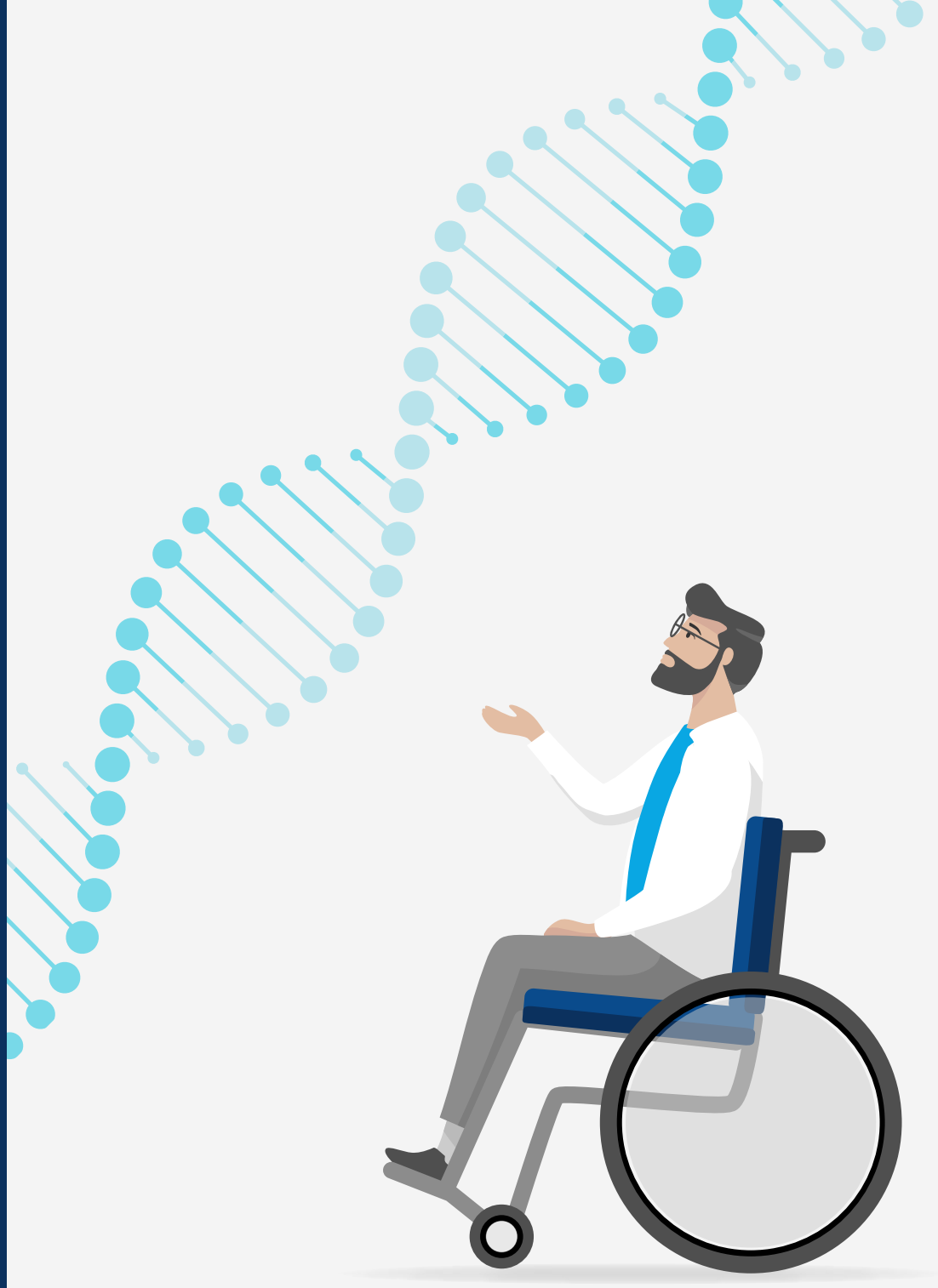
GENE THERAPY PIPELINE
1Q 2022–2Q 2025

Treatment Options Expand in Robust Gene Therapy Pipeline



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	Therapy Name	Manufacturer	Phase of Development	Type	Breakthrough Therapy Designation	Drug Class	Indication	Route of Administration	FDA Decision Date	Estimated Potential U.S. Candidates
Projected Launch Year: 2022										
1Q	**Kymriah** (tisagenlecleucel)	Novartis	Pending FDA approval	Supplemental Indication	No	Chimeric antigen receptor (CAR) T-cell therapy, ex vivo	The treatment of relapsed or refractory follicular lymphoma in adults	Injection-IV, one-time	02/27/22	86,000–100,000 adult patients
	ciltacabtagene autoleucel	Janssen Pharmaceuticals/ Johnson & Johnson	Pending FDA approval	New Biologic	Yes	CAR T-cell therapy, ex vivo	The treatment of relapsed or refractory multiple myeloma in adults	Injection-IV, one-time	02/28/22	9,000 adult patients
2Q	**Yescarta** (axicabtagene ciloleucel)	Gilead Sciences/Kite	Pending FDA approval	Supplemental Indication	No	CAR T-cell therapy, ex vivo	The second-line treatment of relapsed or refractory diffuse large B-cell lymphoma in adults	Injection-IV, one-time	04/01/22	90,000 adult patients
3Q	**Zynteglo** (betibeglogene autotemcel)	Bluebird Bio	Pending FDA approval	New Biologic	Yes	Gene therapy, ex vivo	The treatment of transfusion-dependent beta-thalassemia in adults and pediatrics	Injection-IV, one-time	08/19/22	1,450 adult and pediatric patients
