

# **Stem Cells for Cardiovascular Diseases Clinical Research Update**

September 27, 2011  
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Minneapolis Heart Institute Foundation

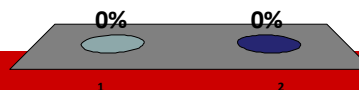
# Agenda

- Stem cell overview
- Research overview
- Current Studies
- Questions



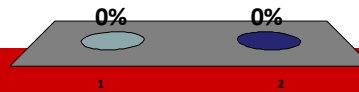
**I know of cardiovascular research going on currently in my institution.**

1. Yes
2. No



**I have taken care of patients that  
were involved in a research study.**

1. Yes
2. No



## **Why Stem Cells?**

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- Body's natural repair mechanism
- Readily available
- Easy to isolate and manipulate
- Immunoprivileged

## Purpose of stem cell therapy

- Treat disease and injury
- Repair
- Contribute to cardiac regeneration
- Promotion of “angiogenesis”
- Improve quality of life



## Role of the Cell in Cell Therapy



- **Cell as a *cell***
- **Cell as a *factory***
- **Cell as a *courier***

## Cell Therapy

- Embryonic stem cells
- Cord blood stem cells
- Adult stem cells
  - Circulating
  - Bone marrow
  - Tissue specific



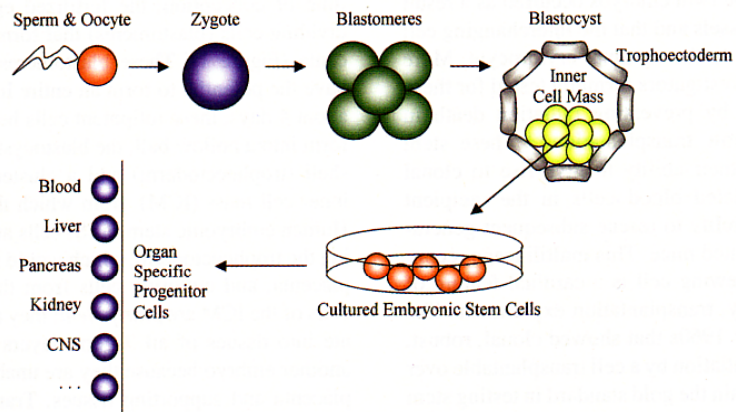
## Embryonic Stem Cells



## Embryonic Stem Cells

- Derived from 4 or 5 day old blastocyst-stage embryo
- Potential for unlimited, undifferentiated proliferation
- Cells are pluripotent
- Controversial
- Rejection
- Tumors

## Where Do Embryonic Stem Cells Come From ?



Cogle et al Mayo Clin Proc 2003;78

## Adult Stem Cells



## Adult Stem Cell

- Purpose: maintenance of homeostasis and repair of tissues
- Autologous (own) or Allogeneic (donor)
- Long-term self renewal
- Differentiate into majority of tissues
- No ethical issues
- Easy harvest
- Can give rise to specialized cells

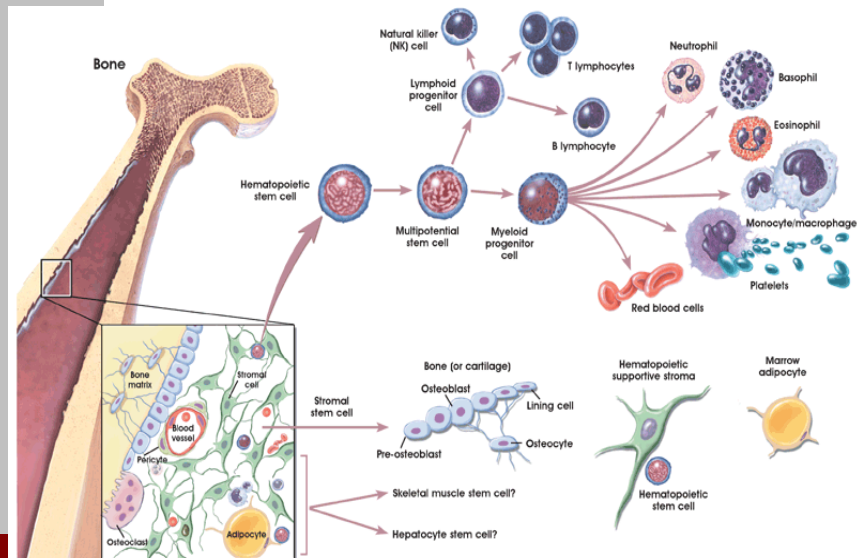
## Adult Stem Cells (cont)

Found in:

