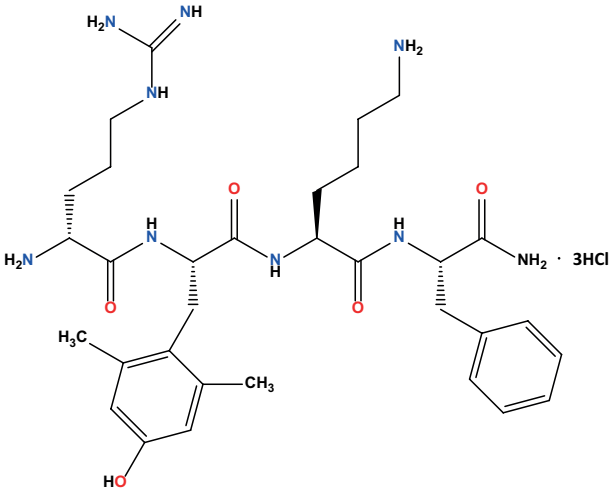
delgocitinib



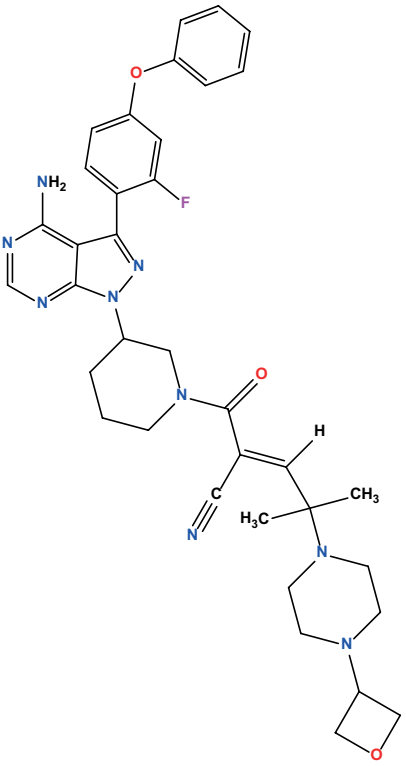
brensocatib



aceclidine



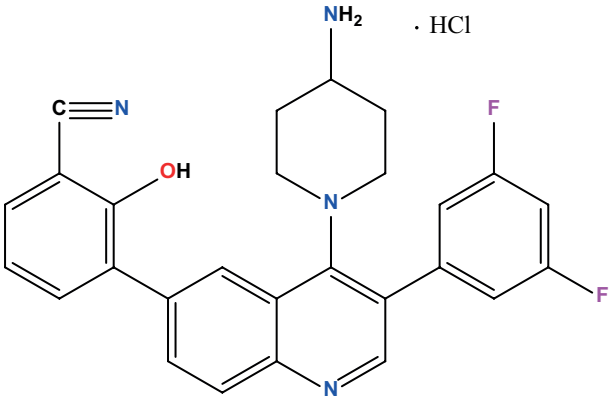
elamipretide



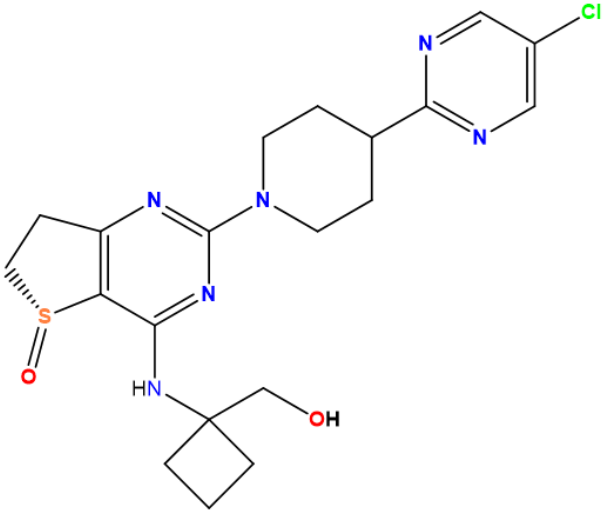
rilzabrutinib

ISSN 2307-9266 e-ISSN 2413-2241

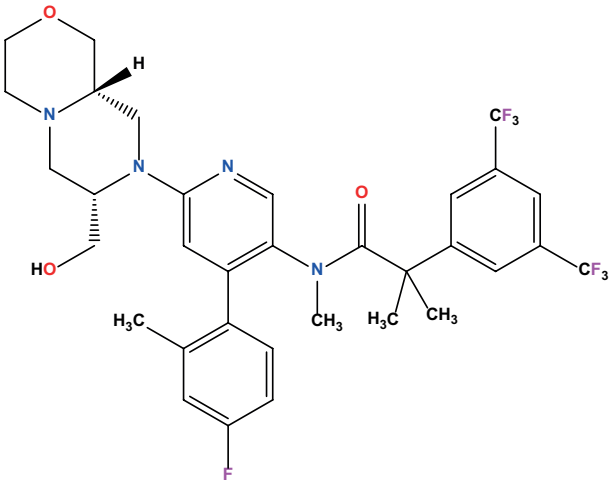
Scientific and Practical Journal
PHARMACY & PHARMACOLOGY
(ФАРМАЦИЯ И ФАРМАКОЛОГИЯ)



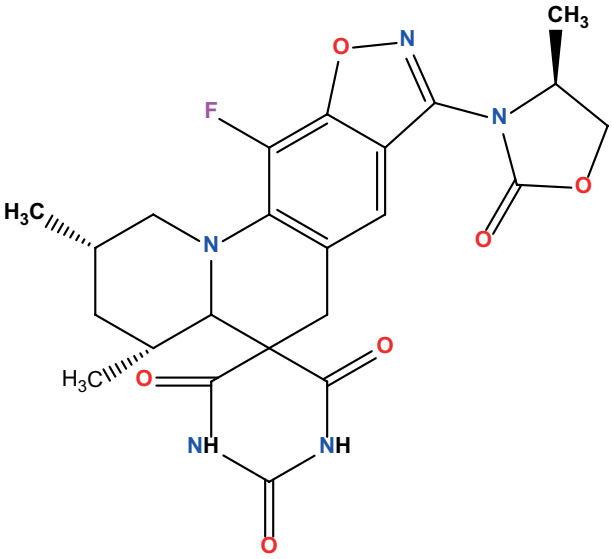
paltusotin



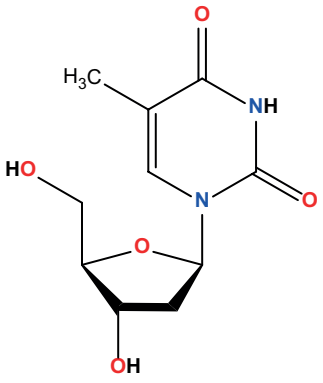
nerandolast



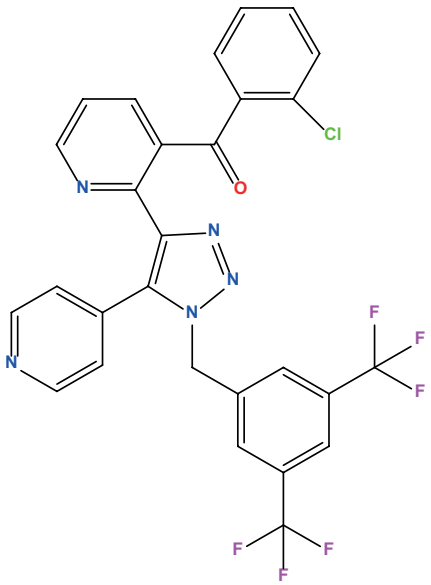
elinzanetant



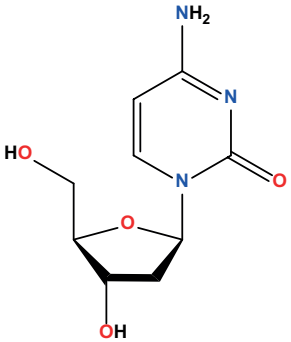
zolliflodacin



doxiribtimin



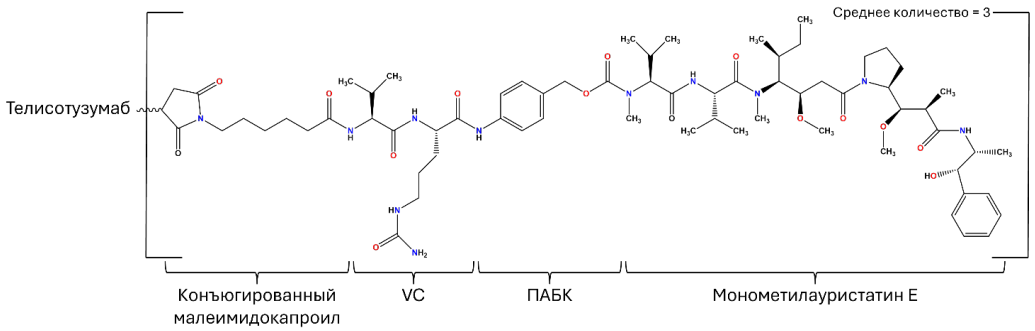
tradipitant



doxecitin

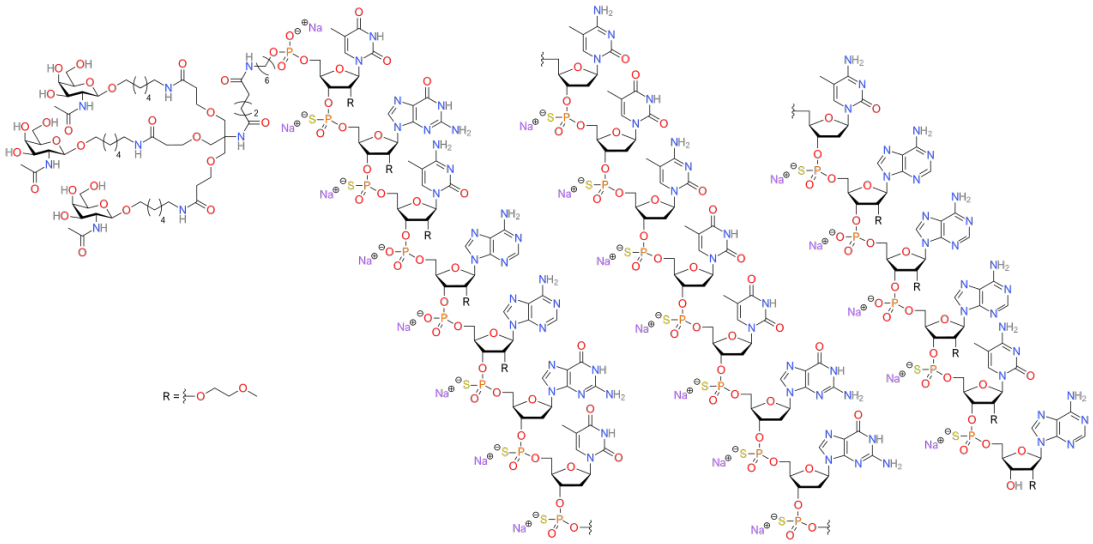
ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

BIOLOGICS
Antitumor Monoclonal Antibodies

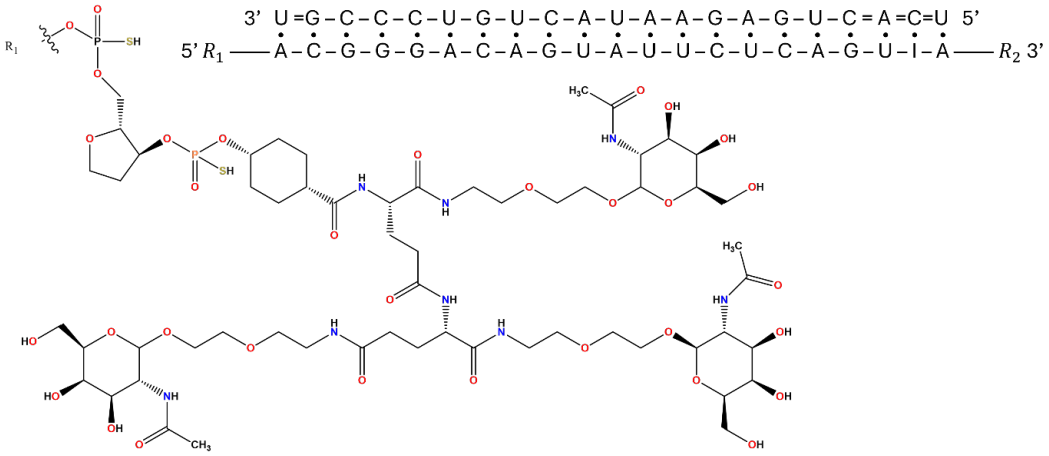


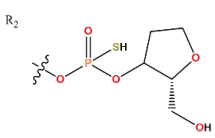
telisotuzumab vedotin-tllv

Nucleic Acid-Based

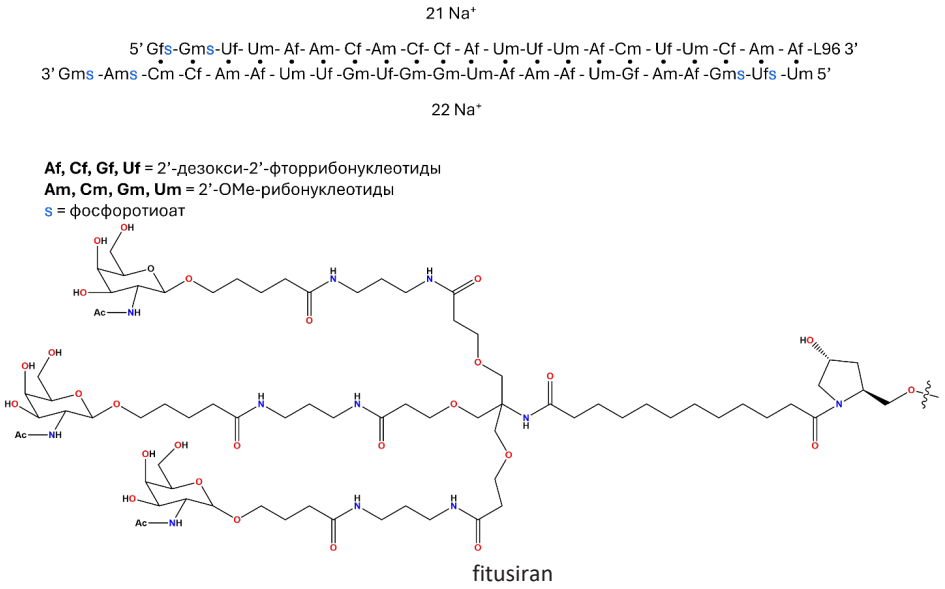


donidalorsen





plozasiran



fitusiran

Figure 3 — Structural formulas of approved molecules.

