



# Cell Therapies for Type 1 Diabetes

—

Linda A Tempelman, PhD  
**How close are we?**



## Type 1 Diabetes: 2 Million Americans

**Lifelong Consequences:** Typically diagnosed in childhood, diabetes affects ongoing quality of life

Constant monitoring  
(sensors, pumps,  
injections)

Diet & physical activity  
limitations

Financial impact

Social isolation and  
depression

Health complications increase with aging:  
cardiovascular, vision loss, neuropathy,  
amputations, kidney damage



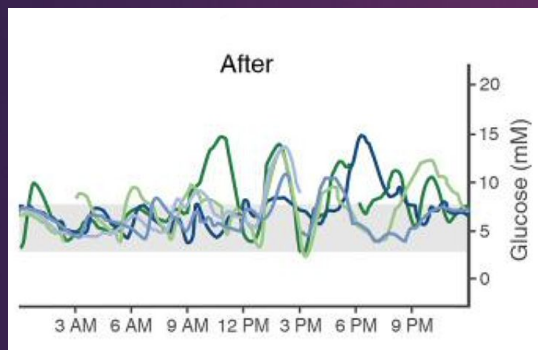
# Type 1 Diabetes: 10 Million World-Wide

## — Today's advanced therapies still fall short

### Advanced insulin therapy

Closed-loop insulin pump  
(artificial pancreas)

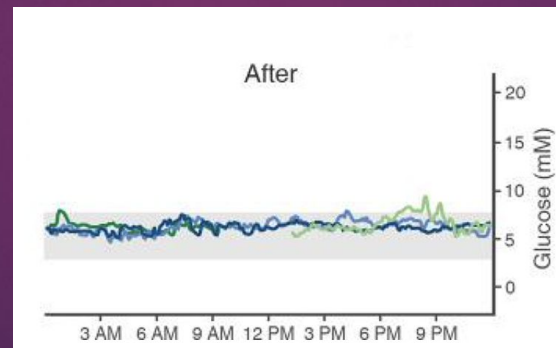
Suboptimal glucose control



### Current cell therapy treatment

Cadaveric islet transplantation  
(requires immunosuppression)

Robust glucose control



### Emerging cell therapies

Holy Grail: Robust glucose control with no need for immunosuppression

Living like  
someone  
without  
diabetes



# What do diabetes PATIENTS want?

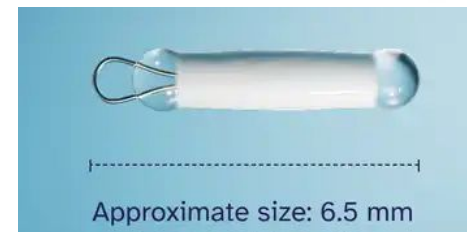
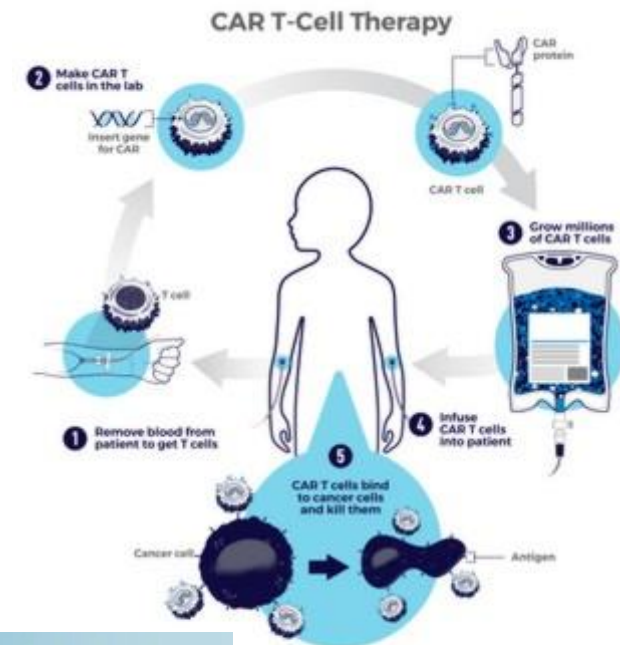
- **Safety:** No more fear of hypoglycemia
- **Freedom:** Reduction or elimination of exogenous insulin
- **Affordability** and accessible care
- **Relief** from the mental & emotional load of diabetes management
- **Long-term health:** Normal, healthy life without classic diabetes complications



