



# EARLY STEM CELL RESEARCH

## THE SCIENCE, ETHICAL ISSUES, AND POLICY CONSIDERATIONS

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The Center for Practical Bioethics' *Science and Ethics Literacy Project* is a two-year initiative designed to promote informed policymaking at the state and national levels and to increase science and ethics literacy across the United States.

### SEEKING CLARITY AND COMMON GROUND

**G**roundbreaking discoveries in stem cell research are bringing new hope to the prospect of treating and potentially curing some of the world's most devastating diseases. These recent advances in medical research are promising, but they are not without scientific hurdles and ethical challenges.

Research that uses stem cells harvested from the earliest forms of human life has become a particularly contentious topic. The public debate has been politicized, and even efforts to engage in rigorous analytical discussions have given way to emotionally charged arguments.

With a twenty-year history of building consensus on difficult issues, the Center for Practical Bioethics responded to this divisive topic by convening a multidisciplinary panel of international, national, and regional experts for a day of dialogue and consensus building.

What followed was an informed and at times heated exchange on key questions, such as:

- Are there viable alternatives to early stem cell research?
- What do we owe the earliest forms of developing human life?
- What do we owe the sick and suffering who could potentially benefit from the results of early stem cell research?
- How can we promote a well-informed public policy debate?

This policy briefing reports the outcomes of the roundtable discussion and presents information about the science, the ethical issues, and the policy considerations. The Center hopes to promote thoughtful policymaking by presenting the fundamentals of the science of early stem cell research, the variety of ethical arguments for and against it, and key public policy considerations.

### EARLY STEM CELL RESEARCH: WHY ALL THE CONTROVERSY?

In the 20th century, new drugs and medical technologies brought considerable benefits to society. Life spans increased and human health improved worldwide in part due to new medical treatments. Many of these treatments drew public concern, such as the initial testing and administration of vaccines and the replacement of sulfa drugs with antibiotics.

At the dawn of the 21st century, proponents of early human stem cell research profess it to be as important as these earlier medical advances. The convergence of new developments in the fields of genetics, developmental biology, and information technology has enabled early stem cell research to enter a new phase. Although the research is still in its infancy, experts believe this research could yield promising

treatments and cures for certain debilitating diseases and injuries.

Still, early stem cell research is not without controversy. Questions persist about the costs and benefits of its use, the possible intended and unintended consequences of the research procedures, the moral status of early life forms from which stem cells are harvested, and assurances that the benefits of this research will be distributed justly.

## GLOSSARY OF TERMS

**Blastocyst:** A thin-walled hollow sphere made up of an outer layer of cells, a fluid filled cavity, and an inner cell mass containing pluripotent stem cells. Also called the blastula, the blastocyst develops after cleavage and prior to implantation at approximately five days. The development into an embryo occurs *only* if the blastocyst is successfully implanted in the uterus.

**Blastomere:** A cell produced during cleavage of a fertilized egg.

**Cell Culture:** A technique for growing or maintaining cells on an artificial medium (substance) under laboratory conditions (e.g., Petri dish or test tube).

**Cleavage:** The early divisions of the fertilized egg.

**Cloning:** To create a copy. “Therapeutic cloning” creates a line of stem cells genetically identical to the originating cell for use in research. “Reproductive cloning” creates an organism genetically identical to the organism providing the originating cell.

**Embryo:** The developing human organism from the time of implantation in the uterus until the end of the eighth week after conception.

**Fetus:** A developing human from the eighth week of gestation to birth.

**Gamete:** A reproductive cell containing half of the genetic material necessary to form a complete human organism. During fertilization, male and female gametes (sperm and ovum, respectively) fuse, producing a zygote.

**Germ Cells:** Cells comprising actual reproductive components of a human organism (e.g., eggs, sperm).

**In Vitro:** A process that takes place in the laboratory (e.g., in cell culture).

**In Vitro Fertilization (IVF):** A technique in which an egg is fertilized outside the body. For use in assisted reproduction, the fertilized egg is implanted in the uterus at approximately three to four days of cell division for the purpose of development into a baby. For use in research, the fertilized egg is maintained in cell culture until it develops into the blastocyst stage at approximately five days of cell division.

**Inner Cell Mass:** The cluster of cells found inside the blastocyst that gives rise to all the cells of the body in the developing human organism.