Note: vc, valinecitrulline linker; PABA, para-aminobenzoic acid; average = 3, an average of 3 molecules conjugated to the antibody.

Sunvortinib[9] (ZEGFROVY™, oral tablets) is a kinase inhibitor intended for the therapy of locally advanced or metastatic NSCLC with insertion mutations in exon 20 of the epidermal growth factor receptor (EGFR) gene in adult patients whose disease has progressed on or after platinum-based chemotherapy [8]. In cell cultures expressing various EGFR exon 20 mutation variants, sunvortinib inhibited EGFR phosphorylation at concentrations 2–10 times lower than when acting on wild-type gene [9].

Dordaviron[10] (MODEYSO™, oral capsules) is a protease activator intended for the treatment of diffuse midline glioma harboring the H3 K27M mutation with disease progression after prior therapy. Dordaviron is an activator of mitochondrial caseinolytic protease P and a dopamine D2 receptor blocker. Diffuse midline gliomas harboring the H3 K27M mutation are associated with loss of H3 K27 trimethylation [10]. *In vitro*, dordaviron activated the integrated stress response, induced apoptosis, and altered mitochondrial metabolism, leading to the restoration of H3 K27 trimethylation in H3 K27M-mutated diffuse glioma models [10]. Dordaviron demonstrated antitumor activity in *in vivo* diffuse glioma models [10].

Zongertinib[11] (HERNEXEOS®, oral tablets) is a kinase inhibitor intended for the treatment of adult patients with unresectable or metastatic non-squamous NSCLC whose tumors have activating mutations in the HER2 tyrosine kinase domain, identified by an FDA-approved test, and who have previously received systemic therapy. *In vitro*, zongertinib inhibited HER2 phosphorylation, HER2 downstream signaling (ERK phosphorylation), and the proliferation of lung cancer cells harboring activating mutations in the HER2 tyrosine kinase domain [11]. *In vivo*, zongertinib demonstrated antitumor activity in mouse xenograft models of NSCLC harboring activating mutations in the HER2 tyrosine kinase domain [12].

Avutometinib and Defactinib[12,13] (Avmapki Fakzynja Co-Pack, separate oral tablets) is a kinase inhibitor intended for the treatment of recurrent low-grade serous ovarian cancer with *KRAS* gene mutation after prior systemic therapy. Avutometinib is a mitogen-activated protein kinase (MEK1) kinase inhibitor. It induces the formation of inactive RAF / MEK complexes, which inhibits the proliferation of *KRAS*-mutated cells. Defactinib is an inhibitor of FAK and proline-rich tyrosine kinase-2 (Pyk2), two members of the FAK non-receptor tyrosine kinase family. Defactinib inhibited FAK autophosphorylation in cancer cells

[9] Drugs.com. Sunvozertinib. Available from: https://go.drugbank.com/drugs/DB18925

[10] Drugs.com. Dordaviprone. Available from: https://go.drugbank.com/drugs/DB14844

[11] Drugs.com. Zongertinib. Available from: https://go.drugbank.com/drugs/DB18762

[12] Drugs.com. Avutometinib. Available from: https://go.drugbank.com/drugs/DB15254

[13] Drugs.com. Defactinib. Available from: https://go.drugbank.com/drugs/DB12282

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

in vitro and in mouse xenograft models. Together, these drugs markedly suppressed cell proliferation in vitro and demonstrated antitumor activity in mouse tumor models, including low-grade serous ovarian cancer [13].

Imlunestrant[14] (Inluriyo, oral tablets) is an estrogen receptor antagonist intended for the treatment of estrogen receptor-positive, human epidermal growth factor receptor 2-negative, estrogen receptor-1-mutated advanced or metastatic breast cancer with disease progression after at least one course of endocrine therapy. Imlunestrant is an estrogen receptor (ER) antagonist with high affinity for the ERα subtype. By binding to the receptor, the drug inhibits ER-dependent transcription in tumor cells, leading to the suppression of their proliferation [14]. Imlunestrant demonstrated antitumor activity *in vitro* and *in vivo* in ER+ breast cancer xenograft models, including models with mutations consistent with the indication [15].

Ziftomenib[15] (Komzifti, oral capsules) is a menin inhibitor intended for the treatment of adult patients with relapsed or refractory acute myeloid leukemia harboring a susceptible nucleophosmin 1 mutation, who lack satisfactory alternative treatment options. Ziftomenib blocks the interaction of menin and lysine (K)-specific methyltransferase 2A (KMT2A), which is crucial in the context of certain leukemias: in the presence of an NPM1 mutation, the affinity of the KMT2A-menin complex for leukemogenic gene promoters increases. In preclinical studies, ziftomenib demonstrated antitumor activity *in vitro* and in *vivo* in NPM1-mutated leukemia models [16].

Sevabertinib[16] (Hyrnuo, oral tablets) is a kinase inhibitor intended for the treatment of locally advanced or metastatic non-squamous NSCLC with tumors harboring activating mutations in the HER2 tyrosine kinase domain in patients who have received systemic therapy. Sevabertinib is a reversible HER2 kinase inhibitor. It also exhibits activity against EGFR. *In vitro*, sevabertinib inhibited HER2 phosphorylation and downstream signaling pathways in cancer cells with HER2 alterations, as well as the proliferation of cancer cells expressing wild-type HER2 or harboring HER2 mutations [17]. *In vivo*, sevabertinib demonstrated antitumor activity in mice with subcutaneous xenografts of cells derived from human NSCLC tumors harboring an activating HER2 exon 20 mutation [17].

Mirdametinib[17] (Gomekli, oral capsules and oral suspension tablets) is a kinase inhibitor intended for the treatment of neurofibromatosis type 1 in patients with symptomatic plexiform neurofibromas that are not amenable to complete surgical resection. Mirdametinib inhibits mitogen-activated protein kinases 1 and 2 (MEK 1/2). MEK 1/2 proteins are the initial regulators of the extracellular signal-regulated kinase ERK signaling pathway. *In vitro*, mirdametinib inhibited the kinase activity of MEK1 and MEK2, as well as subsequent ERK phosphorylation [18].

Vimseltinib[18] (Romvimza, oral capsules) is a kinase inhibitor intended for the treatment of symptomatic tenosynovial giant cell tumor where surgical resection may lead to functional impairment or severe morbidity. *In vitro*, vimseltinib inhibited CSF1R autophosphorylation, CSF1 ligand binding-induced signaling, and the proliferation of CSF1R-expressing cells [19].

Immunotropic Drugs

Sebebtalstat[19] (EKTERLY, tablets for oral use) is a kallikrein inhibitor indicated for the treatment of acute attacks of hereditary angioedema. Sebebtalstat is a competitive, reversible inhibitor of plasma kallikrein. Plasma kallikrein is a serine protease that cleaves high-molecular-weight kininogen, releasing bradykinin, which increases vascular permeability by activating bradykinin receptors, causing edema. Sebebtalstat inhibits kininogen cleavage and reduces bradykinin production, thereby alleviating the clinical symptoms of acute hereditary angioedema episodes [20, 21]. Sebebtalstat also inhibits the positive feedback mechanism of the kallikrein-kinin system by plasma kallikrein, thereby reducing factor XIIa levels and further plasma kallikrein generation [22].

[14] Drugs.com. Imlunestrant. Available from: https://go.drugbank.com/drugs/DB19043
[15] Drugs.com. Ziftomenib. Available from: https://go.drugbank.com/drugs/DB17171
[16] Drugs.com. Sevabertinib. Available from: https://go.drugbank.com/drugs/DB21667
[17] Drugs.com. Mirdametinib. Available from: https://go.drugbank.com/drugs/DB07101
[18] Drugs.com. Vimseltinib. Available from: https://go.drugbank.com/drugs/DB17520
[19] Drugs.com. sebetralstat – Available from: https://www.drugs.com/sebetralstat.html

Remibrutinib[20] (Rhapsido, tablets for oral use), a kinase inhibitor indicated for the treatment of chronic spontaneous urticaria in adults who have persistent symptoms despite treatment with H1-type antihistamines. Remibrutinib is a small molecule, reversible inhibitor of Bruton's tyrosine kinase. Thus, its mechanism of action is similar to rilzabrutinib; however, remibrutinib has an effect on kinases associated with Bruton's tyrosine kinase. Remibrutinib prevents mast cell and basophil degranulation, including the release of histamine and other pro-inflammatory mediators, mediated by pathogenic IgE or IgG directed against FcεR1 or IgE [23].

Cardiotropic Drugs

Etripamil[21] (Cardamyst, nasal spray) is an L-type calcium channel blocker indicated for the treatment of episodes of paroxysmal supraventricular tachycardia. Etripamil exerts its pharmacological effect by modulating calcium ion influx across the cell membrane of the atrioventricular node cells, as well as arterial smooth muscle cells and myocardial contractile cells. By interrupting re-entry in the atrioventricular node, etripamil helps restore sinus rhythm in patients with paroxysmal supraventricular tachycardia [24].

Aficamten[22] (Myqorzo, tablets for oral use) is an IL-5 antagonist indicated for the treatment of symptomatic obstructive hypertrophic cardiomyopathy. Aficamten is an allosteric, reversible inhibitor of cardiac myosin motor activity. Aficamten reduces the force generated by myosin in the cardiac sarcomere, which contributes to the pathophysiology of hypertrophic cardiomyopathy. In patients with hypertrophic cardiomyopathy, myosin inhibition with aficamten reduces cardiac contractility and decreases left ventricular outflow tract obstruction [25].

Other Drugs for the Treatment of Various Pathologies

Suzetrigine[23] (JOURNAVX, tablets for oral use) is a Na^+ channel blocker indicated for the treatment of moderate to severe acute pain in adults. Suzetrigine is a selective inhibitor of the voltage-gated NaV1.8 channel. This channel is expressed on the surface of peripheral afferent neurons, including dorsal root ganglion neurons. In dorsal root ganglion neurons, the NaV1.8 channel is responsible for the transmission of pain action potentials [26]. By selectively inhibiting NaV1.8 channels, suzetrigine suppresses the transmission of pain signals to the spinal cord and brain. The main metabolite of suzetrigine, M6-SUZ, is 3.7 times weaker than suzetrigine [27].

Gepotidacin[24] (BLUJEPA, tablets for oral use) is a triazaacenaphthylene antibiotic used to treat female patients aged 12 years and older, weighing at least 40 kg, with uncomplicated urinary tract infections caused by *Escherichia coli*, *Klebsiella pneumoniae*, *Citrobacter freundii* complex, *Staphylococcus saprophyticus*, or *Enterococcus faecalis*. Gepotidacin inhibits bacterial type II topoisomerase (DNA gyrase) and type IV topoisomerase, leading to the cessation of DNA replication in the bacterial cell. The substance exhibits bactericidal activity with a direct relationship between the intensity of the effect and the duration of exposure. *In vitro*, at 5 times the MIC, the post-exposure antibacterial effect against *Escherichia coli* is 1.8–2.2 h, against *Klebsiella pneumoniae*—1–6.6 h, against *Proteus mirabilis*—1.4–3 h, against *Citrobacter freundii*—1–2.6 h, against *Staphylococcus saprophyticus*—2.7–4.3 h, and against *Enterococcus faecalis*—1.2–2.7 h [28–30].

Atrasentan[25] (VANRAFIA™, tablets for oral use) is an endothelin (ET) receptor antagonist indicated for the reduction of proteinuria in adult patients with primary IgA nephropathy at risk of progression and a urine protein/creatinine ratio ≥ 1.5 g/g. The drug was approved under accelerated approval due to its demonstrated ability to reduce proteinuria. It is unknown at the time of writing whether the drug has the ability to slow the decline in kidney function in patients with IgA nephropathy. Atrasentan is an ETA antagonist with an inhibition constant (Ki) of 0.034 nmol/L, which is more than 1800 times more

[20] Drugs.com. Remibrutinib. Available from: https://go.drugbank.com/drugs/DB16852
[21] Drugs.com. Etripamil. Available from: https://go.drugbank.com/drugs/DB12605
[22] Drugs.com. Aficamten. Available from: https://go.drugbank.com/drugs/DB18490
[23] Drugs.com. Suzetrigine. Available from: https://go.drugbank.com/drugs/DB18927
[24] Drugs.com. Gepotidacin. Available from: https://go.drugbank.com/drugs/DB12134
[25] Drugs.com. Atrasentan. Available from: https://go.drugbank.com/drugs/DB06199

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

specific than its Ki for ETB [31–33]. Endothelin is thought to be involved in the pathogenesis of IgA nephropathy by acting on the ETA receptor [34].

Acoltremon[26] (TRYPTYR®, 0.003 % eye drops) is a transient receptor potential cation channel subfamily M member 8 (TRPM8) agonist indicated for the treatment of dry eye symptoms. Acoltremon stimulates TRPM8 thermoreceptors, activating the trigeminal nerve, which leads to increased basal tear production [35].

Delgocitinib[27] (ANZUPGO®, cream for topical application) is a Janus kinase inhibitor indicated for the treatment of moderate to severe chronic hand eczema when topical corticosteroids are not appropriate or do not provide sufficient effect. Delgocitinib inhibits the activity of JAK1, JAK2, JAK3, and tyrosine kinase 2. The JAK signaling pathway involves the mobilization of signal transducers and activators of transcription (STAT) from cytokine receptors, as well as STAT activation in the nucleus, which promotes cytokine-regulated gene expression. All of this contributes to the induction of specific biological responses in target cells [36]. The exact mechanism of action of delgocitinib in the treatment of moderate to severe chronic hand eczema is currently unknown.

Sepiapterin[28] (SEPHIENCE, powder for oral use) is a phenylamine hydroxylase activator indicated for the treatment of hyperphenylalaninemia in patients with phenylketonuria who are responsive to sepiapterin, in conjunction with a phenylalanine-restricted diet [37–39]. The mechanism of action of sepiapterin is based on its role as a precursor to the cofactor tetrahydrobiopterin, which activates phenylalanine hydroxylase [39].

Aceclidine[29] (VIZZ™, ophthalmic solution) is a cholinergic receptor agonist indicated for the treatment of presbyopia (age-related farsightedness). Aceclidine stimulates muscarinic receptors located in smooth muscle cells. The drug has a selective effect on the pupillary sphincter muscle, with minimal effect on the ciliary muscle. By causing contraction of the iris sphincter, aceclidine creates an obscuration effect, thereby increasing depth of focus and improving vision [40, 41]

Brensocatib[30] (Brinsupri, tablets for oral use) is a DPP-1 inhibitor indicated for the treatment of non-cystic fibrosis bronchiectasis. Brensocatib is a competitive inhibitor of DPP-1. DPP-1 activates pro-inflammatory neutrophil serine proteases (NSPs) during their maturation in the bone marrow. Activated NSPs are involved in the pathogenesis of neutrophil-mediated bone marrow inflammation. Inhibition of DPP-1 activity in cell cultures reduces NSP activity [42]. This effect has been confirmed in clinical studies in patients with non-cystic fibrosis bronchiectasis [43].