- Brain
- Bone marrow
- Blood
- Skeletal muscle
- Skin
- Liver
- Adipose tissue

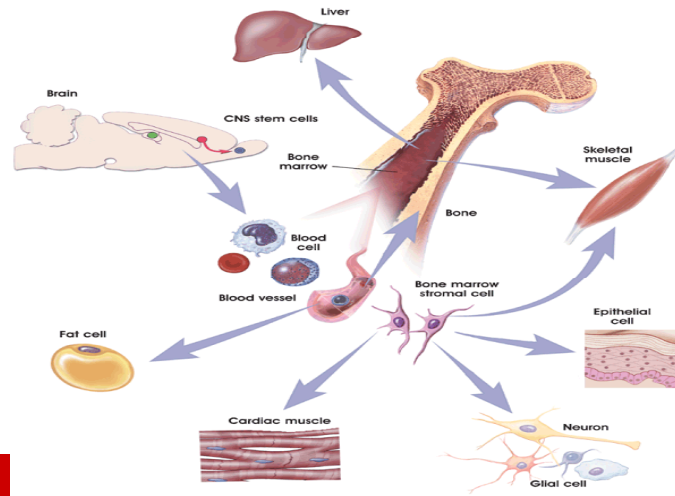


## Bone Marrow stem cells evolve into various cells



© 2001 Teresa Winslow, Lydia Köhler

## Bone Marrow stem cells evolve into various tissue



© 2001 Terese Winslow, Lydia Kibiuk, Caitlin Duckwall

## Cell Choices

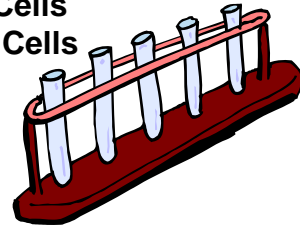
- Autologous vs. Allogeneic
- Cultured vs. fresh
- BM vs. Peripheral vs. Tissue
- Adult vs. Embryonic vs. Cord Blood



## Types of Stem Cells that May be Used for **Cardiac** Repair

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- Embryonic
- Placental Tissue
- Cord Blood
- Induced Pluripotent Stem Cells (iPS)
- Endogenous Cardiac Stem Cells
- Bone Marrow-Derived Stem Cells
- Adipose Tissue
- Skeletal Myoblasts



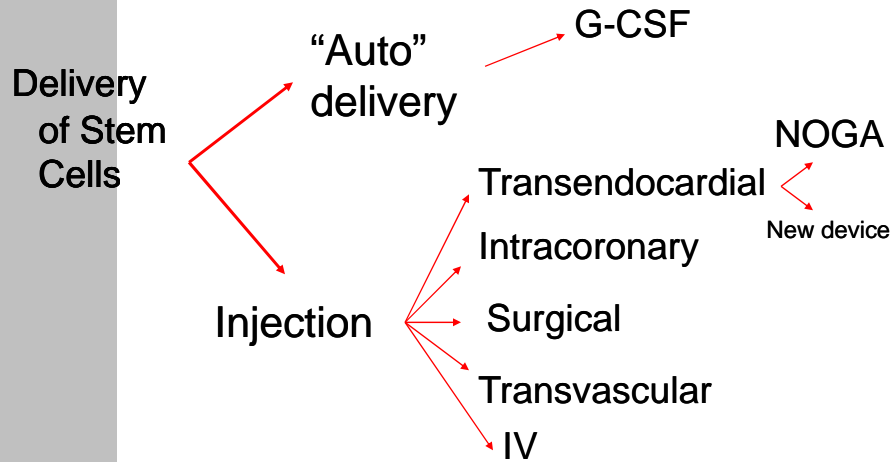
## More Questions Than Answers

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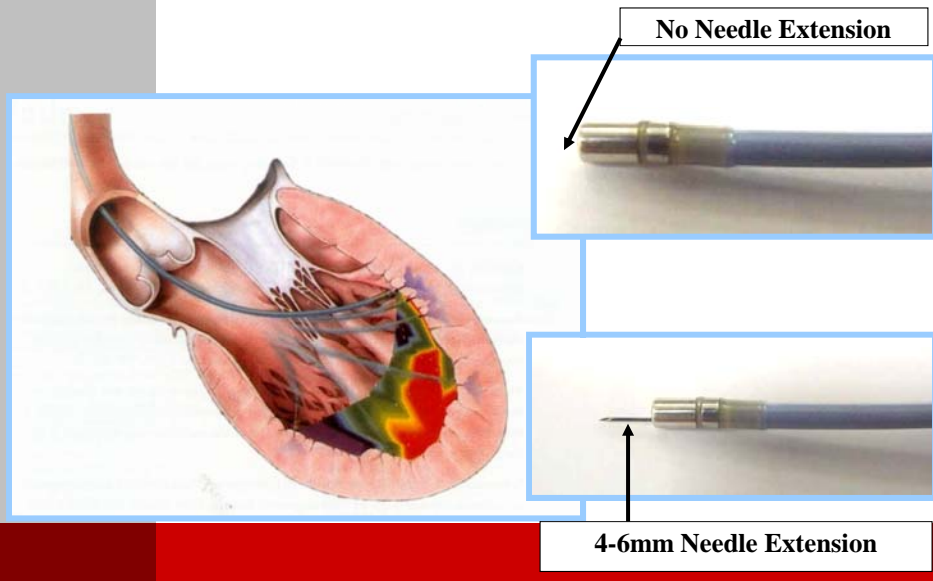


