Ethics of Stem Cell Use
Historical Perspectives

• Major changes in regenerative medicine (replacement of damaged or diseased cells and tissues with new cells and tissues) due to advances in stem cell technologies

• Some stem cell therapies in existence for over 50 years. First successful bone marrow transplant done in 1956 on leukemia patient. Bone marrow contains adult-derived hematopoietic stem cells (able to regenerate tissues similar to the specialized tissues in which they are found.

• **Embryonic stem cells** believed to have greater potential. This line of stem cell research has been the most controversial.
IMPACT:

• Understanding birth defects
• Possibility of generating patient-specific stem cell lines to study the mechanism of different diseases in the laboratory
• Creation of models for drug discovery and testing the toxic effects of drugs
• Tissue engineering (e.g., use of progenitor cells to make artificial bladders)
• Does this alter the debate about the use of human ES cells or not?
Basic Characteristics of Stem Cells

A stem cell can:

1. **Self-renew**
2. **Differentiate** into a specialized cell type

Progenitor cell

Muscle cells

Red blood cells

How do cells remain self-renewing and unspecialized?

Stem cells properties:

1. Capable of dividing and renewing for long periods
2. They are unspecialized.
3. They give rise to specialized cells.

What are the **SIGNALS**?

Hormones

Growth factors

Small proteins

Adapted from *Stem Cells and Cloning* by Kelly A. Hogan;
http://stemcells.nih.gov/info/basics/basics2.asp
Different sources of stem cells during development

Adapted from Stem Cells and Cloning by K.A. Hogan

[P] = pluripotent
[M] = multipotent
[T] = totipotent

Teratomas (benign); Teratocarcinomas (malignant).
“Scientists Turn Human Skin Cells into Stem Cells”

Induction of Pluripotency:
From Mouse to Human

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Questions for discussion:

Who are the patients that would potentially benefit from advances in this growing industry?

What do patients need to know about treatment prospects?

What problems can be identified in this industry?

What solutions can be proposed to address these problems?

What is the value of regulation of this industry?

Can you envision any circumstances where regulations should be eased?
Ethics of Access

1. Organ Transplants

2. Orphan Drugs
Liang Yaoyi, age 11, had a dying wish to donate his organs so others could live. He lost his battle with brain cancer on Friday. As his body was wheeled from the surgery room to harvest his organs, the medical team bowed to honor him and the lives he saved.
Organ Wait List: United States
August 31, 2017

All Organs 127,530

Kidney 104,665

Number of Transplants (2016)

All Organs 33,611

Kidney 19,061

http://optn.transplant.hrsa.gov
Transplants* per million people
Selected countries, 2013 or latest

- Spain
- Norway
- United States
- France
- Britain
- Netherlands
- South Korea
- Turkey
- Canada
- Australia
- Switzerland
- Italy
- Germany
- Poland
- Iran
- Brazil
- Saudi Arabia
- Mexico
- Japan
- Cuba
- Singapore
- Russia
- Thailand
- South Africa
- China
- India
- Philippines
- Ukraine
- Indonesia
- Malaysia

- Kidney and liver transplants, which comprised almost 90% of all transplants in 2012

Sources: Global Observatory on Donation & Transplantation; WHO; ONT
Desperation & Cultural Prohibition

- Should people be allowed to sell their organs?

- What about cultural/religious prohibitions?

- National Policy: Opt-in or Opt-Out
Genetically engineered piglets free of retroviral sequences may provide safer organs for human transplant (Niu et al. (2017) Science).

A partially recellularized human whole-heart cardiac scaffold, reseeded with human cardiac cells derived from induced pluripotent stem cells, being cultured in a bioreactor that delivers a nutrient solution and replicates some of the environmental conditions around a living heart (Guyette et al. (2016))
DRUG PRICING
the PRICE is Right?
Hepatitis C & HARVONI

- An infection caused by a virus that attacks the liver and leads to inflammation. Most people infected with the hepatitis C virus (HCV) have no symptoms.

- In 20% of cases, liver cancer develops and is fatal

- 170,000,000 people

- October, 2014: FDA approves Harvoni, once-daily oral nucleotide analog polymerase inhibitor
Gilead Sciences: Harvoni

- Sales: $10 billion in 2015
- Cost of Treatment: $94,500/patient

Ethical Issues

- Who pays?
- Is the price justified?
- Relative cost?
Hepcinat LP cost about $3000, more than $90,000 less than original Harvoni.
Most Expensive Drugs: United States

- H.P. Acthar Gel (Multiple Sclerosis) $205,681/patient/year
- Cinryze (Hereditary Angioedema)* $230,826/patient/year
- Kalydeco (Cystic Fibrosis) $299,592/patient/year
- Naglazyme (Maroteaux-Lamy Syndrome)* $485,747/patient/year
- Soliris (paroxysmal nocturnal hemoglobinuria) * $536,629/patient/year

*orphan indication
In the News

- Martin Shkreli
  - CEO of Retrophin and Turing
  - Daraprim: toxoplasmosis
  - $13.50 to US$750 per pill overnight

- Michael Pearson
  - CEO of Valeant Pharmaceuticals
  - Nitropress: hypertension: 3-fold
  - Isuprel: bradycardia: 6-fold

- Heather Bresch
  - CEO of Mylan
  - EpiPen: 10-fold increase
Where are They Now

Shkreli: charged in securities fraud case, found guilty on multiple counts, not guilty on others. Awaiting sentencing.

Pearson: “all we care about is shareholder value.”
Price per share was $262 in August, 2015
Current price: $13.42

Bresch: still CEO
April 2017: class action suit for racketeering filed based on EpiPen pricing
Thank you for your time and attention
Innovation & Entrepreneurship

H. Ott, 2013, Nature Medicine

M. Little, 2013, Nature Biology