Rilzabrutinib[31] (Wayrilz, tablets for oral use) is a kinase inhibitor indicated for the treatment of persistent or chronic immune thrombocytopenia that is inadequately treated with immunoglobulins, anti-D therapy, or corticosteroids. Rilzabrutinib is a small molecule, reversible inhibitor of Bruton's tyrosine kinase. The therapeutic effect of rilzabrutinib in immune thrombocytopenia is mediated by immunomodulation, including: 1) inhibition of B-cell activation; 2) interruption of antibody-coated cell phagocytosis via the Fcγ receptor in the spleen and liver. *In vitro*, rilzabrutinib reduced FcγR-mediated signaling of autoantibodies, blocked B-cell signaling, and reduced autoantibody production by affecting B-cell activation [44, 45].

Elamipretide[32] (Forzinity, solution for subcutaneous injection) is a mitochondrial cardiolipin binding agent indicated for improving muscle strength in patients with Barth syndrome weighing at least 30 kg. Elamipretide is a substance that chelates mitochondrial cardiolipin, normalizing mitochondrial morphology and significantly enhancing mitochondrial function [46, 47].

Paltusotine[33] (Palsonify, tablets for oral use) is a somatostatin receptor agonist indicated for the treatment of acromegaly in adults who have

[26] Drugs.com. Acoltremon. Available from: https://go.drugbank.com/drugs/DB19202
[27] Drugs.com. Delgocitinib. Available from: https://go.drugbank.com/drugs/DB16133
[28] Drugs.com. Sepiapterin. Available from: https://go.drugbank.com/drugs/DB16326
[29] Drugs.com. Aceclidine. Available from: https://go.drugbank.com/drugs/DB13262
[30] Drugs.com. Brensocatib. Available from: https://go.drugbank.com/drugs/DB15638
[31] Drugs.com. Rilzabrutinib. Available from: https://go.drugbank.com/drugs/DB17709
[32] Drugs.com. Elamipretide. Available from: https://go.drugbank.com/drugs/DB11981
[33] Drugs.com. Paltusotine. Available from: https://go.drugbank.com/drugs/DB16277

had an inadequate response to surgery and/or for whom surgery is not a viable treatment option. Like endogenous somatostatin, paltusotine suppresses the secretion of growth hormone and insulin-like growth factor 1. The drug has selective agonism at the somatostatin receptor 2 (SSTR2) with minimal affinity for other somatostatin receptor subtypes. Paltusotine inhibited cAMP accumulation via activation of human SSTR2 at a median effective concentration of 0.25 nmol/L [48–50].

Nerandomilast[34] (Jascayd, oral tablets) is an PDE-4 inhibitor indicated for the treatment of idiopathic pulmonary fibrosis. PDE-4 normally hydrolyzes and inactivates cAMP. Nerandomilast has a higher affinity for the PDE-4B isoenzyme than for other isoenzymes—A, C, and D. Nerandomilast has both antifibrotic and immunomodulatory effects, as inhibition of PDE-4B increases intracellular cAMP levels and reduces the expression of profibrotic growth factors and inflammatory cytokines that are overexpressed in idiopathic pulmonary fibrosis [51].

Elinzanetant[35] (Lynkuet, oral capsules) is a neurokinin (NK) 1 and 3 receptor antagonist indicated for the treatment of moderate to severe vasomotor symptoms associated with menopause. Inhibition of substance P and neurokinin B through antagonism of NK1 and NK3 receptor signaling pathways on kisspeptin / neurokinin B / dynorphin neurons may modulate neural activity in thermoregulation related to hot flashes. Elinzanetant has affinity for NK1 and NK3 receptors but not NK2. The efficacy of Lynkuet in treating moderate to severe vasomotor symptoms associated with menopause was confirmed in two randomized, double-blind, placebo-controlled, multicenter clinical trials (796 women with a frequency of moderate or severe hot flashes, including nocturnal, of at least 50 per week) [52, 53]. In both studies, the Lynkuet therapy groups showed a statistically significant and clinically meaningful reduction in the frequency of moderate and severe hot flashes (by at least 2 episodes within 24 hours) by weeks 4 and 12 compared to placebo [52, 53].

Doxecitin and Doxiribtimin[36,37] (Kygevvi, powder for oral solution) are pyrimidine nucleosides indicated for the treatment of thymidine kinase 2 deficiency in patients whose symptoms begin at age 12 years or younger. The administration of doxecitin and doxiribtimin aims to incorporate the pyrimidine nucleosides, deoxycytidine and deoxythymidine, into skeletal muscle mitochondrial DNA. This action restored mitochondrial DNA copy numbers in mice with thymidine kinase 2 mutations [54–56].

Zoliflodacin[38] (Nuzolvence, granules for oral suspension) is a type II topoisomerase inhibitor (Spiropirimidinetrione) indicated for the treatment of uncomplicated urogenital gonorrhea caused by *Neisseria gonorrhoeae*. Zoliflodacin is an inhibitor of bacterial type II topoisomerases (DNA gyrase and topoisomerase IV)—enzymes essential for DNA synthesis and critical for bacterial function and replication. *In vitro* studies of zoliflodacin revealed activity against multidrug-resistant strains of *Neisseria gonorrhoeae*, including strains resistant to ceftriaxone and azithromycin, with no cross-resistance to other antibiotics [57, 58].

Tradipitant[39] (Nereus, oral capsules) is a substance P/neurokinin-1 receptor antagonist indicated for the treatment of vomiting due to motion sickness. Tradipitant has no affinity for NK2 and NK3 receptors, serotonin, dopamine, cholinergic, or histamine receptors. In animal experiments, tradipitant was found to suppress emesis induced by drug. Human positron emission tomography studies with tradipitant showed that it crosses the blood-brain barrier and binds to NK-1 receptors in the brain [59, 60].

BIOLOGICALS

Antitumor Monoclonal Antibodies

Datopotamab deruxtecan-dlnk[40] (DATROWAY®, solution for intravenous infusion) is an antibody-drug conjugate that targets the tumor-associated calcium

[34] Drugs.com. Nerandomilast. Available from: https://go.drugbank.com/drugs/DB18237
[35] Drugs.com. Elinzanetant. Available from: https://go.drugbank.com/drugs/DB18968
[36] Drugs.com. Doxecitine. Available from: https://go.drugbank.com/drugs/DB02594
[37] Drugs.com. Thymidine. Available from: https://go.drugbank.com/drugs/DB04485
[38] Drugs.com. Zoliflodacin. Available from: https://go.drugbank.com/drugs/DB12817
[39] Drugs.com. Tradipitant. Available from: https://go.drugbank.com/drugs/DB12580
[40] Drugs.com. Datopotamab deruxtecan. Available from: https://go.drugbank.com/drugs/DB16410

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

signal transducer 2 (Trop-2) and a topoisomerase inhibitor. The drug is indicated for the treatment of adult patients with unresectable or metastatic breast cancer (HR-positive, HER2-negative, IHC 0, IHC 1+, or IHC 2+/ISH-) who have previously received endocrine therapy for this disease. Deruxtecan is a topoisomerase I inhibitor conjugated to the antibody (datopotamab) via a cleavable linker. After binding to Trop-2, the small molecule portion of the drug (deruxtecan) enters the tumor cell. Topoisomerase inhibition leads to DNA damage and apoptotic cell death. *In vivo*, the drug demonstrated antitumor activity in mice with breast cancer [61, 62].

Penpulimab-kcqx[41] (penpulimab-kcqx, solution for intravenous infusion) is an antibody that blocks the programmed cell death protein 1 (PD-1) receptor. Binding of PD-1 ligands, PD-L1 and PD-L2, to the PD-1 receptor found on T cells inhibits T-cell proliferation and cytokine production. Increased levels of PD-1 ligands are observed in some tumors, and signaling through this pathway may contribute to the suppression of active T-cell immune surveillance of tumors. The drug is a humanized IgG1 monoclonal antibody that binds to PD-1 and blocks its interaction with PD-L1 and PD-L2, thereby removing PD-1-mediated inhibition of immune responses, including antitumor immune responses [63]. In mouse tumor models, blocking PD-1 activity led to reduced tumor growth. Penpulimab-kcqx is used in combination with cisplatin or carboplatin and gemcitabine for the treatment of adult patients with recurrent or metastatic nonkeratinizing nasopharyngeal carcinoma, or as monotherapy during or after platinum-based chemotherapy and at least one prior line of therapy [63].

Telisotuzumab vedotin-tllv[42] (Emrelis, solution for intravenous infusion) is a monoclonal antibody indicated for the treatment of locally advanced or metastatic NSCLC with high c-Met protein expression after prior systemic therapy. Telisotuzumab vedotin is an anti-c-Met antibody conjugated to the drug. The antibody is a humanized IgG1 against the hepatocyte growth factor receptor. The small molecule, monomethyl auristatin E (MMAE), is linked to the antibody via a protease-cleavable linker and is a microtubule-disrupting agent. After binding to cells expressing c-Met, telisotuzumab vedotin is internalized, and MMAE is released upon linker cleavage. MMAE disrupts the microtubule network of actively dividing cells, leading to cell cycle arrest and apoptosis. In NSCLC xenografts, telisotuzumab vedotin demonstrated antitumor activity [64].

Linvoseltamab-gcpt[43] (Lynozyfic, solution for intravenous infusion) is a monoclonal antibody indicated for the treatment of relapsed or refractory multiple myeloma after at least four prior lines of therapy, including a proteasome inhibitor, an immunomodulatory agent, and an anti-CD38 monoclonal antibody. The drug is a bispecific antibody that activates T cells by binding to CD3 and B-cell maturation antigen (BCMA). BCMA is expressed on the surface of multiple myeloma cells and some normal B cells [65]. *In vitro*, linvoseltamab activated T cells and stimulated the release of pro-inflammatory cytokines, leading to the lysis of multiple myeloma cells [66]. In mouse studies, linvoseltamab demonstrated antitumor activity [67].

Pembrolizumab and berugialuronidase alfa-pmph[44,45] (Keytruda Qlex, solution for subcutaneous injection) is a monoclonal antibody indicated for the treatment of solid tumors in adults and children (12 years of age and older) who have previously received intravenous pembrolizumab. Binding of PD-1 ligands, PD-L1 and PD-L2, to the PD-1 receptor on T cells inhibits their proliferation and cytokine production. Increased levels of PD-1 ligands are observed in some tumors, and signaling through this pathway may contribute to the suppression of active T-cell immune surveillance of tumors. Pembrolizumab binds to the PD-1 receptor and blocks its interaction with PD-L1 and PD-L2, thereby removing PD-1-mediated inhibition of immune responses, including antitumor immune responses. In syngeneic mouse tumor models, blocking PD-1 activity led to reduced tumor growth. Combination therapy with a PD-1 blocking antibody and the kinase inhibitor lenvatinib reduced the number of

[41] Drugs.com. Penpulimab. Available from: https://go.drugbank.com/drugs/DB16747
[42] Drugs.com. Telisotuzumab vedotin. Available from: https://go.drugbank.com/drugs/DB15104
[43] Drugs.com. Linvoseltamab. Available from: https://go.drugbank.com/drugs/DB17447
[44] Drugs.com. Pembrolizumab. Available from: https://go.drugbank.com/drugs/DB09037
[45] Drugs.com. Berahyaluronidase alfa. Available from: https://go.drugbank.com/drugs/DB22790

tumor-associated macrophages, increased the number of activated cytotoxic T cells, and slowed tumor growth in syngeneic tumor models [68, 69]. Berugialuronidase alfa is an endoglycosidase, a variant of human hyaluronidase PH20, that temporarily and locally degrades hyaluronan. Hyaluronan is a polysaccharide found in the extracellular matrix of subcutaneous tissue. Unlike stable structural components of the interstitial matrix, hyaluronan has a half-life of approximately half a day. Hyaluronidase increases the permeability of subcutaneous tissue by depolymerizing hyaluronan [70, 71].

Monoclonal Antibodies with Other Effects

Nipocalimab[46] (IMAAVYTM, solution for intravenous infusion) is a human IgG1 monoclonal antibody that binds to the neonatal Fc receptor (FcRn), leading to reduced circulating IgG levels. In patients who tested positive for anti-AChR and anti-MuSK autoantibodies and received IMAAVY treatment, a reduction in anti-AChR and anti-MuSK autoantibody levels was observed compared to baseline. It is indicated for the treatment of myasthenia gravis [72].

Clesrovimab-cfor[47] (Enflonsia, solution for intramuscular injection) is a monoclonal antibody intended for the prophylaxis of RSV—lower respiratory tract disease in newborns and infants born during or entering their first RSV season. Clesrovimab is a recombinant neutralizing IgG1κ with a 3-amino acid substitution—M252Y/S254T/T256E—in the Fc fragment. This substitution increases binding to neonatal FcR, leading to an increased serum half-life. Clesrovimab enhances passive immunity by targeting the extracellular domain of the RSV fusion protein and preventing viral and cellular membrane fusion and subsequent viral entry into the cell [73].

Garadacimab-gxii[48] (Andembry, solution for subcutaneous injection) is a monoclonal antibody intended for the prevention of hereditary angioedema attacks. Garadacimab is an inhibitor of activated Hageman factor (factor XIIa), binding to its catalytic domain. Factor XIIa is the first in the contact pathway of coagulation activation; it initiates the inflammatory bradykinin-producing kallikrein-kinin system. Inhibition of factor XIIa prevents the activation of prekallikrein to kallikrein and the formation of bradykinin, which is associated with inflammation and swelling in hereditary angioedema attacks, thereby slowing the cascade of events leading to an attack [74].

Sibeprenlimab-szsi[49] (Voyxact, solution for subcutaneous injection) is a monoclonal antibody intended to reduce proteinuria in primary immunoglobulin A nephropathy in adults at risk of disease progression. Sibeprenlimab is a blocker of the proliferation-inducing ligand A (APRIL). APRIL binds to APRIL (dissociation constant 0.95 pmol/L), blocking signaling through BCMA and transmembrane activator and calcium modulator and cyclophilin ligand receptor (TACI) [75]. Inhibition of APRIL leads to a decrease in serum galactose-deficient immunoglobulin A1 (Gd-IgA1) levels, which are involved in the pathogenesis of primary immunoglobulin A nephropathy [75].