# The state of cell therapies

## Where we are:

- Autologous ex-vivo CAR-T therapies
- Cord blood cell therapies
- Gene therapies with cellular component
- First encapsulated allogeneic therapy: Neurotech's Encelto™ (2025 FDA approval)



# Expanding the field of cell therapy

## Where we're headed:

- Off-the-shelf allogeneic replacement therapies for chronic diseases and conditions
- Cell therapy in a regenerative medicine modality
- Cell therapy as a “living pharmacy” (ARPA-H REACT program)



# Pancreatic islets can be successfully transplanted

## SUCCESESSES

Almost complete elimination of hypoglycemic events

Reduction, and in some cases, elimination of insulin injections

Best glycemic control of all current tx

***Demonstrated that pancreatic islets (removed from pancreas) can be basis of a treatment***

## LIMITATIONS

Only available for most severe T1D cases (2000 patients in 20 years)

Requires lifelong immunosuppression

Major regulatory hurdles in US

Limited supply of cadaveric islets with multiple infusions required



**CellTrans' Lantidra™**  
Only FDA approved (2023) islet cell therapy

Rickels, et al, Long-term Outcomes With Islet-Alone and Islet-After-Kidney Transplantation for Type 1 Diabetes in the Clinical Islet Transplantation Consortium: The CIT-08 Study. *Diabetes Care* 2022;45(12):2967–2975 <https://doi.org/10.2337/dc21-2688>

# The Successes of Transplantation

**“You have to pay attention to your diabetes, or you die,”**

said Amanda Smith in the August 26, 2024 Washington Post. Then, six months after Smith received a transplant of replacement islet cells, she no longer needed supplemental insulin, she was injection free.

**“I just feel normal again. You didn’t realize how much of your life it took up — until it’s taking up none, now.”**

Smith takes immune suppressing drugs three times a day now. She’s had some side effects and she’s careful around sick people. But she said that’s manageable compared with the roller coaster and health risks of diabetes.

**“Within days and weeks of the operation... my blood sugars were within the normal range... Six months after the first transplant I underwent the second. Two months later I became free of daily insulin injections... My confidence has returned and I am back teaching – hypo free!”**

Mary received islet transplants after decades with Type 1 diabetes and eliminated dangerous hypoglycemia.

<https://www.donatelife.gov.au/all-about-donation/donation-stories>

# Diabetes Stem Cell Therapy: The cells work...the implant systems *don't*

## The Promise: The cells work...

- Major breakthroughs in stem cells for Type 1 diabetes.
- Big pharma are actively investing in implanted cell therapy pipelines—showing confidence in patient acceptance.
- There are no FDA approved T1D stem cell products yet.

## The Problem: Current implant systems DON'T work

- Immunosuppression is still needed; effective encapsulation has been elusive.
- Gene editing will likely be a 2<sup>nd</sup> gen approach.
- Implant trials are early stage and not always meeting endpoints.

**U.S. Market: \$5B for FDA combination product (biologic/device)**

## CELL DEVELOPERS



# Immunoprotection approaches for diabetes cellular implants



## Hydrogel-based encapsulation

Sigalon/Lilly, Aspect Biosystems, Sernova, Otsuka Pharmaceutical Factory (porcine)



## Membrane-based encapsulation

Vertex, Persista Bio, Procyon Technologies, Encellin



## Immune modulation and/or genetic approaches

Sigalon/Lilly, Sana Biotechnology, Minutia, CRISPR, Seraxis, Vertex?