	LentiD (elivaldogene autotemcel)	Bluebird Bio	Pending FDA approval	New Biologic	Yes	Gene therapy, ex vivo	The treatment of cerebral adrenoleukodystrophy in males aged younger than 18 years	Injection-IV, one-time	09/16/22	700 pediatric patients
	Instiladrin (nadofaragene firadenovec)	FKD Therapies/ Ferring Pharmaceuticals	Pending FDA approval	New Biologic	Yes	Gene therapy, in vivo	The treatment of high-grade, non-muscle invasive, bacillus Calmette-Guérin (BCG)-refractory bladder cancer in adults	Injection-Intravesical, multi-dose		60,000 adult patients per year
4Q	**Breyanzi** (lisocabtagene maraleucel)	Bristol-Myers Squibb	Phase III	Supplemental Indication	No	CAR T-cell therapy, ex vivo	The second-line treatment of relapsed or refractory, aggressive, large B-cell lymphoma, in adults who are eligible for stem cell transplant	Injection-IV, one-time		90,000 adult patients
	Roctavian (valoctocogene roxaparvovec)	BioMarin Pharmaceutical	Phase III	New Biologic	Yes	Gene therapy, in vivo	The treatment of severe hemophilia A in adults	Injection-IV, one-time		7,500 adult patients
	EtranaDez (etranacogene dezaparvovec)	CSL Behring/ Uniqure	Phase III	New Biologic	Yes	Gene therapy, in vivo	The treatment of hemophilia B in adults	Injection-IV, one-time		2,600 adult patients

Treatments for severe hemophilia A and hemophilia B are anticipated to be approved in 2022.

Source: RxPipeline, CVS Health Clinical Affairs. Information current as of February 2, 2022.