Depemokimab-ulaa[50] (Exdensur, solution for subcutaneous injection) is a monoclonal antibody intended for the treatment of severe eosinophilic asthma as additional maintenance therapy. Severe asthma is defined as asthma requiring treatment with medium- or high-dose inhaled corticosteroids plus a second therapy (e.g., systemic corticosteroids or biologics) to prevent uncontrolled development, or that remains uncontrolled despite treatment. Eosinophilic asthma is a subtype of asthma characterized by elevated levels of eosinophils (a type of white blood cell) in the airways and/or blood. Depemokimab-ulaa is an ultra-long-acting IL-5 antagonist that prevents activation of the corresponding receptor on the surface of eosinophils, which in turn reduces eosinophil production, activation, and survival in the body [76].

Narsopeplimab-wuug[51] (Yartemlea, solution for intravenous infusion) is a monoclonal antibody intended for the treatment of thrombotic microangiopathy associated with hematopoietic stem cell transplantation. It is a monoclonal antibody that inhibits mannose-binding lectin-associated

[46] Drugs.com. Nipocalimab. Available from: https://go.drugbank.com/drugs/DB16257
[47] Drugs.com. Clesrovimab. Available from: https://go.drugbank.com/drugs/DB18877
[48] Drugs.com. Garadacimab. Available from: https://go.drugbank.com/drugs/DB15629
[49] Drugs.com. Sibeprenlimab. Available from: https://go.drugbank.com/drugs/DB18919
[50] Drugs.com. Depemokimab. Available from: https://go.drugbank.com/drugs/DB18846
[51] Drugs.com. Narsoplimab. Available from: https://go.drugbank.com/drugs/DB16418

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

serine protease type 2 (MASP2). Thrombotic microangiopathy associated with hematopoietic stem cell transplantation is a systemic multifactorial disease caused by endothelial cell damage induced by immunosuppressive therapy, infection, graft-versus-host disease, and other factors related to stem cell transplantation [77].

Other Proteins

Lerodalcibep-liga[52] (Lerochol, solution for subcutaneous injection) is a proprotein convertase subtilisin/kexin type 9 inhibitor intended to lower low-density lipoprotein cholesterol levels in adults with hypercholesterolemia, including heterozygous familial hypercholesterolemia, as an adjunct to diet and exercise. Lerodalcibep-liga is a recombinant hybrid protein that binds to proprotein convertase subtilisin/kexin type 9 (PCSK9). By preventing PCSK9 from binding to the low-density lipoprotein (LDL) receptor on the surface of hepatocytes, it increases the number of these receptors, thus preventing their degradation. The medicine is administered once a month subcutaneously. Efficacy was confirmed by data from the Phase III LIBerate clinical program, which included over 2900 patients with cardiovascular disease (CVD), without CVD but with very high and high risk of developing it, including heterozygous and homozygous familial hypercholesterolemia [78]. Lerochol achieved sustained LDL reduction of ≥60% in patients with CVD or very high or high risk of developing it, and ≥50% in patients with heterozygous familial hypercholesterolemia with more pronounced LDL elevation [79].

Nucleic Acid-Based

Donidalorsen[53] (Dawnzera, solution for subcutaneous injection) is an antisense oligonucleotide targeting prekallikrein, intended for the prevention of hereditary angioedema attacks. Donidalorsen, supplied as a single-use autoinjector, is an ASO-N-acetylgalactosamine conjugate that induces ribonuclease H1 (RNase H1)-mediated degradation of PKK mRNA by binding to PKK mRNA, leading to reduced PKK protein production. PKK is a proenzyme of plasma kallikrein, leading to the release of bradykinin, a potent vasodilator that causes swelling and pain in hereditary angioedema. In patients with hereditary angioedema, deficiency or dysfunction of C1 inhibitor (C1-INH) leads to excessive plasma kallikrein activity, bradykinin formation, and angioedema attacks. Donidalorsen reduces PKK concentration, preventing excessive bradykinin formation in patients with hereditary angioedema [80].

Plozasiran[54] (Redemplo, solution for subcutaneous injection) is a small interfering RNA targeting apolipoprotein C-III, intended to lower triglyceride levels in adults with familial chylomicronemia syndrome [81]. Plozasiran is an N-acetylgalactosamine-conjugated miRNA that has the ability to degrade apolipoprotein C-III mRNA through RNA interference. This leads to a decrease in the levels of this protein in the liver and serum. Reduced apolipoprotein C-III levels enhance serum triglyceride clearance [82].

Fitusiran[55] (Qfitlia, solution for subcutaneous injection) is an miRNA used to prevent or reduce the frequency of bleeding in hemophilia A or B. Fitusiran causes degradation of messenger RNA through RNA interference, reducing plasma antithrombin concentration [83, 84].

DISCUSSION

Advances in RNA interference therapy

In 2025, the pharmaceutical innovation landscape has witnessed significant progress in RNA-based therapies, particularly those utilizing RNA interference. This mechanism, involving the targeted suppression of specific genes using small interfering RNAs (siRNAs) or antisense oligonucleotides (ASOs), has evolved from a Nobel Prize-winning discovery (awarded in 2006 to Fire and Mello) into a clinically validated approach for treating rare and complex diseases. In 2025, the FDA approved several RNA interference-based drugs, including fitusiran (Qfitlia) for hemophilia A or B [83, 84], plozasiran (Redemplo) for familial chylomicronemia syndrome [81, 82], and donidalorsen (Dawnzera) for the prevention of hereditary angioedema attacks [80].

[52] Drugs.com. Lerodalcibep. Available from: https://go.drugbank.com/drugs/DB19071
[53] Drugs.com. Donidalorsen. Available from: https://go.drugbank.com/drugs/DB18751
[54] Drugs.com. Plozasiran. Available from: https://go.drugbank.com/drugs/DB18997
[55] Drugs.com. Fitusiran. Available from: https://go.drugbank.com/drugs/DB15002

These approvals were made possible by key breakthroughs in RNA stability, delivery systems, and tissue-specific targeting, which addressed long-standing challenges such as off-target effects and rapid *in vivo* degradation.

RNA interference works by leveraging a natural cellular mechanism to degrade messenger RNA (mRNA) transcripts, preventing protein synthesis from disease-causing genes. The process begins with the processing of double-stranded RNA by the enzyme Dicer into siRNA duplexes, which are then loaded into the RNA-induced silencing complex (RISC). The process is illustrated in Figures 4 and 5. The guide strand directs RISC to cleave complementary mRNA, leading to gene silencing. Recent research has refined our understanding of this pathway, particularly in optimizing siRNA design for enhanced specificity and efficacy [85, 86].

One of the main discoveries that led to the approval of these drugs in 2025 was the improvement of delivery platforms, particularly GalNAc conjugates and lipid nanoparticles. In the early stages of RNA interference technology development, scientists faced difficulties with systemic delivery, but GalNAc technology, in which siRNA is linked to a carbohydrate moiety that binds to asialoglycoprotein receptors on hepatocytes, enabled specific liver targeting with over 95 % efficacy in animal studies[56].

Donidalorsen is an ASO targeting prekallikrein mRNA. When administered subcutaneously, it has a longer duration of action, leading to an 80 % reduction in hereditary angioedema attacks, as demonstrated in Phase III clinical trials [80, 87]. Liposomal nanoparticles, modeled after mRNA vaccines against COVID-19, encapsulate siRNA to prevent endosomal degradation, and pH-sensitive lipids facilitate release into the cell's cytosol. This played a crucial role in the approval of fitusiran, as it allows for monthly administration while maintaining therapeutic suppression of antithrombin [83, 84]. Furthermore, exosome-based carriers are a promising form for overcoming the blood-brain barrier, potentially expanding the application of RNA interference to rare neurodegenerative diseases[57,58].

The sharp increase in approvals of RNA interference-based drugs for rare diseases in 2025 reflects the accumulation of data linking genetic mutations to signaling pathway hyperactivation. In the case of hemophilia, it has been established that siRNA-mediated suppression of anticoagulant genes, such as antithrombin, can functionally compensate for the deficiency of blood clotting factors, offering an alternative to replacement therapy. Phase III clinical trial data for fitusiran indicated a reduction in bleeding episodes by approximately 90 %, attributed to the selective degradation of the target mRNA without significant impact on other transcripts[59] [88].

The GalNAc platform as a key driver of RNA therapy evolution

One of the most significant technological shifts in pharmacology in recent years is the development of targeted oligonucleotide delivery systems, among which the GalNAc (N-acetylgalactosamine) platform holds a dominant position. This technology ensures highly specific delivery of therapeutic molecules to hepatocytes through interaction with the asialoglycoprotein receptor (ASGPR), which is predominantly expressed on the surface of liver cells [89, 90].

The delivery mechanism involves sequential steps: after subcutaneous administration, GalNAc-conjugated molecules circulate in the bloodstream and selectively bind to ASGPR, initiating receptor-mediated endocytosis. The acidic intracellular environment of endosomes promotes complex dissociation, release of the therapeutic agent, and receptor recycling to the cell surface. This scheme ensures a high degree of drug utilization and minimizes systemic exposure [90].

[56] RNAi Therapeutics, from Possibility to Patients | Alnylam® Newsroom. Available from: https://news.alnylam.com/rnai/articles/rnai-therapeutics-possibility-patients

[57] RNAi-Based Therapeutics Summit 2026. Nucleic Acid Insights. DOI: 10.18609/nuc.2026.001

[58] Antisense and RNAi Therapeutics Drug Market, Global Outlook and Forecast 2026-2032. Available from: https://www.24marketreports.com/life-sciences/global-antisense-rnai-therapeutics-drug-forecast-market

[59] HMP Global Learning Network. 2025. Advances in HAE Therapeutics Highlight Path Toward Personalized, Patient-Centered Care. Available from: https://www. hmpgloballearningnetwork.com/site/allergy/news/advances-hae-therapeutics-highlight-path-toward-personalized-patient-centered

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

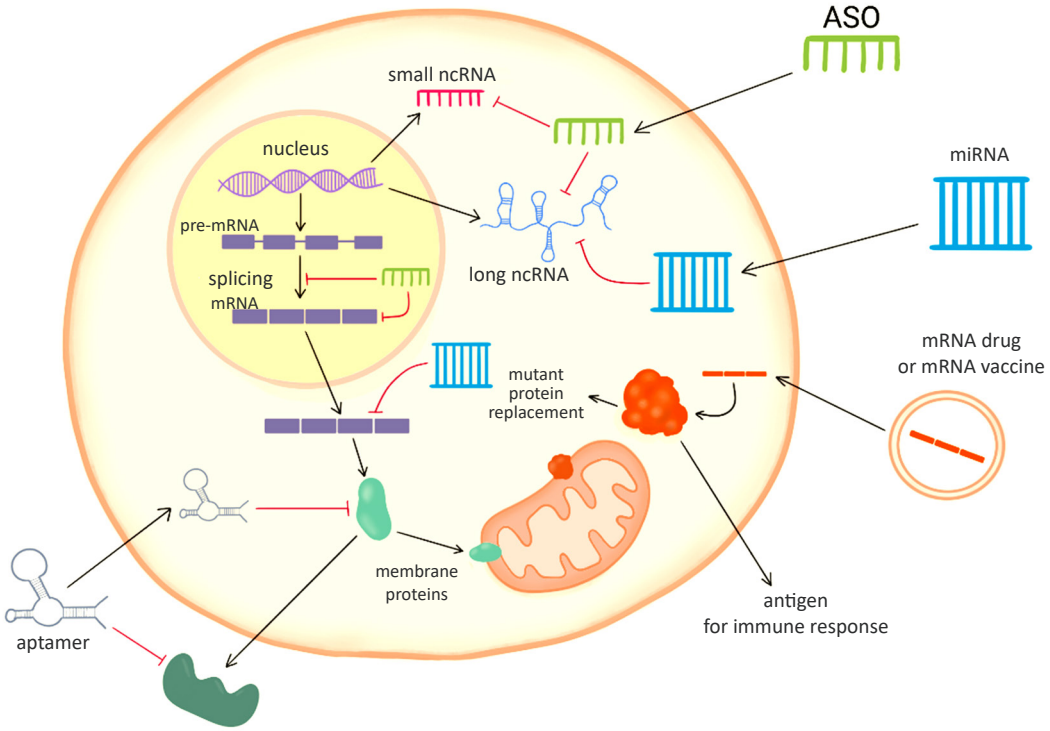


Figure 4 — Mechanism of action of interfering ribonucleic acids.
Note: adapted from [85]; small ncRNA, small non-coding RNA; long ncRNA, long non-coding RNA; ASO, antisense oligonucleotide; miRNA, small interfering RNA; mRNA, messenger RNA; pre-mRNA, precursor messenger RNA.

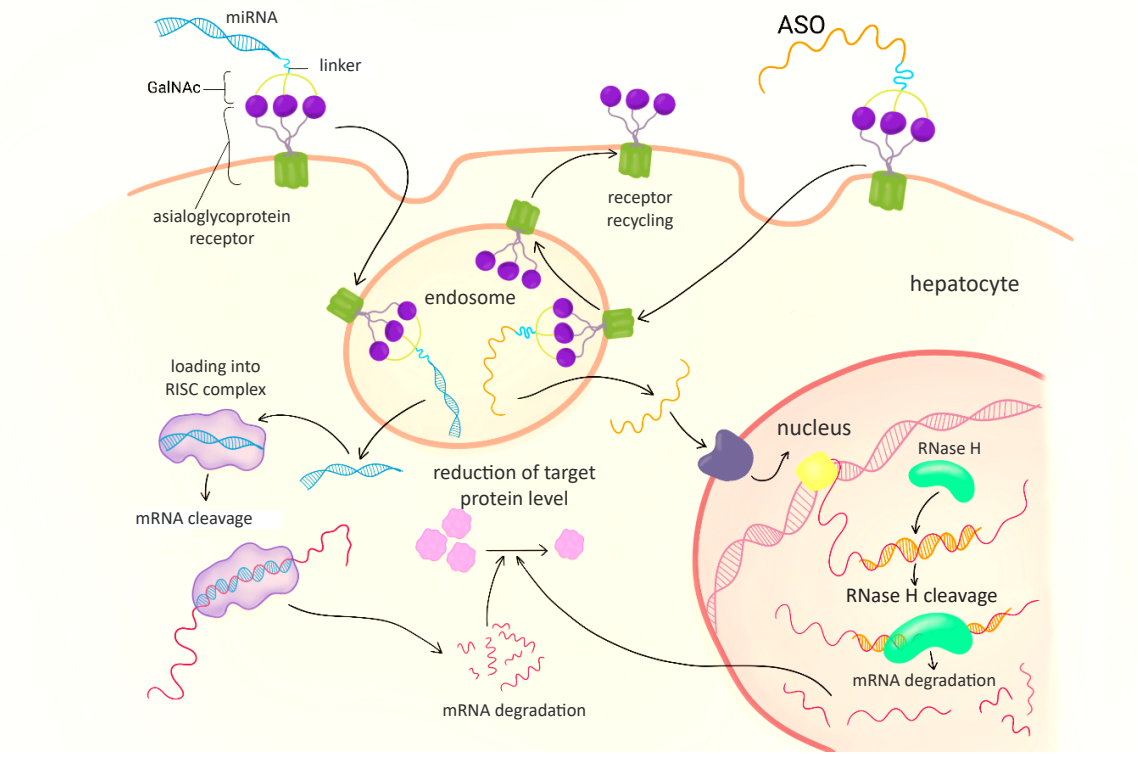


Figure 5 — Mechanism of Action of Interfering Ribonucleic Acids on the GalNAc Platform.
Note: adapted from [95]; mRNA, messenger RNA; miRNA, small interfering RNA; ASO, antisense oligonucleotide; RISC, RNA-induced silencing complex.

