Diabetes Fact Sheet

CIRM funds many projects seeking to better understand diabetes and to translate those discoveries into new therapies.

Description

Diabetes comes in two forms: type 1 (also known as juvenile) and type 2 (also known as adult). Approximately 1.25 million people in the U.S. have type 1 diabetes, which is the form primarily being targeted by stem cell research.

Type 1 diabetes is an autoimmune disorder where the body's own immune system destroys the cells in the pancreas that make the hormone insulin. Insulin normally circulates in the bloodstream after a meal and allows cells of the body to take up sugar and use it for food. Without insulin, cells starve and the sugar builds up in the bloodstream where it can damage the kidneys, blood vessels and retina.

Any potential cure for type 1 diabetes requires replacing the lost insulin-producing cells of the pancreas. Currently, the only cells that can be used for such a transplant come from donated organs, which are in short supply. Such insulin-producing cell transplants are also risky because the cells can be rejected by the recipient's body if they don't receive immune suppressing drugs.

To solve the first problem, groups of CIRM-funded researchers have developed methods to make replacement insulin-producing cells derived from human embryonic stem cells, which can be grown in large amounts. Implanted into mice and rats these cells are able to regulate blood sugar.

To get around the problem of rejection, CIRM-funded teams have placed donor progenitor cells in a device that implants under the skin and shields the cells from the patient's immune system. Other groups are studying how to regulate the immune system to make stem cell-derived transplants safer.

Clinical Stage Programs

UC San Francisco

Transplantation of beta cells, contained in donor pancreatic islets, can reverse the symptoms of diabetes. However, due to a poor islet survival rate, transplants require islets from multiple donors. Since islet cells are transplanted directly into the vessels that enter the liver, it is extremely difficult to monitor and retrieve these cells should the need arise. Peter Stock and his team at UCSF are using parathyroid glands to aid in the success and viability of the transplant procedure. Co-transplantation of islets and parathyroid glands, from the same donor, substantially increases beta cell survival, potentially enabling adequate long-term insulin production and removing the need for multiple donors. The co-transplantation will occur in the patient's forearm, which allows for easier monitoring and improves the effectiveness and accessibility of islet transplants for patients.

- To learn more about this trial on clinicaltrials.gov

Caladrius Biosciences

Caladrius is targeting the immune system as an alternative strategy for treating patients with type 1 diabetes. This disease causes the immune system to destroy the insulin-producing cells of the pancreas. The team is developing a stem cell-based therapy using the patient's own cells. They will take cells, called regulatory T cells (Tregs), from the patient's own immune system, expand the number of those cells in the lab and enhance them to make them more effective at preventing the autoimmune attack on the insulin-producing cells.

- Read more about the project
- Read more about the clinical trial

ViaCyte

ViaCyte is developing cell therapies to replace lost beta cells for people with type 1 diabetes (T1D). The therapies are derived from human embryonic stem cells, which are partially matured into becoming pancreatic tissues (the type destroyed in T1D). The cells are

inserted into a small pouch that is transplanted under the patient's skin. The transplanted cells will develop into fully matured beta cells that secrete the hormone insulin, which is needed to keep blood sugar levels at a healthy level. CIRM is funding ViaCyte's two Phase 1/2 trials testing different product candidates. The first product, VC-01, encapsulates the cells and protects them from the patient's immune system. The second product, VC-02, allows the patient's blood vessels to make direct contact with the implanted cells. VC-02 is being developed for patients with high-risk T1D.