**Other enhancements:** pre-vascularization, scaffolds, oxygenation

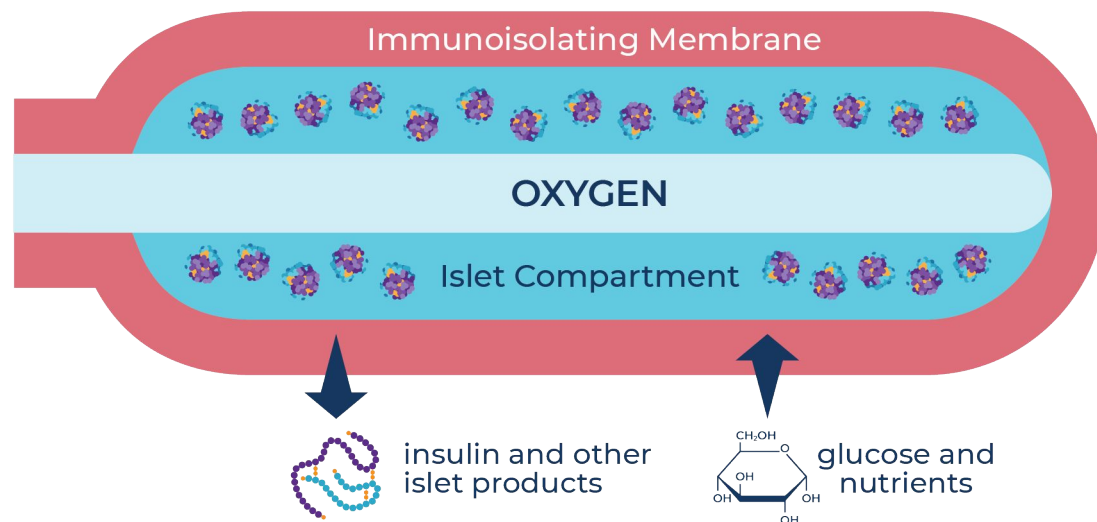
# Addressing cell encapsulation's major challenges

## Persista Bio<sup>®</sup> O2Line<sup>™</sup> Cell Delivery Platform

**Macroencapsulation protects cells from the immune system;  
allows full molecular exchange with tissue**

### Oxygenated Cell Capsule

Diabetes Application | Cross Section



### Addresses major challenges in cell encapsulation:

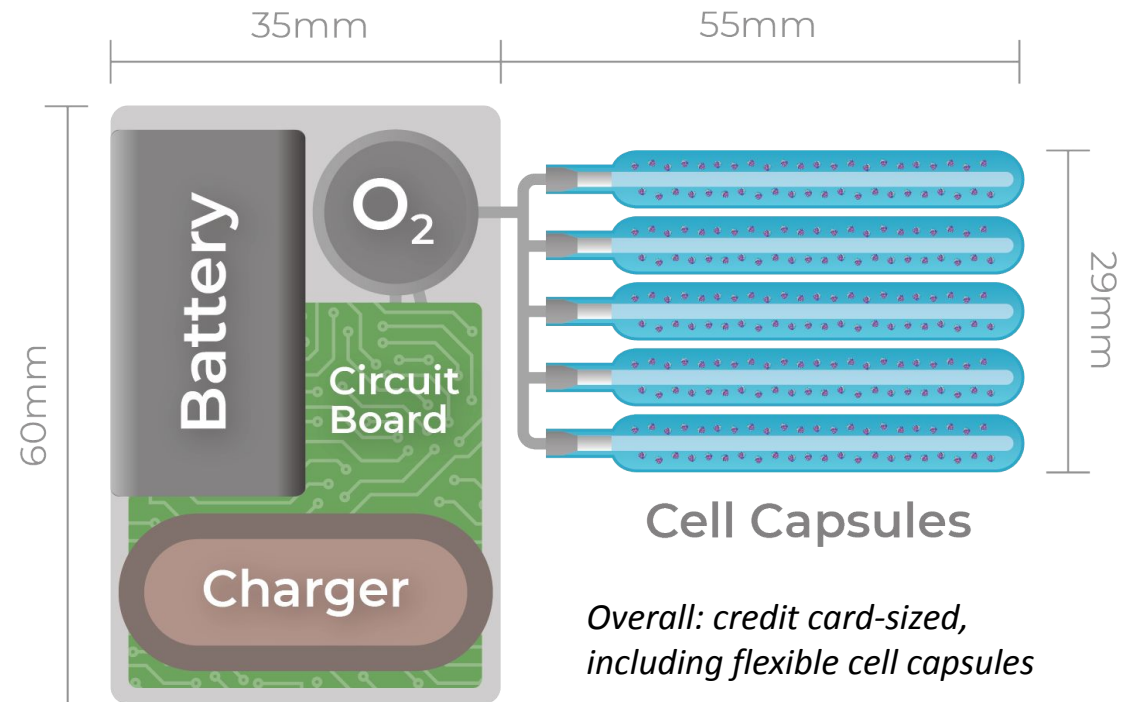
- Allogeneic immunoprotection
- Anti-fibrotic
- Oxygenation
- High capacity
- Safety/Retrievability