Table 3 — Trends in FDA Drug Approvals in 2025

Drug	Fast Track Development	Rare Disease Drugs	First in Class	Breakthrough	First U.S. Approval
Andembry	Yes	Yes	Yes	No	No
Anzupgo	**Yes**	No	No	No	No
Avmapki Fakzynja Co-Pack	No	**Yes**	**Yes**	**Yes**	**Yes**
Blujepa	No	No	**Yes**	No	**Yes**
Brinsupri	No	No	**Yes**	No	**Yes**
Cardamyst	No	No	No	No	**Yes**
Datroway	No	No	No	No	No
Dawnzera	No	**Yes**	**Yes**	No	**Yes**
Ekterly	**Yes**	**Yes**	No	No	**Yes**
Emrelis	No	No	**Yes**	**Yes**	**Yes**
Enflonsia	**Yes**	No	No	No	**Yes**
Exdensur	No	No	Yes	No	**Yes**
Forzinity	**Yes**	**Yes**	No	No	**Yes**
Gomekli	**Yes**	**Yes**	No	No	**Yes**
Grafapex	No	**Yes**	No	No	No
Hernexeos	**Yes**	No	No	**Yes**	**Yes**
Hyrnuo	No	**Yes**	No	**Yes**	**Yes**
Ibtrozi	No	**Yes**	No	**Yes**	**Yes**
Imaavy	**Yes**	**Yes**	No	No	**Yes**
Inluriyo	**Yes**	No	No	No	**Yes**
Jascayd	No	**Yes**	**Yes**	**Yes**	**Yes**
Journavx	**Yes**	No	**Yes**	**Yes**	**Yes**
Keytruda Qlex	No	No	No	No	**Yes**
Komzifti	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Kygevvi	No	**Yes**	No	**Yes**	**Yes**
Lerochol	No	No	No	No	**Yes**
Lynkuet	No	No	No	No	**Yes**
Lynozyfic	No	**Yes**	No	No	**Yes**
Modeyso	No	**Yes**	**Yes**	No	**Yes**
Myqorzo	No	No	No	No	**Yes**
Nereus	No	No	No	No	**Yes**
Nuzolvence	No	No	**Yes**	No	**Yes**
Palsonify	No	**Yes**	No	No	**Yes**
penpulimab-kcqx	No	**Yes**	No	**Yes**	No
Qfitlia	No	**Yes**	**Yes**	No	**Yes**
Redemplo	No	**Yes**	**Yes**	**Yes**	**Yes**
Rhapsido	No	No	**Yes**	No	**Yes**
Romvimza	No	No	No	No	**Yes**
Sephience	No	**Yes**	No	No	No
Tryptyr	No	No	**Yes**	No	**Yes**
Vanrafia	No	No	No	No	**Yes**
Vizz	No	No	No	No	No
Voyxact	No	No	**Yes**	**Yes**	**Yes**
Wayrilz	No	**Yes**	**Yes**	No	**Yes**
Yartemlea	No	No	No	No	**Yes**
Zegfrovy	No	No	No	**Yes**	No

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

A key advantage of the GalNAc platform is the dramatic increase in tissue specificity. Unlike lipid nanoparticles (LNPs), which show significant distribution in the spleen and immune system activation, GalNAc conjugates ensure preferential accumulation in hepatocytes (up to ~95 %), accompanied by reduced systemic toxicity and the possibility of using significantly lower doses. The clinical consequence is a shift from infusion forms to infrequent subcutaneous injections (once every 3–6 months), which significantly improves therapy adherence [90].

The practical significance of the platform is confirmed by a number of registered drugs. These include givosiran (treatment of acute hepatic porphyria), lumasiran (primary hyperoxaluria type 1), vutrisiran (hereditary transthyretin amyloidosis), nedosiran (hyperoxaluria), and inclisiran, used to lower low-density lipoprotein levels with a twice-yearly dosing regimen. Eplontersen deserves special attention, demonstrating the expansion of the platform beyond siRNA into the realm of antisense oligonucleotides.

In 2025, the development of this technology received further validation through the approval of RNA interference-based drugs such as fitusiran, plozasiran, and donidalorsen, which implement various therapeutic strategies—from antithrombin suppression to apolipoprotein C-III and prekallikrein inhibition. The examples presented illustrate the transition from replacement therapy to gene expression regulation as a new therapeutic paradigm [91].

Despite its obvious advantages, GalNAc technology has several limitations. First and foremost, its application is currently almost entirely limited to liver tissue, which significantly narrows the range of indications. Attempts to expand delivery to other organs (e.g., kidneys) are in the early stages of development. Furthermore, risks of off-target effects associated with non-specific RNA binding persist, which can lead to hepatotoxicity. Clinically, local injection site reactions and a flu-like syndrome are also observed [91].

The special problem remains the insufficient understanding of long-term safety. The historical example of revusiran demonstrates that even with high targeting, adverse outcomes may occur, identified in later stages of clinical studies [92]. Additional complexities are associated with the chemical modification of oligonucleotides, necessary to increase their stability in plasma and prevent rapid degradation [93].

From a development perspective, GalNAc conjugates are characterized by high synthesis complexity and strict quality control requirements, which are reflected in the cost of therapy. Nevertheless, the combination of advantages—high specificity, reduced dosing burden, and improved safety profile—makes this platform one of the most promising in modern pharmacotherapy [94].

Following the development of GalNAc technology, the liver has effectively become the first organ for which systemic and highly selective gene therapy has become possible. In the context of the overall evolution of medicinal products, this represents a shift from targeting proteins to managing gene expression, which aligns with the key requirement of personalized medicine [95].

Trends in Registration

Summarized conclusions on existing registration trends for drugs are presented in Table 3.

Drugs for the Treatment of Rare Diseases

Among the rare diseases for which registered medicines are indicated, the following should be noted:

- Hereditary angioedema;
- Low-grade serous ovarian cancer with KRAS gene mutation;
- Barth syndrome;
- Neurofibromatosis;
- Acute myeloid leukemia and myelodysplastic syndrome;
- Locally advanced or metastatic non-small cell lung cancer of non-squamous type with tumors having activating mutations in the HER2 tyrosine kinase domain;
- Locally advanced or metastatic ROS1-positive NSCLC;
- Myasthenia gravis;
- Idiopathic pulmonary fibrosis;
- Recurrent or refractory acute myeloid leukemia with a susceptible nucleophosmin 1 mutation;

- Thymidine kinase 2 deficiency;
- Recurrent or refractory multiple myeloma;
- Midline glioma, H3 K27M-mutant;
- Acromegaly in adults;
- Recurrent or metastatic non-keratinizing nasopharyngeal carcinoma;
- Hemophilia types A or B;
- Hyperphenylalaninemia in patients with phenylketonuria;
- Persistent or chronic immune thrombocytopenia.

Drugs with a new indication

The presented list of drugs is not part of the list of newly registered drugs. Nevertheless, it should be noted that adding a new indication is a relevant registration strategy.

Acalabrutinib (Calquence, capsules) is approved in combination with bendamustine and rituximab for the treatment of patients with untreated mantle cell lymphoma (a rare type of non-Hodgkin lymphoma) who are ineligible for autologous hematopoietic stem cell transplantation[60].

Belzutifan (Welireg, tablets) is approved for the treatment of patients aged 12 years and older with locally advanced, unresectable, or metastatic pheochromocytoma or paraganglioma[61].

Vutrisiran (Amvuttra, solution for injection) is approved for the treatment of cardiomyopathy caused by wild-type or hereditary transthyretin-mediated amyloidosis in adults to reduce cardiovascular mortality, cardiovascular hospitalizations, and urgent heart failure visits. In patients with this disease, abnormal proteins called amyloid fibrils accumulate, affecting the heart's pumping function[62].

Glecaprevir and pibrentasvir (Mavyret, tablets and granules for oral use) are approved for the treatment of acute hepatitis C virus infection in patients aged 3 years and older. Mavyret was previously approved for the treatment of chronic hepatitis C[63,64].

Guselkumab (Tremfya, solution for infusion) is approved for the treatment of moderate to severe Crohn's disease. It is also approved in a new subcutaneous formulation for the treatment of moderate to severe ulcerative colitis[65].

Durvalumab (Imfinzi, solution for injection) is approved for the treatment of muscle-invasive bladder cancer in patients who have undergone radical cystectomy. Durvalumab is also approved as neoadjuvant and adjuvant treatment in combination with fluorouracil, leucovorin, oxaliplatin, and docetaxel chemotherapy (followed by Imfinzi alone) for the treatment of patients with resectable gastric or gastroesophageal junction adenocarcinoma[66].

Inebilizumab-cdon (Uplizna, solution for infusion) is approved as the first treatment for immunoglobulin G4-related disease, a chronic inflammatory condition that can lead to organ damage. Uplizna is also approved for the treatment of myasthenia gravis[67].

Ipilimumab (Yervoy) in combination with nivolumab (Opdivo) in injectable forms is approved for the treatment of patients aged 12 years and older with unresectable or metastatic colorectal cancer with high microsatellite instability or DNA mismatch repair deficiency[68,69].

Iptacopan (Fabhalta, capsules) is approved as the first treatment for adults with C3 glomerulopathy to reduce proteinuria[70].

Cabozantinib (Cabometyx, tablets) is approved for the treatment of patients aged 12 years and older with previously treated, unresectable, locally advanced or metastatic, well-differentiated pancreatic neuroendocrine tumors[71].

Lenacapavir (Yeztugo, solution for subcutaneous injection) is approved for pre-exposure prophylaxis

[60] Drugs.com. Acalabrutinib. Available from: https://go.drugbank.com/drugs/DB11703
[61] Drugs.com. Belzutifan. Available from: https://go.drugbank.com/drugs/DB15463
[62] Drugs.com. Vutrisiran. Available from: https://go.drugbank.com/drugs/DB16699
[63] Drugs.com. Glecaprevir. Available from: https://go.drugbank.com/drugs/DB13879
[64] Drugs.com. Pibrentasvir. Available from: https://go.drugbank.com/drugs/DB13878
[65] Drugs.com. Guselkumab. Available from: https://go.drugbank.com/drugs/DB11834
[66] Drugs.com. Durvalumab. Available from: https://go.drugbank.com/drugs/DB11714
[67] Drugs.com. Inebilizumab. Available from: https://go.drugbank.com/drugs/DB12530
[68] Drugs.com. Ipilimumab. Available from: https://go.drugbank.com/drugs/DB06186
[69] Drugs.com. Nivolumab. Available from: https://go.drugbank.com/drugs/DB09035
[70] Drugs.com. Iptacopan. Available from: https://go.drugbank.com/drugs/DB16200
[71] Drugs.com. Cabozantinib. Available from: https://go.drugbank.com/drugs/DB08875

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

to reduce the risk of sexually acquired HIV infection in patients weighing at least 35 kg[72].

Lutetium 177Lu vipivotide tetraxetan (Pluvicto, solution for injection) is approved for the treatment of patients with metastatic castration-resistant prostate cancer associated with prostate-specific membrane antigen that has progressed following treatment with an androgen receptor pathway inhibitor (a type of hormone therapy)[73].

Mirikizumab-mrkz (Omvoh, solution for infusion and injection) is used for the treatment of moderate to severe Crohn's disease, a type of inflammatory bowel disease[74].

Mitapivat (Aqvesme, tablets) is intended for the treatment of anemia in patients with thalassemia, a blood disorder in which the body has a reduced level of hemoglobin, the protein in red blood cells that carries oxygen[75].

Nitisinone (Nityr) and nitisinone (Harliku) in tablet form are approved for the treatment of homogentisic acid in urine in patients with alkaptonuria, a condition that causes arthritis, kidney stones, dark pigment spots, and dark urine[76,77].

Pegcetacoplan (Empaveli, solution for injection) is approved for the treatment of patients aged 12 years and older with C3 glomerulopathy or primary immune complex membranoproliferative glomerulonephritis, two rare diseases that can lead to kidney failure[78].

Pembrolizumab (Keytruda, solution for injection) is approved for adult patients with surgically resectable locally advanced head and neck squamous cell carcinoma whose tumors express PD-L1, as monotherapy in the neoadjuvant setting, followed by use as adjuvant therapy in combination with radiation therapy with or without cisplatin after surgery, and then as monotherapy[79].

Ranibizumab (Susvimo, solution for injection) is approved for the treatment of patients with diabetic macular edema and diabetic retinopathy, with a clinical response to other medications[80].

Retifanlimab-dlwr (Zynyz, solution for injection) is approved for use in combination with carboplatin and paclitaxel or as monotherapy for the treatment of various types of anal canal squamous cell carcinoma[81].

Semaglutide (Ozempic, solution for injection) is approved to reduce the risk of sustained decline in estimated glomerular filtration rate, end-stage renal disease, or cardiovascular death in patients with type 2 diabetes and chronic kidney disease[82].

Semaglutide (Wegovy, solution for injection) is approved for the treatment of metabolic liver disease in adults with moderate to severe fibrosis[83].

Sotorasib (Lumakras, tablets) is approved for use in combination with panitumumab for the treatment of patients with metastatic colorectal cancer who have received chemotherapy[84].

Tafasitamab-cxix (Monjuvi, solution for injection) is approved for use in combination with lenalidomide and rituximab for the treatment of relapsed or refractory follicular lymphoma, providing an alternative to chemotherapy[85].

Tenecteplase (TNKase, solution for infusion) is approved for the treatment of acute ischemic stroke within three hours of its onset[86].