Learn More:

- VC-01 trial
- VC-02 trial

Progress and Promise in Diabetes Research

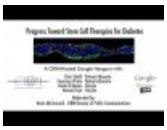
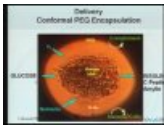
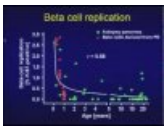
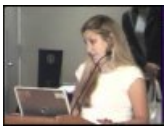
CIRM Grants Targeting Diabetes

Researcher name	Institution	Grant Title	Grant Type	Award Amount
Felicia Pagliuca	Semma Therapeutics	Personalized Cell Therapy for Diabetes	Therapeutic Translational Research Projects	$597,333
Peter Butler	University of California, Los Angeles	Personalized Cell Therapy for Diabetes	Therapeutic Translational Research Projects	$1,494,896
Senta Georgia	Children's Hospital of Los Angeles	Developing a personalized approach to beta cell replacement for patients with a genetic form of diabetes	Inception - Discovery Stage Research Projects	$179,995
Ronald Evans	Salk Institute for Biological Studies	Therapeutic immune tolerant human islet-like organoids (HILOs) for Type 1 Diabetes	Quest - Discovery Stage Research Projects	$1,637,209
Allan Robins	ViaCyte, Inc.	Cell Therapy for Diabetes	Disease Team Research I	$22,999,933
Kevin D'Amour	ViaCyte, Inc.	Stem cell-derived islet cell replacement therapy with immunosuppression for high-risk type 1 diabetes	Late Stage Preclinical Projects	$3,544,721
Peter Stock	University of California, San Francisco	Pancreatic Islets and Parathyroid Gland Co-transplantation for Treatment of Diabetes in the Intra-Muscular Site: PARADIGM	Clinical Trial Stage Projects	$11,083,012

Didier Stainier	University of California, San Francisco	Endodermal differentiation of human ES cells	SEED Grant	$611,027
Tejal Desai	University of California, San Francisco	Thin Film Encapsulation Devices for Human Stem Cell derived Insulin Producing Cells	Quest - Discovery Stage Research Projects	$1,092,063
Eiji Yoshihara	Lundquist Institute for Biomedical Innovation at Harbor - UCLA Medical Center	Dual angiogenic and immunomodulating nanotechnology for subcutaneous stem cell derived islet transplantation for the treatment of diabetes	Quest - Discovery Stage Research Projects	$250,000
Yang Xu	University of California, San Diego	Developing induced pluripotent stem cells into human therapeutics and disease models	Early Translational I	$5,165,028
Julie Sneddon	University of California, San Francisco	Designing a cellular niche for transplantation of human embryonic stem cell-derived beta cells	Quest - Discovery Stage Research Projects	$2,006,076
Olivia Kelly	ViaCyte, Inc.	Methods for detection and elimination of residual human embryonic stem cells in a differentiated cell product	Early Translational I	$5,405,397
Fouad Kandeel	City of Hope, Beckman Research Institute	2009 Rachmiel Levine Diabetes and Obesity Symposium: Advances in Diabetes Biology, Immunology and Cell Therapy	Conference	$15,000
Evert Kroon	ViaCyte, Inc.	Development of the Theracyte Cellular Encapsulation System for Delivery of human ES Cell-derived Pancreatic Islets and Progenitors.	Tools and Technologies I	$827,072
Fouad Kandeel	City of Hope, Beckman Research Institute	2013 Rachmiel Diabetes and Obesity Levine Symposium - Advances in Diabetes Research	Conference	$27,750
Jeffrey Bluestone	University of California, San Francisco	Stem cell tolerance through the use of engineered antigen-specific regulatory T cells	Transplantation Immunology	$1,152,768
Fouad Kandeel	City of Hope, Beckman Research Institute	2011 Rachmiel Levine Diabetes and Obesity Symposium: Advances in Diabetes Research	Conference	$15,000
Charles King	University of California, San Diego	Biological relevance of microRNAs in hESC differentiation to endocrine pancreas	Basic Biology III	$1,313,649
Fouad Kandeel	City of Hope, Beckman Research Institute	2012 Rachmiel Levine Diabetes and Obesity Symposium: Advances in Diabetes Research	Conference	$15,000
Maike Sander	University of California, San Diego	Deciphering transcriptional control of pancreatic beta-cell maturation in vitro	Basic Biology IV	$1,258,560
Richard Jove	City of Hope, Beckman Research Institute	Innovation and Translational Stem Cell Therapy for Diabetes and Neurological Diseases: Paving the way for real life solutions	Conference	$14,878
Howard Foyt	ViaCyte, Inc.	Preclinical and clinical testing of a stem cell-based combination product for insulin-dependent diabetes	Strategic Partnership I	$9,475,070