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1H	**obecabtagene autoleucel**	Autolus Therapeutics	Phase I/II	New Biologic	No	CAR T-cell therapy, ex vivo	The treatment of acute lymphoblastic leukemia in adults	Injection-IV, one-time		30,000 adult patients
1H	**Breyanzi** (lisocabtagene maraleucel)	Bristol-Myers Squibb	Phase I/II	Supplemental Indication	No	CAR T-cell therapy, ex vivo	The treatment of relapsed or refractory chronic lymphocytic leukemia or small lymphocytic lymphoma in adults	Injection-IV, one-time		135,000 adult patients
1Q	**Vyjuvek** (beremagene geperpavec)	Krystal Biotech	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of dystrophic epidermolysis bullosa in adults and pediatrics	Topical, multi-dose		900 adult and pediatric patients
2Q	**Tavo** (tavokinogene telsaplasmid)	Merck/OncoSec	Phase II	New Biologic	No	Gene therapy, in vivo	The treatment of advanced or metastatic malignant melanoma in adults whose cancer has progressed on a checkpoint inhibitor, in combination with Keytruda (pembrolizumab)	Injection, multi-dose		Eligible patient candidates unknown, subset of the ~1.2 million living with melanoma
2Q	**eladocagene exuparvovec**	PTC Therapeutics	Phase II	New Biologic	No	Gene therapy, in vivo	The treatment of aromatic L-amino acid decarboxylase deficiency in patients aged 17 years and younger	Injection-Intracerebral, one-time		100 pediatric patients worldwide
2Q	**EB101**	Abeona Therapeutics	Phase III	New Biologic	Yes	Gene therapy, ex vivo	The treatment of recessive dystrophic epidermolysis bullosa in patients aged 6 years and older	Topical, one-time		400 adult and pediatric patients
2Q	**Lumevoq** (lenadogene nolparvovec)	GenSight Biologics	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of Leber's hereditary optic neuropathy, in adults with the ND4 mutation	Injection-Intraocular, one-time		4,500–7,500 adult patients
2Q	**dabocemagene autoficel**	Castle Creek Pharma	Phase III	New Biologic	No	Gene therapy, ex vivo	The treatment of recessive dystrophic epidermolysis bullosa in patients aged 7 years and older	Injection-Intradermal, multi-dose		400 adult and pediatric patients
2Q	**olenasufligene relduparvovec**	Lysogene	Phase II/III	New Biologic	No	Gene therapy, in vivo	The treatment of mucopolysaccharidosis type IIIA, also called Sanfilippo type A, in pediatrics	Injection-Intracerebral, one-time		240–1,840 pediatric patients
2H	**OTL103**	Orchard Therapeutics	Phase II	New Biologic	No	Gene therapy, ex vivo	The treatment of Wiskott Aldrich syndrome in pediatrics	Injection-IV, one-time		500 pediatric male patients

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Projected Launch Year: 2023 (cont.)										
3Q	**CTX001**	CRISPR Therapeutics/Vertex Pharmaceuticals	Phase I/II	New Biologic	No	Gene therapy, ex vivo	The treatment of sickle cell disease in patients aged 12 years and older	Injection-IV, one time		58,000 adult and pediatric patients
	CTX001	CRISPR Therapeutics/Vertex Pharmaceuticals	Phase I/II	New Biologic	No	Gene therapy, ex vivo	The treatment of transfusion-dependent beta thalassemia in patients aged 12 years and older	Injection-IV, one time		1,000 adult and pediatric patients
	atidarsagene autotemcel	Orchard Therapeutics	Phase II	New Biologic	No	Gene therapy, ex vivo	The treatment of pre-symptomatic, early-onset metachromatic leukodystrophy in pediatrics	Injection-IV, one-time		400–1,700 pediatric patients worldwide
	RPL201	Rocket Pharmaceuticals	Phase I/II	New Biologic	No	Gene therapy, ex vivo	The treatment of severe leukocyte adhesion deficiency type 1 in pediatrics	Injection-IV, one-time		300 pediatric patients worldwide
4Q	**lovotibeglogene autotemcel** (formerly known as LentiGlobin)	Bluebird Bio	Phase III	New Biologic	No	Gene therapy, ex vivo	The treatment of sickle cell disease in adults and pediatrics	Injection-IV, one-time		58,000 adult and pediatric patients
	RPL102	Rocket Pharmaceuticals	Phase II	New Biologic	No	Gene therapy, ex vivo	The treatment of Fanconi anemia in pediatrics	Injection-IV, one-time		<1,000 pediatric patients

Sickle cell anemia and dystrophic epidermolysis bullosa are two conditions targeted by gene therapies looking for approval in 2023.

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1H	**Abecma** (idecabtagene vicleucel)	Bluebird Bio/ Bristol-Myers Squibb/Celgene	Phase III	Supplemental Indication	Yes	CAR T-cell therapy, ex vivo	The treatment of adults with relapsed or refractory multiple myeloma after 2 or 3 prior lines of therapy	Injection-IV, one time		9,000 adult patients
1Q	**ABO102**	Abeona Therapeutics	Phase I/II	New Biologic	No	Gene therapy, in vivo	The treatment of mucopolysaccharidosis type IIIA, also called Sanfilippo type A, in pediatrics	Injection-IV, one time		240–1,800 pediatric patients
	fidanacogene elaparvovec	Pfizer/Spark Therapeutics	Phase III	New Biologic	Yes	Gene therapy, in vivo	The treatment of hemophilia B in adults	Injection-IV, one time		2,600 adult patients
	resamirigene bilparvovec	Audentes Therapeutics	Phase I/II	New Biologic	No	Gene therapy, in vivo	The treatment of X-linked myotubular myopathy in males aged younger than 5 years	Injection-IV, one-time		40 male newborns per year
	giroctocogene fitelparvovec	Pfizer/Sangamo BioSciences	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of severe hemophilia A in adults	Injection-IV, one-time		7,500 adult patients