Upadacitinib (Rinvoq, tablets) is approved for the treatment of patients with giant cell arteritis, an inflammatory disease of large arteries that reduces blood flow[87].

Fam-trastuzumab deruxtecan-nxki (Enhertu, solution for injection) is approved for the treatment

[72] Drugs.com. Lenacapavir. Available from: https://go.drugbank.com/drugs/DB15673
[73] Drugs.com. Lutetium Lu-177 vipivotide tetraxetan. Available from: https://go.drugbank.com/drugs/DB16778
[74] Drugs.com. Mirikizumab. Available from: https://go.drugbank.com/drugs/DB14910
[75] Drugs.com. Mitapivat. Available from: https://go.drugbank.com/drugs/DB16236
[76] Drugs.com. Nitisinone. Available from: https://go.drugbank.com/drugs/DB00348
[77] Ibid.
[78] Drugs.com. Pegcetacoplan. Available from: https://go.drugbank.com/drugs/DB16694
[79] Drugs.com. Pembrolizumab. Available from: https://go.drugbank.com/drugs/DB09037
[80] Drugs.com. Ranibizumab. Available from: https://go.drugbank.com/drugs/DB01270
[81] Drugs.com. Retifanlimab. Available from: https://go.drugbank.com/drugs/DB15766
[82] Drugs.com. Semaglutide. Available from: https://go.drugbank.com/drugs/DB13928
[83] Ibid.
[84] Drugs.com. Sotorasib. Available from: https://go.drugbank.com/drugs/DB15569
[85] Drugs.com. Tafasitamab. Available from: https://go.drugbank.com/drugs/DB15044
[86] Drugs.com. Tenecteplase. Available from: https://go.drugbank.com/drugs/DB00031
[87] Drugs.com. Upadacitinib. Available from: https://go.drugbank.com/drugs/DB15091

of unresectable or metastatic hormone receptor-positive / HER2-low or ultra-low breast cancer that progresses on one or more endocrine therapies in the metastatic setting. It is also approved in combination with pertuzumab for the first-line treatment of breast adenocarcinoma with unresectable or metastatic HER2-positive (IHC 3+ or ISH+) breast cancer[88].

Finerenone (Kerendia, tablets) is approved to reduce the risk of cardiovascular death, hospitalization for heart failure, and urgent medical visits for heart failure in patients with heart failure with a left ventricular ejection fraction of 40% or greater[89].

Chenodiol (Ctexli, tablets) is approved for the treatment of cerebrotendinous xanthomatosis, a rare genetic disorder that causes abnormal fat accumulation in various parts of the body[90].

Cemiplimab-rwlc (Libtayo) is approved for the adjuvant treatment of patients with cutaneous squamous cell carcinoma who are at high risk of recurrence after radical surgery and radiation therapy[91].

Emapalumab-lzsg (Gamifant, solution for injection) is approved as a first therapy for hemophagocytic lymphohistiocytosis/macrophage activation syndrome in Still's disease, a hyperinflammatory, life-threatening condition[92].

Enfortumab vedotin-ejfv (Padcev) is approved for the treatment of patients with muscle-invasive bladder cancer who are undergoing radical cystectomy (bladder removal) and who cannot receive cisplatin-based chemotherapy[93].

Esketamine (Spravato, nasal spray) is approved for the treatment of treatment-resistant depression as monotherapy. Initially, approval was granted for the treatment of treatment-resistant depression in combination with an oral antidepressant[94].

[88] Drugs.com. Trastuzumab deruxtecan. Available from: https://go.drugbank.com/drugs/DB14962
[89] Drugs.com. Finerenone. Available from: https://go.drugbank.com/drugs/DB16165
[90] Drugs.com. Chenodeoxycholic acid. Available from: https://go.drugbank.com/drugs/DB06777
[91] Drugs.com. Cemiplimab. Available from: https://go.drugbank.com/drugs/DB14707
[92] Drugs.com. Emapalumab. Available from: https://go.drugbank.com/drugs/DB14724
[93] Drugs.com. Enfortumab vedotin. Available from: https://go.drugbank.com/drugs/DB13007
[94] Drugs.com. Esketamine. Available from: https://go.drugbank.com/drugs/DB11823

CONCLUSION

An analysis of original New Drugs Approved by the FDA in 2025 demonstrates the continuation of key trends in the pharmaceutical industry, alongside the emergence of new technological and therapeutic emphases. Despite the dominance of small molecules (31 out of 46 New Drugs), a significant portion of innovation remains concentrated in the biopharmaceutical segment, primarily monoclonal antibodies, confirming the sustained interest in highly specific targeted approaches.

An important feature of 2025 is the continued expansion of the application of nucleic acid-based drugs, including small interfering RNAs and antisense oligonucleotides, targeting previously hard-to-reach targets. This class of drugs demonstrates a transition from experimental solutions to clinically significant therapeutic strategies, including in the areas of hereditary and cardiometabolic diseases.

Oncology maintains a leading position among therapeutic areas; however, the structure of registered drugs indicates a gradual diversification: the proportion of agents for the treatment of immune, cardiovascular, and rare diseases is increasing. At the same time, there is a growth in the number of drugs with fundamentally new mechanisms of action, including selective signaling pathway inhibitors, receptor modulators, and drugs targeting previously unused molecular targets.

The development of anti-infective therapy deserves special attention, where new representatives of classes with alternative mechanisms of action are emerging, reflecting the possibilities of overcoming antibiotic resistance.

Thus, the profile of 2025 approvals indicate a shift in the pharmaceutical industry towards more differentiated and molecularly oriented treatment strategies, combining the development of biotechnological platforms, nucleic acid therapies, and highly selective small molecules. Further development of these areas will likely be associated with improvements in delivery technologies, enhanced safety, and an expanded range of therapeutic indications.

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

FUNDING

This study did not have financial support from third-party organizations.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS CONTRIBUTION

Denis V. Kurkin — conceptualization, writing—review & editing; Nazar A. Osadchenko — visualization, writing—review & editing; Daria A. Galkina, Yulia G. Ustyakina — visualization; Anastasia R. Makarova, Dmitry A. Bakulin, Olga V. Marincheva, Yuliya V. Gorbunova, Ksenia N. Koryanova, Ekaterina S. Mishchenko, Ilyas Sh. Gadaev — data analysis, writing—original draft; Olga O. Shatalova, Evgeny I. Morkovin, Andrey V. Strygin, Sergey A. Voskresensky — writing—review & editing; Vladimir I. Petrov, Anna S. Shuvaeva — conceptualization, writing—review & editing. All the authors confirm their authorship compliance with the ICMJE international criteria (all the authors made a significant contribution to the conceptualization, conduct of the study and preparation of the article, read and approved the final version before publication).

REFERENCES

1. Bashirynejad M, Soleymani F, Nikfar S, Kebriaeezadeh A, Majdzadeh R, Fatemi B, Zackery A, Zare N. Trends analysis and future study of the pharmaceutical industry field: a scoping review. Daru. 2024;33(1):6. DOI: 10.1007/s40199-024-00550-x
2. Kim E, Yang J, Park S, Shin K. Factors Affecting Success of New Drug Clinical Trials. Ther Innov Regul Sci. 2023;57(4):737–50. DOI: 10.1007/s43441-023-00509-1
3. Liu M, Wang Y, Zhang Y, Hu D, Tang L, Zhou B, Yang L. Landscape of small nucleic acid therapeutics: moving from the bench to the clinic as next-generation medicines. Signal Transduct Target Ther. 2025;10(1):73. DOI: 10.1038/s41392-024-02112-8
4. Naeem S, Zhang J, Zhang Y, Wang Y. Nucleic acid therapeutics: Past, present, and future. Mol Ther Nucleic Acids. 2024;36(1):102440. DOI: 10.1016/j.omtn.2024.102440
5. Andrés CMC, Pérez de la Lastra JM, Munguira EB, Andrés Juan C, Pérez-Lebeña E. Dual-Action Therapeutics: DNA Alkylation and Antimicrobial Peptides for Cancer Therapy. Cancers (Basel). 2024;16(18):3123. DOI: 10.3390/cancers16183123
6. Fichtner I, Becker M, Baumgart J. Antileukaemic activity of treosulfan in xenografted human acute lymphoblastic leukaemias (ALL). Eur J Cancer. 2003;39(6):801–7. DOI: 10.1016/s0959-8049(02)00767-0
7. Samaeekia R, Arter Z, Nagasaka M. An evaluation of taletrectinib for the treatment of ROS1+ non-small cell lung cancer. Expert Rev Anticancer Ther. 2026:10.1080/14737140.2026.2615129. DOI: 10.1080/14737140.2026.2615129
8. Sangwan K, Agarwal G. Sunvozertinib: a Promising Oral EGFR Inhibitor Approved for NSCLC with EGFR Ex20ins Mutations. Invest New Drugs. 2025;43(5):1177–89. DOI: 10.1007/s10637-025-01588-7
9. Haider E, Akhtar I, Taj J, Ekouo J. Sunvozertinib in EGFR exon 20 insertion-mutated non-small cell lung cancer: expanding targeted therapy beyond standard EGFR inhibitors: a correspondence. Ann Med Surg (Lond). 2025;87(12):9057–8. DOI: 10.1097/MS9.0000000000004137
10. Zafar S, Furqan M, Binte Rahim S, Haider MU. Dordaviprone in H3K27M-mutant diffuse midline glioma: an editorial on emerging targeted therapy. Ann Med Surg (Lond). 2025;87(12):7886–8. DOI: 10.1097/MS9.0000000000004079
11. Wilding B, Woelflingseder L, Baum A, Chylinski K, Vainorius G, Gibson N, Waizenegger IC, Gerlach D, Augsten M, Spreitzer F, Shirai Y, Ikegami M, Tilandyová S, Scharn D, Pearson MA, Popow J, Obenauf AC, Yamamoto N, Kondo S, Opdam FL, Bruining A, Kohsaka S, Kraut N, Heymach JV, Solca F, Neumüller RA. Zongertinib (BI 1810631), an Irreversible HER2 TKI, Spares EGFR Signaling and Improves Therapeutic Response in Preclinical Models and Patients with HER2-Driven Cancers. Cancer Discov. 2025;15(1):119–38. DOI: 10.1158/2159-8290.CD-24-0306
12. Haider E, Ahmad N, Taj J, Ekouo J. Clinical significance of Zongertinib in HER2-mutated non-small cell lung cancer: advancing targeted therapy options. Ann Med Surg (Lond). 2025;88(2):2108–9. DOI: 10.1097/MS9.0000000000004571
13. Masuyama M, Shimoda M, Seto I, Kikumori K, Abe K, Masunaga N, Mishima C, Tsukabe M, Yoshinami T, Sota Y, Miyake T, Tanei T, Shimazu K. Targeting focal adhesion kinase inhibits cell migration and non-angiogenic vascularization in malignant breast cancer. Breast Cancer. 2026;33(1):188–99. DOI: 10.1007/s12282-025-01792-6
14. Bhave M, Jhaveri KL, Kaufman PA, Aftimos P, Lombard J, Giridhar KV, Im SA, Ma CX, Lee KT, Kim SB, Sohn J, Li Y, Yuen E, Estrem ST, Nguyen B, Makena MR, Ismail-Khan R, Beeram M. Imlunestrant, an oral selective estrogen

receptor degrader, in combination with HER2 directed therapy, with or without abemaciclib, in ER-positive, HER2-positive advanced breast cancer: results from the phase 1a/1b EMBER study. Breast Cancer Res. 2025;28(1):18. DOI: 10.1186/s13058-025-02168-6

