Gene therapy: Overview and Update

Bryce Fincher, BS
Overview of gene therapy
Gene therapy

Treatment that uses specific genetic material to treat a condition by:

- Providing a functional copy of a gene
- Increasing disease-modifying genes
- Suppressing activity of a damaged gene

(Belete, 2021)
Vectors

**Viral**
Surface proteins on viruses interact with host receptor to enter the cell and release their genome

Common viral vectors used:
- Herpes simplex virus (HSV)
- Adenovirus (Ad)
- Adeno-associated virus (AAV)
- Lentivirus (LV)

**Non-Viral**
Organic and nonorganic vectors that deliver small/large DNA or RNA

Methods of delivery:
- Chemical
- Physical

(Belete, 2021)
Current clinical applications of gene therapy
Diseases treated with gene therapy

- Spinal muscular atrophy
- Retinal dystrophy
- Lymphoma & Leukemia
- Melanoma
- Prostate cancer
- Hematopoietic conditions

(FDA, 2021)
In vivo
- Spinal muscular atrophy
- Retinal dystrophy
- Melanoma

Ex vivo
- Lymphoma & Leukemia
- Hematopoietic conditions
- Prostate cancer

(FDA, 2021; Ma et al., 2019)
# Gene Therapy Centers

This list of gene therapy centers in the U.S. is intended for use by patients, advocates, and caregivers who are seeking gene therapy research for a rare disease. This list excludes oncology (cancer) due to the wide scope of cancers and number of centers working on them. The Blood & Marrow Transplant Information Network has a list of medical centers offering CAR T-cell therapy. If you are unsure whether a clinical trial is open for your disease, search by diagnosis using the ASGCT Clinical Trials Finder. To suggest a center or make an update to a center listed please contact us.

<table>
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<tr>
<th>Center</th>
<th>Disease focus area*</th>
<th>Location</th>
<th>Contact</th>
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| Cell and Gene Therapy Collaborative at CHOP | • Beta thalassemia  
• Choroideremia  
• Hemophilia  
• Leber congenital amaurosis (LCA)  
• Methylmalonic acidemia  
• Mucopolysaccharidosis (MPS I, MPS II)  
• Phenylketonurias (PKU)  
• Sickle cell disease  
• Spinal muscular atrophy (SMA) | The Children’s Hospital of Philadelphia  
3501 Civic Center Blvd  
Philadelphia, PA 19104 | [Contact](#)  
[Learn more](#) |
Medical Centers Offering CAR T-cell Therapy

Click on the state below to view information about those centers.

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<td>Alabama</td>
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https://www.bmtinfonet.org/transplant-article/medical-centers-offering-car-t-cell-therapy
Outlook for gene therapy and current research
Current Clinical Trials

~900+ in US

(Clinicaltrials.gov, 2021)
Sickle Cell Gene Therapy Trial

- Ex vivo administration
- HIV modified virus vector (lentivirus)
- DNA encoding hemoglobin
- Compensate for defective gene

(Biopharmadive, 2021; Clinicaltrials.gov, 2021)
Sickle Cell Gene Therapy Trial

- 14 people free of pain crises
- 1 has developed acute myeloid leukemia (AML)
- 2 have developed myelodysplastic syndrome (MDS)

(Biopharmadive, 2021)
**LentiGlobin**

**PHASE 1/2 STUDIES**

**HGB-206**  
Evaluating safety and efficacy of LentiGlobin gene therapy in patients with SCD  
**STATUS:** ACTIVE, NOT RECRUITING

**HGB-205**  
Evaluating safety and efficacy of LentiGlobin gene therapy in patients with TDT or SCD  
**STATUS:** COMPLETE

**PHASE 3 STUDY**

**HGB-210**  
Evaluating safety and efficacy of LentiGlobin gene therapy in patients with SCD  
**STATUS:** RECRUITING

**LONG-TERM FOLLOW-UP**

**LTF-307**  
Long-term Follow-up of Subjects With Sickle Cell Disease Treated With Ex Vivo Gene Therapy Using Autologous Hematopoietic Stem Cells Transduced With a Lentiviral Vector  
**STATUS:** ENROLLING BY INVITATION

https://www.bluebirdbio.com/our-science/clinical-trials
Impact of gene therapy on patients
Cost

Retinal dystrophy
$425,000

Spinal muscular atrophy
$2.1 million

(Wong et al., 2020)
Considerations

- Access to services
- Patient understanding
- Elimination of disability
- Informed consent
- Social effects and barriers
Common misconceptions

- Genetic so it will be passed to children
- If it is changing the genes then it will change who I am
- It can be used for any condition with a known genetic component
References


References


Thank You!

DO YOU HAVE ANY QUESTIONS?