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2Q	**Engensis** (donaperminogene seltoplasmid)	Helixmith	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of diabetic peripheral neuropathy in adults	Injection-IM, multi-dose		7.1–13.5 million adult patients
	ofranergene obadenovec	VBL Therapeutics	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of adults with recurrent platinum-resistant ovarian cancer, in combination with paclitaxel	Injection-IV, multi-dose		15,000 adult patients
	Generx (alferminogene tadenovec)	Gene Biotherapeutics/ Molecular Medicine BioServices	Phase III	New Biologic	No	Gene therapy, in vivo	Improvement of exercise tolerance in adults with refractory angina due to myocardial ischemia	Injection-Intracoronary, one-time		900,000–1.2 million adult patients
	GS030	GenSight Biologics	Phase I/II	New Biologic	No	Gene therapy, in vivo	The treatment of retinitis pigmentosa in adults	Injection-Intraocular, one-time		65,000 adult patients
	fordadistrogene movaparvovec	Pfizer	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of ambulatory patients with Duchenne muscular dystrophy	Injection-IV, one-time		4,000 pediatric males
3Q	**ProstAtak** (aglatimagene besadenovec)	Advantagene/ Candel Therapeutics	Phase III	New Biologic	No	Gene therapy, in vivo	The first-line treatment of adults with intermediate to high risk, localized, prostate cancer, in combination with external beam radiation therapy and valacyclovir	Injection-Intratumoral, multi-dose		125,000 adult patients
	JNJ64400141	Janssen Pharmaceuticals/ Johnson & Johnson	Phase III	New Biologic	Yes	Gene therapy, in vivo/Vaccine	The prevention of respiratory syncytial virus-mediated lower respiratory tract disease in adults aged 60 years or older	Injection-IM, multi-dose		34 million adult patients
4Q	**delandistrogene moxeparvovec**	Sarepta Therapeutics	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of ambulatory patients with Duchenne muscular dystophy	Injection-IV, one-time		4,000 pediatric males
	Tecartus (brexucabtagene autoleucel)	Gilead Sciences/ Kite	Phase I/II	Supplemental Indication	No	CAR T-cell therapy, ex vivo	The treatment of relapsed or refractory B-cell precursor acute lymphoblastic leukemia in patients aged 2 to 21 years	Injection-IV, one-time		7,500 pediatric patients

The 2024 treatment pipeline is robust and includes therapies for Duchenne muscular dystrophy and the prevention of respiratory syncytial virus-mediated lower respiratory tract disease.

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1H	**RGX314**	AbbVie/ RegenxBio	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of neovascular (wet) age-related macular degeneration	Injection-Intraocular, one-time		2 million adult patients
1H	**verbrinacogene setparvovec**	Freeline Therapeutics	Phase I/II	New Biologic	No	Gene therapy, in vivo	The treatment of severe hemophilia B in adults	Injection-IV, one-time		2,600 adult patients
2Q	**Invossa** (tonogenchoncel-L)	Kolon Group	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of knee osteoarthritis	Injection-Intra-articular, one-time		13 million adult patients
2Q	**nadofaragene firadenovec**	Trizell	Phase III	New Biologic	No	Gene therapy, in vivo	The treatment of malignant pleural mesothelioma	Injection-Intrapulmonary, one-time		2,400 adult patients per year

Four new biologics are projected to be approved in 2025 including for neovascular (wet) age-related macular degeneration and knee osteoarthritis.

Information compiled from external sources. Manufacturer drug launch dates are subject to change without notice. Some products may not be dispensed by CVS Specialty Pharmacy.

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Source: RxPipeline, CVS Health Clinical Affairs. Information current as of February 2, 2022.

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