# Persista Bio<sup>®</sup> O2Line<sup>™</sup> Oxygenated Encapsulation Platform

## Persista O2Line<sup>™</sup> System

Human concept model

Solves current challenges to  
allow curative treatment



# Persista Bio<sup>®</sup> O2Line<sup>™</sup> Oxygenated Encapsulation Platform solves current challenges to allow curative treatment

Preclinical study shows effectiveness of Persista's technology

August 11, 2025



**Licensed Intellectual Property:**

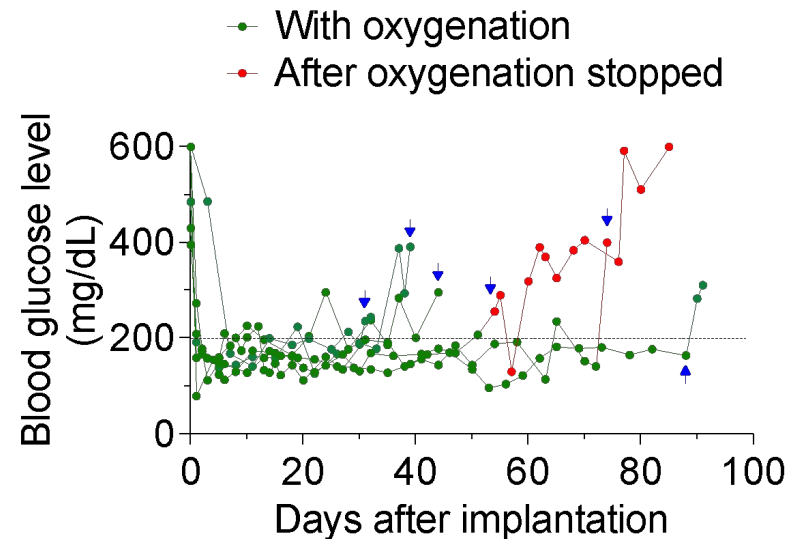
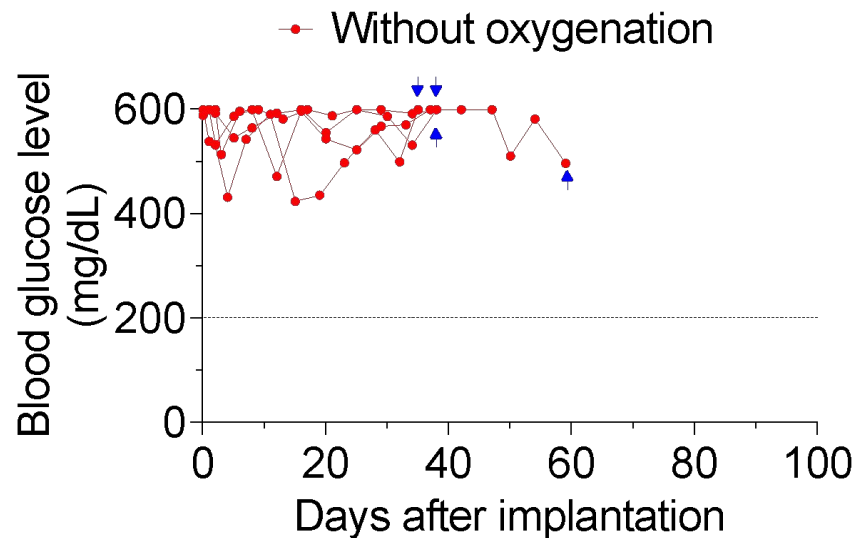
**Giner Inc.**'s oxygenation technology and