William Sietsema	Caladrius Biosciences	Phase 2 Safety and Efficacy Study of CLBS03 Autologous T-Regulatory Cells in Adolescents with Recent Onset Type 1 Diabetes Mellitus	Clinical Trial Stage Projects	$8,175,946	
Mark Anderson	University of California, San Francisco	Generation of a functional thymus to induce immune tolerance to stem cell derivatives	Basic Biology V	$1,191,000	
Esther Latres	JDRF International	JDRF Encapsulation Consortium Fall 2017 Meeting	Conference II	$42,425	
David Tirrell	California Institute of Technology	Engineered matrices for control of lineage commitment in human pancreatic stem cells	Basic Biology V	$526,896	
Howard Foyt	ViaCyte, Inc.	Clinical trial of directly vascularized islet cell replacement therapy for high-risk type 1 diabetes	Clinical Trial Stage Projects	$19,752,463	
Jeffrey Bluestone	University of California, San Francisco	A CIRM Disease Team for the Treatment and Cure of Diabetes	Disease Team Planning	$55,000	
Yang Xu	University of California, San Diego	Development of immune invisible beta cells as a cell therapy for type 1 diabetes through genetic modification of hESCs	Quest - Discovery Stage Research Projects	$1,924,791	
Howard Foyt	ViaCyte, Inc.	Clinical Development of a Cell Therapy for Diabetes	Accelerated Development Pathway I	$8,783,852	
Alan Agulnick	ViaCyte, Inc.	Preclinical development of an immune evasive islet cell replacement therapy for type 1 diabetes	Quest - Discovery Stage Research Projects	$1,470,987	
Roslyn Isseroff	University of California, Davis	Scaffold for dermal regeneration containing pre-conditioned mesenchymal stem cells to heal chronic diabetic wounds	Preclinical Development Awards	$4,620,144	
Shuvo Roy	University of California, San Francisco	Silicon Nanopore Membrane encapsulated enriched-Beta Clusters for Type 1 Diabetes treatment	Quest - Discovery Stage Research Projects	$1,113,000	
					Total: $117,837,941.00

CIRM Diabetes Videos

 **Diabetes: Progress toward stem cell therapies, a Live Google Hangout**	 **Ron Piran, Sanford-Burnham - CIRM Stem Cell #SciencePitch**	 **Eugene Brandon, Viacyte, Inc. - CIRM Stem Cell #SciencePitch**	 **Diabetes: Progress and Promise in Stem Cell Research**
 **Diabetes: Advancing Stem Cell Therapies - 2011 CIRM Grantee Meeting**	 **Alan Lewis Talks About Getting an Embryonic Stem Cell-Based Therapy to Patients**	 **Spotlight on Type 1 Diabetes: Welcoming Remarks**	 **Spotlight on Type 1 Diabetes: Seminar by Ed Baetge, Ph.D.**
 **Spotlight on Type 1 Diabetes: Seminar by Peter Butler, M.D.**	 **Spotlight on Type 1 Diabetes: Seminar by Joelle Johnson**	 **Stem Cell Based Diabetes Treatment: Alan Lewis - CIRM Science Writer's Seminar**	

Resources

- CIRM Stem Cellar blogs on diabetes
- NIH: Diabetes Information
- CDC: Diabetes Resources
- Find a clinical trial near you: NIH Clinical Trials database
- Juvenile Diabetes Research Foundation
- American Diabetes Association
- Family Caregiver Alliance
- National Family Caregivers Association

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Source URL: https://www.cirm.ca.gov/our-progress/disease-information/diabetes-fact-sheet