15. Bhagwat SV, Mur C, Vandekopple M, Zhao B, Shen W, Marugán C, Capen A, Kindler L, Stephens JR, Huber L, Castanares MA, Garcia-Tapia D, Cohen JD, Bastian J, Mattioni B, Yuen E, Baker TK, Rodriguez Cruz V, Fei D, Manro JR, Pulliam N, Dowless MS, Ortiz Ruiz MJ, Yu C, Puca L, Klippel A, Bacchion F, Ismail-Khan R, Rodrik-Outmezguine V, Peng SB, Lallena MJ, Gong X, de Dios A. Imlunestrant Is an Oral, Brain-Penetrant Selective Estrogen Receptor Degrader with Potent Antitumor Activity in ESR1 Wild-Type and Mutant Breast Cancer. Cancer Res. 2025;85(4):777–90. DOI: 10.1158/0008-5472.CAN-24-2608
16. Wang ES, Montesinos P, Foran J, Erba H, Rodríguez-Arbolí E, Fedorov K, Heiblig M, Heidel FH, Altman JK, Baer MR, Ades L, Pettit K, Peterlin P, Papayannidis C, Berthon C, Walter RB, Shah MV, Balasubramanian S, Khawandanah M, Salamero Garcia O, Bergeron J, Madanat YF, Roboz GJ, Ulrickson M, Redner RL, McCloskey J, Pigneux A, de la Fuente Burguera A, Mitra A, Soifer HS, Tabachri M, Zhang Z, Riches M, Corum D, Leoni M, Issa GC, Fathi AT; KOMET-001. Ziftomenib in Relapsed or Refractory NPM1-Mutated AML. J Clin Oncol. 2025;43(31):3381–90. DOI: 10.1200/JCO-25-01694
17. Siegel F, Siegel S, Kotýnková K, Karsli Uzunbas G, Korr D, Tomono H, Andersen S, Denney D, Berger M, Schulze VK, Lewis TA, Kaplan B, Golfier S, Mortier J, Hillig RC, Boemer U, Petersen K, Eis K, Williams S, Rüttinger D, Cherniack AD, Loong HH, Goto K, Grassi P, Meyerson M, Greulich H. Sevabertinib, a Reversible HER2 Inhibitor with Activity in Lung Cancer. Cancer Discov. 2026;16(1):81–94. DOI: 10.1158/2159-8290.CD-25-0605
18. Levy AS, Bryant JP, Matichak D, Onishi S, Banasavadi-Siddegowda YK. MEK Inhibition in Glioblastoma: Current Perspectives and Future Directions. International Journal of Molecular Sciences. 2025;26(14):6875. DOI: 10.3390/ijms26146875
19. Smith BD, Kaufman MD, Wise SC, Ahn YM, Caldwell TM, Leary CB, Lu WP, Tan G, Vogeti L, Vogeti S, Wilky BA, Davis LE, Sharma M, Ruiz-Soto R, Flynn DL. Vimseltinib: A Precision CSF1R Therapy for Tenosynovial Giant Cell Tumors and Diseases Promoted by Macrophages. Mol Cancer Ther. 2021;20(11):2098–109. DOI: 10.1158/1535-7163.MCT-21-0361
20. Qadri M, Iqbal MU, Hajj F. Sebetralstat: a paradigm shift in hereditary angioedema management. Ann Med Surg (Lond). 2025;87(12):9141–2. DOI: 10.1097/MS9.0000000000004158
21. Bukhari SMR, Rashidi R. The power of a pill: Ekterly (Sebetralstat): first oral on-demand therapy for hereditary angioedema-a paradigm shift in treatment. Ann Med Surg (Lond). 2026;88(2):1203–5. DOI: 10.1097/MS9.0000000000004683
22. Feener EP, Davie RL, Murugesan N, Pethen SJ, Hampton SL, Smith MD, Audhya PK, Yea CM. Sebetralstat: A Rapidly Acting Oral Plasma Kallikrein Inhibitor for the On-Demand Treatment of Hereditary Angioedema. Drugs and Drug Candidates. 2024; 3(2):328–41. DOI: 10.3390/ddc3020019
23. Gimeno R, Ribas-Llauradó C, Pesque D, Andrades E, Cenni B, Ambros B, Pujol R, Giménez-Arnau AM. Remibrutinib inhibits hives effector cells stimulated by serum from chronic urticaria patients independently of FcεR1 expression level and omalizumab clinical response. Clin Transl Allergy. 2023;13(3):e12227. DOI: 10.1002/clt2.12227
24. Ip JE, Coutu B, Ip JH, Noseworthy PA, Parody ML, Rafii F, Sears SF, Singh N, Stambler BS, Tahirkheli NK, Agudelo-Uribe J, Hu D, Shardonofsky S, Sheikh MB, Holz A, Bharucha DB, Camm AJ. Etripamil Nasal Spray for Recurrent Paroxysmal Supraventricular Tachycardia Conversion: Results From the NODE-303 Open-Label Study. J Cardiovasc Electrophysiol. 2025;36(11):2990–3003. DOI: 10.1111/jce.70086
25. Hartman JJ, Hwee DT, Robert-Paganin J, Chuang C, Chin ER, Edell S, Lee KH, Madhvani R, Paliwal P, Pernier J, Sarkar SS, Schaletzky J, Schauer K, Taheri KD, Wang J, Wehri E, Wu Y, Houdusse A, Morgan BP, Malik FI. Aficamten is a small-molecule cardiac myosin inhibitor designed to treat hypertrophic cardiomyopathy. Nat Cardiovasc Res. 2024;3(8):1003–1016. DOI: 10.1038/s44161-024-00505-0
26. Osteen JD, Immani S, Tapley TL, Indersmitten T, Hurst NW, Healey T, Aertgeerts K, Negulescu PA, Lechner SM. Pharmacology and Mechanism of Action of Suzetrigine, a Potent and Selective NaV1.8 Pain Signal Inhibitor for the Treatment of Moderate to Severe Pain. Pain Ther. 2025;14(2):655–674. DOI: 10.1007/s40122-024-00697-0
27. Pham A, Yep H, Wozniak S, Javvaji A, Nada E, Bergese S. Beyond Opioids: A Review of Suzetrigine for Acute Pain Management. Int J Mol Sci. 2025;26(20):9865. DOI: 10.3390/ijms26209865
28. Singley CM, Kurumaddali A, Hoover JL. Pharmacokinetic and pharmacodynamic characterization of gepotidacin against Escherichia coli and Klebsiella pneumoniae in a neutropenic mouse thigh infection model. Antimicrob Agents Chemother. 2026;70(1):e0117625. DOI: 10.1128/aac.01176-25
29. Kresken M, Wohlfarth E, Weikel C, Butler D, Pfeifer Y, Werner G; 'Antimicrobial Resistance' Study Group of the Paul Ehrlich Society for Infection Therapy. In vitro activity of gepotidacin against urine isolates of Escherichia coli from outpatient departments in Germany. J Antimicrob Chemother. 2022:dkac406. DOI: 10.1093/jac/dkac406
30. Hackel MA, Karlowsky JA, Sahm DF, West JM, Scangarella-Oman NE. In vitro activity of gepotidacin against urinary tract infection isolates of Enterobacterales, Enterococcus faecalis, and Staphylococcus saprophyticus. Antimicrob Agents Chemother. 2025;69(6):e0029625. DOI: 10.1128/aac.00296-25

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

31. Yuyama H, Noguchi Y, Fujimori A, Ukai M, Fujiyasu N, Ohtake A, Sato S, Sudoh K, Sasamata M, Miyata K. Superiority of YM598 over atrasentan as a selective endothelin ETA receptor antagonist. Eur J Pharmacol. 2004;498(1-3):171–7. DOI: 10.1016/j.ejphar.2004.07.003
32. Weiss J, Haefeli WE. Interaction potential of the endothelin-A receptor antagonist atrasentan with drug transporters and drug-metabolising enzymes assessed in vitro. Cancer Chemother Pharmacol. 2011;68(4):1093–8. DOI: 10.1007/s00280-011-1715-8
33. Banerjee S, Hussain M, Wang Z, Saliganan A, Che M, Bonfil D, Cher M, Sarkar FH. In vitro and in vivo molecular evidence for better therapeutic efficacy of ABT-627 and taxotere combination in prostate cancer. Cancer Res. 2007;67(8):3818–3826. DOI: 10.1158/0008-5472.CAN-06-3879. Erratum in: Cancer Res. 2018;78(18):5465. DOI: 10.1158/0008-5472.CAN-18-1171
34. Kohan DE, Barratt J, Heerspink HJL, Campbell KN, Camargo M, Ogbaa I, Haile-Meskale R, Rizk DV, King A. Targeting the Endothelin A Receptor in IgA Nephropathy. Kidney Int Rep. 2023;8(11):2198–210. DOI: 10.1016/j.ekir.2023.07.023
35. Chen K, Blair HA. Acoltremon 0.003% ophthalmic solution in dry eye disease: a profile of its use. Drugs Ther Perspect. 2026;42:10–5. DOI: 10.1007/s40267-026-01232-1
36. Jawaid Z, Khalid M, Waafira A. Delgocitinib 2% cream: a promising FDA-approved therapy for moderate-to-severe chronic hand eczema. Ann Med Surg (Lond). 2025;87(10):6916–7. DOI: 10.1097/MS9.0000000000003771
37. Lah M, Kopesky J, Vucko E. Sepiapterin: A Distinct, Dual Mechanism of Action that Leads to Potential Treatment Benefits Across the Spectrum of Phenylketonuria Disease Severities. Adv Ther. 2026. DOI: 10.1007/s12325-026-03607-2
38. Chandani HK, Sahira, Hujjat SFZ, Khan MS, Mahmoud A. From dietary restriction to disease-targeted therapy: Sephience TM (sepiapterin) in phenylketonuria. Ann Med Surg (Lond). 2025;87(12):9147–8. DOI: 10.1097/MS9.0000000000004163
39. Lamb YN. Sepiapterin: First Approval. Drugs. 2026;86(1):93–99. DOI: 10.1007/s40265-025-02247-0
40. Bukhari SMR, Mehdi H, Abdullah G, Ans M, Raza M. Beyond glasses: FDA approval of VIZZ (aceclidine) transforming presbyopia management. Ann Med Surg (Lond). 2025;88(1):61–4. DOI: 10.1097/MS9.0000000000004593
41. Haghpanah N, Alany R. Pharmacological treatment of presbyopia: A systematic review. Eur J Transl Myol. 2022;32(3):10781. DOI: 10.4081/ejtm.2022.10781
42. Chen KJ, Zhang J, LaSala D, Basso J, Chun D, Zhou Y, McDonald PP, Perkins WR, Cipolla DC. Brensocatib, an oral, reversible inhibitor of dipeptidyl peptidase 1, mitigates interferon-α-accelerated lupus nephritis in mice. Front Immunol. 2023;14:1185727. DOI: 10.3389/fimmu.2023.1185727
43. Mihălțan FD, Ulmeanu R, Constantin AA. Brensocatib-Another Therapeutic "Window of Opportunity" for Patients with Bronchiectasis. J Clin Med. 2026;15(3):1257. DOI: 10.3390/jcm15031257
44. Kuter DJ, Ghanima W. Evaluating rilzabrutinib in the treatment of immune thrombocytopenia. Immunotherapy. 2025;17(11):767–82. DOI: 10.1080/1750743X.2025.2545170
45. Labanca C, Martino EA, Vigna E, Bruzzese A, Mendicino F, Caridà G, Lucia E, Olivito V, Manicardi V, Amodio N, Neri A, Morabito F, Gentile M. Rilzabrutinib for the Treatment of Immune Thrombocytopenia. Eur J Haematol. 2025;115:4–15. DOI: 10.1111/ejh.14425
46. Shirley M. Elamipretide: First Approval. Drugs. 2026;86(3):377–83. DOI: 10.1007/s40265-025-02269-8
47. Sabbah HN, Taylor C, Vernon HJ. Temporal evolution of the heart failure phenotype in Barth syndrome and treatment with elamipretide. Future Cardiol. 2023;19(4):211–25. DOI: 10.2217/fca-2023-0008
48. Sun Y, Lu D, Gao J. Paltusotine: The first selective nonpeptide agonist of somatostatin receptor 2 (SSTR2) for the treatment of acromegaly. Drug Discov Ther. 2025;19(5):358–9. DOI: 10.5582/ddt.2025.01109
49. McLaren DS, Murray RD. Paltusotine, a Novel Oral Somatostatin Receptor Ligand in the Management of Acromegaly. J Clin Endocrinol Metab. 2023;108(5):e193–e194. DOI: 10.1210/clinem/dgac762
50. Madan A, Markison S, Betz SF, Krasner A, Luo R, Jochelson T, Lickliter J, Struthers RS. Paltusotine, a novel oral once-daily nonpeptide SST2 receptor agonist, suppresses GH and IGF-1 in healthy volunteers. Pituitary. 2022;25(2):328–39. DOI: 10.1007/s11102-021-01201-z
51. Carriera L, Lipsi R, Dodaj M, Inchingolo R, Smargiassi A, Coppola A, Mari PV, Barone R, Ielo S, Scala R, Richeldi L. Most Promising Emerging Therapies for Pulmonary Fibrosis: Targeting Novel Pathways. Biomedicines. 2026;14(1):154. DOI: 10.3390/biomedicines14010154
52. Pinkerton JV, Simon JA, Joffe H, Maki PM, Nappi RE, Panay N, Soares CN, Thurston RC, Caetano C, Haberland C, Haseli Mashhadi N, Krahn U, Mellinger U, Parke S, Seitz C, Zuurman L. Elinzanetant for the Treatment of Vasomotor Symptoms Associated With Menopause: OASIS 1 and 2 Randomized Clinical Trials. JAMA. 2024;332(16):1343–54. DOI: 10.1001/jama.2024.14618
53. Lee A. Elinzanetant: First Approval. Drugs. 2026;86(1):121–5. DOI: 10.1007/s40265-025-02244-3
54. Blair HA. Doxecitine and Doxribtimine: First Approval. Paediatr Drugs. 2026;28(2):209–15. DOI: 10.1007/s40272-025-00734-1
55. Mittur A, VanMeter SA, Orujov E, Glidden P. Pharmacokinetics and Safety of a 1:1 Mixture of Doxecitine and Doxribtimine: Open-label Phase 1 Single Ascending Dose and Food Effect Studies in Healthy Adults. Clin Ther. 2024;46(7):576–87. DOI: 10.1016/j.clinthera.2024.06.006
56. Lopez-Gomez C, Levy RJ, Sanchez-Quintero MJ, Juanola-Falgarona M, Barca E, Garcia-Diaz B, Tadesse S, Garone C, Hirano M. Deoxycytidine and Deoxythymidine Treatment

for Thymidine Kinase 2 Deficiency. Ann Neurol. 2017;81(5):641–52. DOI: 10.1002/ana.24922