**Cornell's** macroencapsulation technologies

Funding includes:



# The O2line™ prototype cured diabetic rats, normalizing blood glucose in preclinical testing



## PERSISTA'S NEXT STEPS

Large animal/  
pig studies  
under NIH  
NIDDK SBIR  
funding

**Without oxygenation** all 4 rats failed  
(no blood glucose control)

**With oxygenation** all 6 rats had diabetes corrected rapidly  
**Stopping oxygen** led to increase of blood glucose

## Partnering and Acquisitions—Combining capabilities

ACQUIRER/LICENSOR DEAL TYPE	COMPANY	TECHNOLOGY	DEAL STAGE	TERMS	DATE
Vertex - acquisition	ViaCyte	Cells/Device	Clinical	\$320M	2022
Vertex - acquisition	SEMMA	Cells/Device	Preclinical	\$980M	2019
Lilly - acquisition	Sigilon	Hydrogel	Preclinical	\$34M cash; \$309M upside	2022
Novo Nordisk - partnership	Aspect Biosystems	Hydrogel	Preclinical	\$75M cash; \$650M +royalties upside Terms not disclosed	2023 2026
Evotec - partnership	Sernova	Hydrogel	Preclinical (cells)	\$27MCAN invested; cells provided	2022

## Early Clinical Trial Activity—2025

COMPANY	PRODUCT	CELL TYPE	APPROACH	2025 STATUS	N=
Vertex	VX-880	stem cell	immunosuppressed	Expanded	37
Vertex	VX-264	stem cell	membrane capsule	Closed, no C-peptide	<17
CRISPR Tx	CTX211	stem cell	gene edit; capsule	Enrolling?	40
Sernova	Cell Pouch System	cadaveric	immunosuppressed	Completed	13
Sana	HypoImmune Islet Study	cadaveric	gene edit (Ph I)	Ongoing	1
Encellin	ENCRT	cadaveric	membrane capsule	Completed	5
Otsuka	OPF-310	porcine	membrane capsule	Recruiting	13

# Additional challenges for diabetes curative cell therapy

## TECHNICAL

CMC cell manufacture

Translation from  
pre-clinical to clinical

Implant longevity  
(cells, fibrosis, fouling,  
other features)



## Cell Therapy Challenges

## BUSINESS

Development funding

Pricing and  
reimbursement

Market capacity for  
multiple products

Patient acceptance

## Predictions:

# Where are we going with T1D treatment?

**PRESENT  
–2035**

### **Islet or stem cell transplants with immunosuppression**

- Thousands of patients could receive islets (CellTrans) or stem cells (Vertex trial/future BLA) with immunosuppression

**PRESENT  
–2035**

### **Stem cells with encapsulation**

- Continued partnering/acquisitions. Predict several Phase III clinical trials with possible approval around 2035?

**2040+**

### **Stem cells with stealth or genetic modifications**

- Difficult to predict due to complex human immune system
- Will probably be 2<sup>nd</sup> gen treatment around 2040?

***The patients are waiting...***

LTempelman@persistabio.com

Linda Tempelman, CEO ·