- ❖ Routes of Delivery
- ❖ Timing of Delivery
- ❖ Dose
- ❖ Target Pt Population
- ❖ Cell Type and Marker
- ❖ Cell origin

# Stem Cell Delivery



# Injection Catheter



## Cardiovascular Disease Targets

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- Refractory angina
- Acute myocardial infarction
- Congestive heart failure
- Peripheral arterial disease
- Stroke



## Just for the Record!

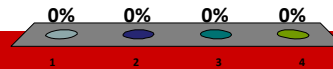
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- CABG did not work!
- PCI did not work!
- Medical therapy did not work!
- TLC did not work!

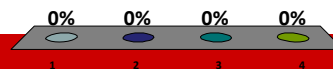
**Approximately how many  
cardiovascular trials using stem cells  
are currently ongoing in the US?**

1. 100-199
2. 200-400
3. 400-500
4. >500



**Approximately how many  
cardiovascular trials using stem cells  
are currently recruiting in Minnesota?**

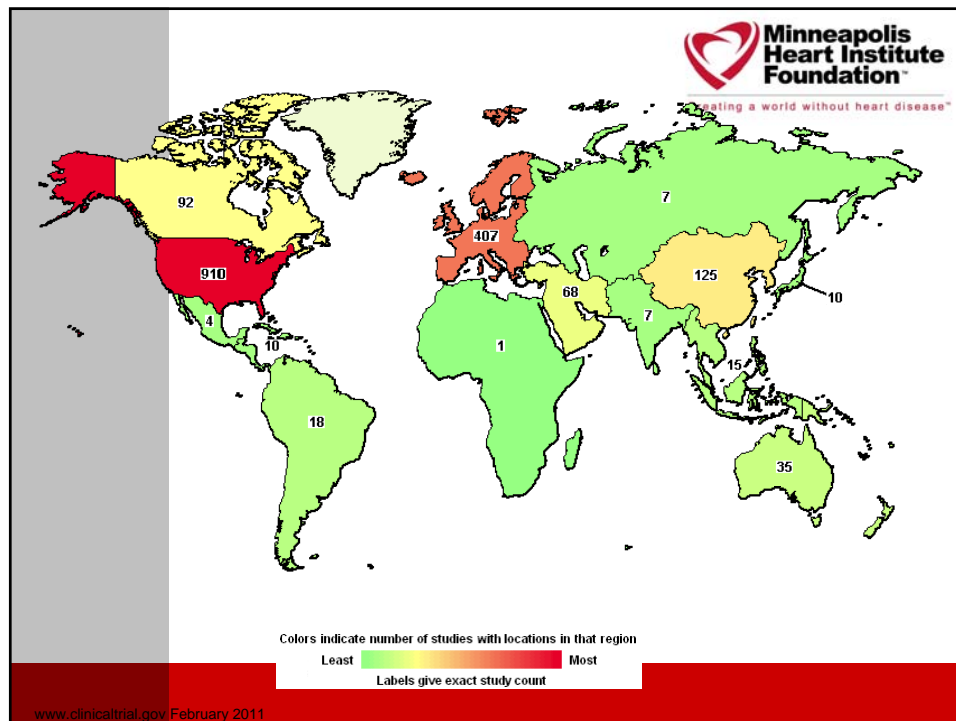
1. 5-15