57. Yao L, Tian T, Lu X, Zou D, Tang Z, Feng X, Zheng T, Ning Z, Lin Y, Ye M, Jiang J, Zhou P. In Vitro Activity of Zoliflodacin Against Neisseria gonorrhoeae Isolates from Shanghai, China (2020–2023). Antibiotics (Basel). 2026;15(1):61. DOI: 10.3390/antibiotics15010061
58. Luckey A, Balasegaram M, Barbee LA, Batteiger TA, Broadhurst H, Cohen SE, Delany-Moretlwe S, de Vries HJC, Dionne JA, Gill K, Kenyon C, Kittiyaowamarn R, Lewis D, Mueller JP, Naicker V, O'Brien S, O'Donnell JP, Phanuphak N, Spooner E, Srinivasan S, Taylor SN, Unemo M, Zwane Z, Hook EW 3rd; Zoliflodacin Phase 3 Study Group. Zoliflodacin versus ceftriaxone plus azithromycin for treatment of uncomplicated urogenital gonorrhoea: an international, randomised, controlled, open-label, phase 3, non-inferiority clinical trial. Lancet. 2026;407(10524):147–60. DOI: 10.1016/S0140-6736(25)01953-1
59. Coe MA, Lofwall MR, Vessels V, Nuzzo PA, Walsh SL. Evaluation of tradipitant, a selective NK1 antagonist, on response to oxycodone in humans. Psychopharmacology (Berl). 2021;238(7):1857–66. DOI: 10.1007/s00213-021-05814-x
60. Polymeropoulos VM, Kiely L, Bushman ML, Sutherland EB, Goldberg AR, Pham AX, Miller CR, Mourad R, Davis TR, Pham NV, Morgan DB, Giles AK, Xiao C, Polymeropoulos CM, Birznieks G, Polymeropoulos MH. Motion Syros: tradipitant effective in the treatment of motion sickness; a multicenter, randomized, double-blind, placebo-controlled study. Front Neurol. 2025;16:1550670. DOI: 10.3389/fneur.2025.1550670
61. Mobashir M, Tarique H, Ahmad S, Habib I, Inam A, Qamar I, Sajjad W. Datopotamab deruxtecan: a new era in targeted therapy for metastatic breast cancer. Ann Med Surg (Lond). 2025;87(11):6942–3. DOI: 10.1097/MS9.0000000000003857
62. Okajima D, Yasuda S, Maejima T, Karibe T, Sakurai K, Aida T, Toki T, Yamaguchi J, Kitamura M, Kamei R, Fujitani T, Honda T, Shibutani T, Muramatsu S, Nakada T, Goto R, Takahashi S, Yamaguchi M, Hamada H, Noguchi Y, Murakami M, Abe Y, Agatsuma T. Datopotamab Deruxtecan, a Novel TROP2-directed Antibody-drug Conjugate, Demonstrates Potent Antitumor Activity by Efficient Drug Delivery to Tumor Cells. Mol Cancer Ther. 2021;20(12):2329–40. DOI: 10.1158/1535-7163.MCT-21-0206
63. Chen X, Wang W, Zou Q, Zhu X, Lin Q, Jiang Y, Sun Y, Shen L, Wang L, Zou G, Lin X, Lin S, Li M, Wang Y, Xu R, Ao R, Wang R, Lin H, Huang S, Xu T, Li W, Xia M, Xia Y, Wang Z, Li B, Li J, Hu C. Penpulimab, an anti-PD-1 antibody, for heavily pretreated metastatic nasopharyngeal carcinoma: a single-arm phase II study. Signal Transduct Target Ther. 2024;9(1):148. DOI: 10.1038/s41392-024-01865-6
64. Babel H, Brunsdon P, Engelhardt B, Schmitt V, Ratajczak C, Mensing S, Menon RM, Parikh A. Population Pharmacokinetics and Exposure-Response Analyses for Telisotuzumab Vedotin in Patients With c-Met Protein Overexpressing Tumors. CPT Pharmacometrics Syst Pharmacol. 2026;15(3):e70219. DOI: 10.1002/psp4.70219
65. Ur Rehman R. Lynozyfic (Linvoseltamab): A First-in-Class Off-the-Shelf T-Cell Redirector for Refractory Multiple Myeloma. EJHaem. 2025;6(6):e70182. DOI: 10.1002/jha2.70182
66. DiLillo DJ, Olson K, Mohrs K, Meagher TC, Bray K, Sineshchekova O, Startz T, Kuhnert J, Retter MW, Godin S, Sharma P, Delfino F, Lin J, Smith E, Thurston G, Kirshner JR. A BCMAxCD3 bispecific T cell-engaging antibody demonstrates robust antitumor efficacy similar to that of anti-BCMA CAR T cells. Blood Adv. 2021;5(5):1291–304. DOI: 10.1182/bloodadvances.2020002736
67. Smith EJ, Olson K, Haber LJ, Varghese B, Duramad P, Tustian AD, Oyejide A, Kirshner JR, Canova L, Menon J, Principio J, MacDonald D, Kantrowitz J, Papadopoulos N, Stahl N, Yancopoulos GD, Thurston G, Davis S. A novel, native-format bispecific antibody triggering T-cell killing of B-cells is robustly active in mouse tumor models and cynomolgus monkeys. Sci Rep. 2015;5:17943. DOI: 10.1038/srep17943
68. Picheta N, Piekarz J, Kułak K, Tarkowski R. The Efficacy of Pembrolizumab Immunotherapy in the Treatment of Endometrial Cancer: A Systematic Review. Int J Mol Sci. 2025;26(18):8789. DOI: 10.3390/ijms26188789
69. Banerjee A, Narasimhulu CA, Singla DK. Immune interactions in pembrolizumab (PD-1 inhibitor) cancer therapy and cardiovascular complications. Am J Physiol Heart Circ Physiol. 2023;325(4):H751–H767. DOI: 10.1152/ajpheart.00378.2023
70. Lu J, Zhao Z, Pan L, Wu H, Wang S, Tong X, Wu S. Hyaluronidase: structure, mechanism of action, diseases and therapeutic targets. Mol Biomed. 2025;6(1):50. DOI: 10.1186/s43556-025-00299-y
71. Seo Y, Sung J, Lee JY. From permeation enhancer to therapeutic enabler: Advances, applications, and translational perspectives in hyaluronidase-based drug delivery. Mater Today Bio. 2026;38:103052. DOI: 10.1016/j.mtbio.2026.103052
72. Antozzi C, Fitzgibbon M. An evaluation of nipocalimab for the treatment of generalized myasthenia gravis. Expert Opin Biol Ther. 2025;25(10):1047–58. DOI: 10.1080/14712598.2025.2561935. Erratum in: Expert Opin Biol Ther. 2025;25(12):1359. DOI: 10.1080/14712598.2025.2610041
73. Syed YY. Clesrovimab: First Approval. Drugs. 2025;85(11):1487–92. DOI: 10.1007/s40265-025-02224-7
74. Fung S. Garadacimab: First Approval. Drugs. 2025;85(6):827–32. DOI: 10.1007/s40265-025-02180-2
75. Lee A. Sibeprenlimab: First Approval. Drugs. 2026;86(5):765–8. DOI: 10.1007/s40265-026-02298-x
76. Lee A. Depemokimab: First Approval. Drugs. 2026;86(6):943–8. DOI: 10.1007/s40265-026-02306-0
77. Shirley M. Narsoplimab: First Approval. Drugs. 2026. DOI: 10.1007/s40265-026-02328-8

ОРИГИНАЛЬНАЯ СТАТЬЯ
DOI: 10.19163/2307-9266-2026-14-3-248-282

78. Raal F, Fourie N, Scott R, Blom D, De Vries Basson M, Kayikcioglu M, Caldwell K, Kallend D, Stein E; LIBerate-HeFH Investigators. Long-term efficacy and safety of lerodalcibep in heterozygous familial hypercholesterolaemia: the LIBerate-HeFH trial. Eur Heart J. 2023;44(40):4272–80. DOI: 10.1093/eurheartj/ehad596
79. Zhuang-Yan A, Blair HA. Lerodalcibep: First Approval. Drugs. 2026. DOI: 10.1007/s40265-026-02317-x
80. Syed YY. Donidalorsen: First Approval. Drugs. 2026;86(2):243–8. DOI: 10.1007/s40265-025-02257-y
81. Syed YY. Plozasiran: First Approval. Drugs. 2026;86(5):753–8. DOI: 10.1007/s40265-026-02293-2. Epub 2026 Mar 6. Erratum in: Drugs. 2026. DOI: 10.1007/s40265-026-02334-w
82. Ballantyne CM, Gaudet D, Rosenson RS, Hegele RA, Zhou R, Melquist S, Hellawell J, Leeper NJ. Effect of Targeting ApoC-III With Plozasiran on Lipoprotein Particle Size and Number in Hypertriglyceridemia. J Am Coll Cardiol. 2025;85(19):1839–1854. DOI: 10.1016/j.jacc.2025.03.496
83. Lee A. Fitusiran: First Approval. Drugs. 2025;85(8):1073–7. DOI: 10.1007/s40265-025-02203-y
84. Lu D, Dou F, Gao J. Fitusiran: The first approved siRNA therapy for hemophilia via reducing plasma antithrombin levels. Drug Discov Ther. 2025;19(2):131–2. DOI: 10.5582/ddt.2025.01031
85. Saw PE, Song E. Advancements in clinical RNA therapeutics: Present developments and prospective outlooks. Cell Rep Med. 2024;5(5):101555. DOI: 10.1016/j.xcrm.2024.101555
86. Tani H. Recent Advances and Prospects in RNA Drug Development. Int J Mol Sci. 2024;25(22):12284. DOI: 10.3390/ijms252212284
87. Riedl MA, Yarlas A, Bordone L, Treadwell S, Wang S, Newman KB, Cohn DM. Patient-Reported Outcomes in the Phase III OASIS-HAE Study of Donidalorsen for Hereditary Angioedema. Allergy. 2025;80(8):2361–8. DOI: 10.1111/all.16563
88. Ebenezer O, Oyebamiji AK, Olanlokun JO, Tuszynski JA, Wong GK. Recent Update on siRNA Therapeutics. Int J Mol Sci. 2025;26(8):3456. DOI: 10.3390/ijms26083456
89. Cui H, Zhu X, Li S, Wang P, Fang J. Liver-Targeted Delivery of Oligonucleotides with N-Acetylgalactosamine Conjugation. ACS Omega. 2021;6(25):16259–65. DOI: 10.1021/acsomega.1c01755
90. Zhang L, Liang Y, Liang G, Tian Z, Zhang Y, Liu Z, Ji X. The therapeutic prospects of N-acetylgalactosamine-siRNA conjugates. Front Pharmacol. 2022;13:1090237. DOI: 10.3389/fphar.2022.1090237
91. Fan X, Xiao Y, Cao K, Zhang R, Yan X. A computational model-powered platform to inform the development of GalNAc-conjugated siRNA therapeutics. Mol Ther Nucleic Acids. 2026;37(2):102936. DOI: 10.1016/j.omtn.2026.102936
92. Judge DP, Kristen AV, Grogan M, Maurer MS, Falk RH, Hanna M, Gillmore J, Garg P, Vaishnaw AK, Harrop J, Powell C, Karsten V, Zhang X, Sweetser MT, Vest J, Hawkins PN. Phase 3 Multicenter Study of Revusiran in Patients with Hereditary Transthyretin-Mediated (hATTR) Amyloidosis with Cardiomyopathy (ENDEAVOUR). Cardiovasc Drugs Ther. 2020;34(3):357–70. DOI: 10.1007/s10557-019-06919-4. Erratum in: Cardiovasc Drugs Ther. 2020;34(6):889. DOI: 10.1007/s10557-020-07023-8
93. Gagliardi M, Ashizawa AT. The Challenges and Strategies of Antisense Oligonucleotide Drug Delivery. Biomedicines. 2021;9(4):433. DOI: 10.3390/biomedicines9040433
94. Huang Y. Preclinical and Clinical Advances of GalNAc-Decorated Nucleic Acid Therapeutics. Mol Ther Nucleic Acids. 2017;6:116–32. DOI: 10.1016/j.omtn.2016.12.003
95. Debacker AJ, Voutila J, Catley M, Blakey D, Habib N. Delivery of Oligonucleotides to the Liver with GalNAc: From Research to Registered Therapeutic Drug. Mol Ther. 2020;28(8):1759–71. DOI: 10.1016/j.ymthe.2020.06.015

AUTHORS

Denis V. Kurkin — Doctor of Sciences (Pharmacy), Assistant Professor, Director of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine; Professor of the Department of Clinical Pharmacology and Intensive Care of the Volgograd State Medical University. ORCID ID: 0000-0002-1116-3425. E-mail: strannik986@mail.ru

Nazar A. Osadchenko — Candidate of Sciences (Medicine), Senior researcher of the Laboratory of Health Technology Assessment and Clinical and Economic Expertise of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0000-0002-7398-2186. E-mail: n.a.osadchenko@gmail.com

Daria A. Galkina — Candidate of Pharmaceutical Sciences, Assistant Professor of the Department of Medical and Pharmaceutical Chemistry, Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0000-0002-0270-2888. E-mail: skretti@hotmail.com

Dmitry A. Bakulin — Candidate of Sciences (Medicine), Head of the Interdepartmental Scientific and Educational Center of Pharmacy of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0000-0003-4694-3066. E-mail: mbfdoc@gmail.com

Yulia G. Ustyakina — a 3rd year student of the Faculty of Medicine of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0009-0007-7599-8353. E-mail: korolparketa.ju@gmail.com

Sergey A. Voskresensky — Candidate of Sciences

(Biology), research fellow of Scientific Center for Innovative Medicines, Volgograd State Medical University. E-mail: Voskresenskiy_1983@mail.ru

Anastasia R. Makarova — researcher of the Research Laboratory of Economics and Pharmacy, Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine**.** ORCID ID: 0009-0001-5116-2240. E-mail: agliulova34@gmail.com

Olga O. Shatalova — Doctor of Sciences (Medicine), Professor of the Department of Clinical Pharmacology and Intensive Care of the Volgograd State Medical University. ORCID ID: 0000-0002-7311-4549. E-mail: shov_med@mail.ru

Andrey V. Strygin — Candidate of Sciences (Medicine), Assistant Professor, Head of the Department of Fundamental Biology and Medicine of the Volgograd State Medical University. ORCID ID: 0000-0002-6997- 1601. E-mail: drumsav@mail.ru

Vladimir I. Petrov — Doctor of Sciences (Medicine), Professor, Head of the Department of Clinical Pharmacology and Intensive Care of the Volgograd State Medical University; Chief freelance specialist — Clinical Pharmacologist of the Ministry of Health of the Russian Federation; Honored Scientist of the Russian Federation; Honored Doctor of the Russian Federation; Academician of the Russian Academy of Sciences. ORCID ID: 0000-0002-0258-4092. E-mail: brain@sprintnet.ru

Olga V. Marincheva — Candidate of Sciences (Pharmacy), Head of the Laboratory of Economics and Pharmacy of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0000-0003-4333-322X. E-mail: ovivanova134@mail.ru

Yuliya V. Gorbunova — Candidate of Sciences (Pharmacy), Head of the Laboratory of Pharmacy, Pharmacology, Pharmacognosy, Pharmaceutical Technology and Chemistry of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0000-0002-6416-0500. E-mail: yvgorbunova@yandex.ru

Ksenia N. Koryanova — Candidate of Sciences (Pharmacy), Assistant Professor of the Department of Pharmacy, Faculty of Postgraduate Education of the Pyatigorsk Medical and Pharmaceutical Institute — branch of Volgograd State Medical University; Assistant Professor of the Department of Pharmacy, General Pharmacology and Pharmaceutical Consulting of the Russian Medical Academy of Continuing Professional Education. ORCID ID: 0000-0003-1571-9301. E-mail: kskor-16@mail.ru

Ekaterina S. Mishchenko — Candidate of Pharmaceutical Sciences, Assistant Professor of the Department of Toxicological and Analytical Chemistry of the Pyatigorsk Medical and Pharmaceutical Institute — branch of Volgograd State Medical University**.** ORCID ID: 0000-0001-7778-8391. E-mail: ekaterina-mischenko1809@mail.ru

Ilyas Sh. Gadaev — 4 year student at the Faculty of the Stavropol State Medical University. ORCID ID: 0009-0002-7998-2352. E-mail: ilyas.gadayev.03@mail.ru

Larisa I. Shcherbakova — Candidate of Sciences (Pharmacy), Assistant Professor, Deputy Director for Educational Affairs, Head of the Department of Chemistry, Pyatigorsk Medical and Pharmaceutical Institute – branch of Volgograd State Medical University. ORCID ID: 0000-0002-7806-2805. E-mail: shcherbakovali@mail.ru

Irina N. Dyakova — Candidate of Sciences (Pharmacy), Assistant Professor, Head of the Department of Biology and Physiology, Acting Dean of the Faculty of Postgraduate Education, Pyatigorsk Medical and Pharmaceutical Institute – branch of Volgograd State Medical University. ORCID ID: 0009-0002-9522-7605. E-mail: irochkadyakova@mail.ru

Evgeny I. Morkovin — Candidate of Sciences (Medicine), Assistant Professor, Deputy Director for Scientific Work of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0000-0002-7119-3546. E-mail: e.i.morkovin@gmail.com

Anna S. Shuvaeva — junior researcher of the Scientific and Educational Institute of Pharmacy n.a. K.M. Lakin, Russian University of Medicine. ORCID ID: 0000-0001- 6586-7148. E-mail: annaxo@mail.ru