2. 16-25
3. 26-35
4. >36

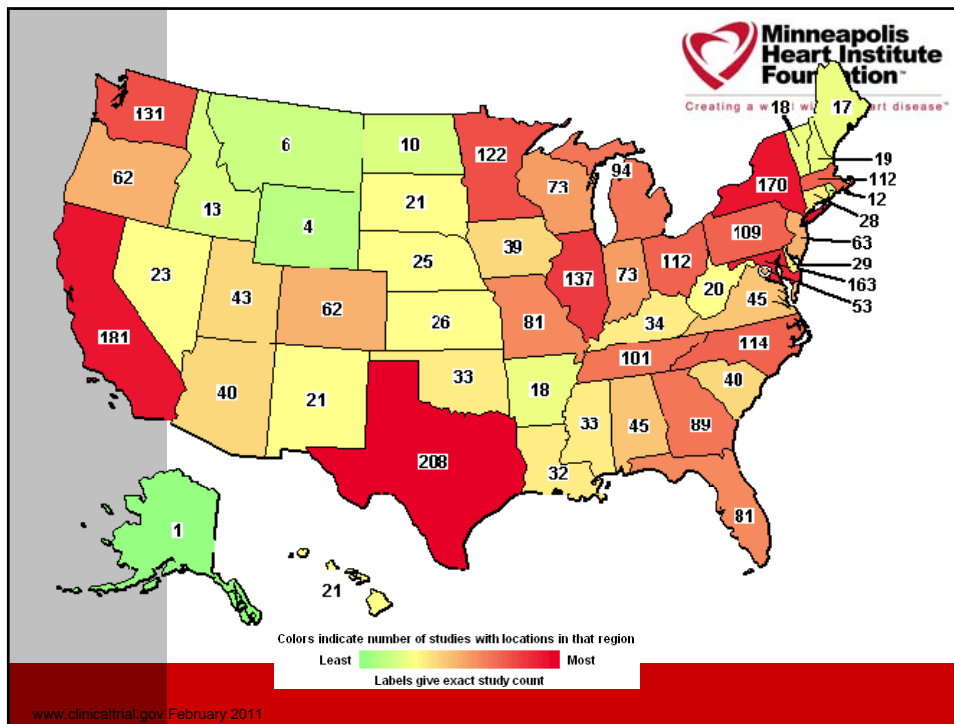




## World View

- **2006** -50 cardiac stem cell studies enrolling, or soon to be enrolling
- **2009** – 150+ sites enrolling cardiac stem cell studies.
- **2011**- 376 studies cardiac clinical trials using stem cells





## Phases of Research

- Preclinical
- Clinical
  - Phase I
  - Phase II
  - Phase III (pivotal); then FDA
  - Phase IV/post-marketing

## Ongoing Clinical Trials

## Acute MI Trials

# Refractory Angina

# CHF Trials

# Stroke Trials

# PAD



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## Lessons Left to Learn

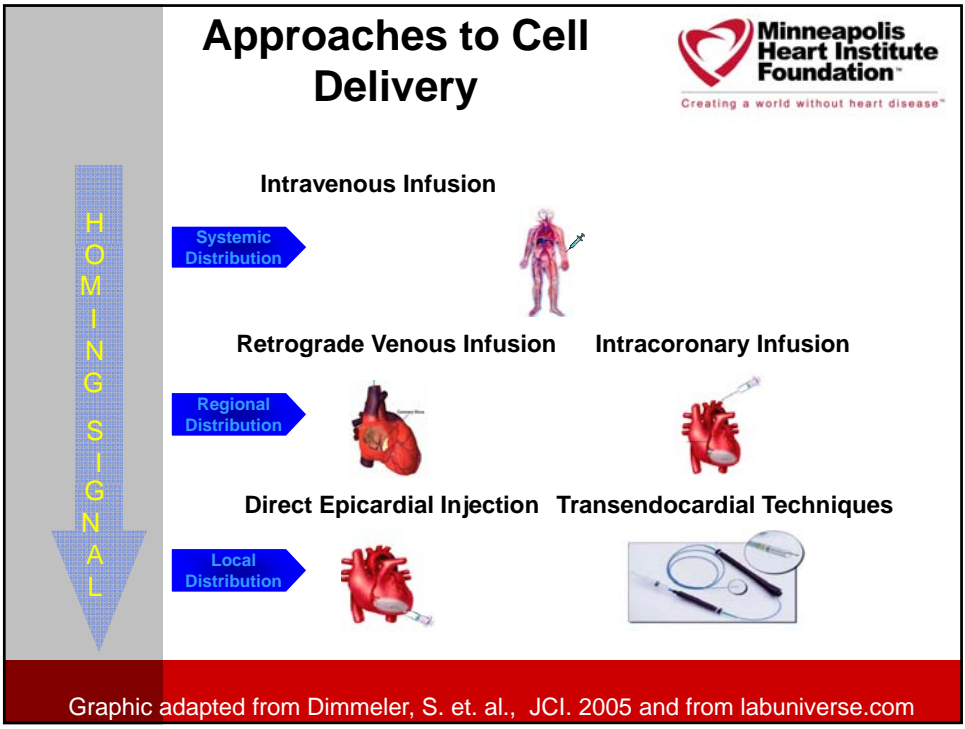
- Ideal Product
- Ideal Dose and Route of administration
- Ideal Patient
- Ideal Time points
- Ideal Endpoint
- Targeted Treatment Strategy



### Potential uses of Stem cells



# Approaches to Cell Delivery



Graphic adapted from Dimmeler, S. et. al., JCI. 2005 and from labuniverse.com