**Morula:** A globular solid mass of cells (called blastomeres) formed by cleavage of a zygote.

**Multipotent Stem Cells:** Stem cells that can give rise to a limited number of other cell types. They are committed to becoming a variety of cell types associated with specific functions or organs/tissues (e.g., blood, heart, muscle) in the body. For example, blood stem cells give rise to red blood cells, white blood cells, and platelets.

**Placenta:** The oval spongy structure in the uterus from which the fetus derives its nourishment and oxygen. The placenta develops from the outer cell layer of the blastocyst, called the trophoblast.

**Pluripotent Stem Cells:** Stem cells that can develop into all the different cell types in the body except the placenta. They give rise to multipotent and unipotent stem cells as the embryo develops.

**Primitive Streak:** The beginning of the vertebral column in the human embryo that develops at approximately 14 days after conception.

**Somatic Cells:** Cells from the body other than sperm or egg cells.

**Somatic Cell Nuclear Transfer:** A laboratory procedure that produces a blastocyst by replacing the nucleus of a donated egg that has not been fertilized with the nucleus of an ordinary body (somatic) cell (e.g., from a single skin cell), which contains all the genetic information of an adult.

**Stem Cell Line:** Stem cells that have been growing in cell culture for six or more months without becoming specialized and appear genetically normal.

**Totipotent Stem Cells:** The master cells of the body that contain all the genetic information needed to create all the cells of the body and the placenta. Totipotent cells exist only in the first three to four divisions of the fertilized egg and give rise to the next stage of development — the pluripotent cells.

**Trophoblast:** The outer layer of cells of the blastocyst that attach to the uterine wall and give rise to the placenta.

**Unipotent Stem Cells:** Stem cells that can renew and give rise to only a single mature cell type.

**Wharton’s Jelly:** A gelatinous substance within the umbilical cord recently shown to be a potential source of stem cells.

**Zygote:** A cell formed by the union of two gametes.



## WHAT IS THE SCIENCE?

Many kinds of cells are found in all stages of human development. Some are more focused on a particular function than others and some are not specific and can give rise to all types of cells. These more flexible or undifferentiated cells are called “stem cells.”

Stem cells differentiate into more than 200 cell types, such as heart, muscle, brain, and blood, as the human embryo develops in the uterus. Stem cells also can remain unspecialized and ready to repair the wear and tear on the human body throughout a life time. These renewing or self-regenerating mature stem cells are found throughout the tissues of the body (e.g., in the lining of the stomach, skin, and blood). Researchers are studying how these mature stem cells renew our bodies. In particular, they are trying to determine how this renewing capacity is triggered and whether it can be awakened in any or all mature stem cells for specific clinical purposes.

The most fundamental and extraordinary of the stem cells are found in one of the earliest stages of human development known as the “blastocyst.” The blastocystic stage occurs after an egg is fertilized and goes through approximately five days of cell division.

In normal reproductive development, the blastocyst implants in the wall of the uterus, and if successfully implanted, develops into an embryo. The stem cells found in the inner cell mass of the blastocyst differentiate into all the tissues of the body as the human embryo develops.

In research, blastocysts are created in the laboratory and maintained in cell culture until the stem cells located in the blastocyst’s inner cell mass can be isolated and removed. Research is demonstrating that these stem cells are “pluripotent,” meaning they can be directed to differentiate into any tissue of the body. It is hoped that they will serve as a source for repairing diseased or injured tissue.

There are four categories of stem cells associated with the various stages of human development described in this brief, including: **early/blastocystic stem cells** (pre-implantation); **embryonic/fetal stem cells** (post-implantation); **umbilical cord/placental stem cells** (at birth); and **mature/adult stem cells** (from birth to death). To facilitate a better understanding of the science behind stem cell research, the following topics are addressed in this section:

- History of stem cell research,
- Potential applications of stem cell research, and
- Sources of pluripotent stem cells.

“If pursued diligently and responsibly, research with early human stem cells may lead to new therapies that repair damage-causing disabilities, such as spinal cord injuries, and degenerative diseases, such as Type 1 Diabetes, Parkinson’s, and Alzheimer’s.”



— William Neaves, PhD  
Stowers Institute for Medical Research

### Note on Terminology

The debate on early human stem cell research is fraught with confusing and conflicting language and terminology. The term “embryonic” is of particular concern because its use is inconsistent when describing early stem cell research. Some sources use the term “embryonic” to refer to the time from conception to development of the fertilized egg into a fetus. Other sources use the term “embryonic” to refer to the developmental stage that occurs only once the blastocyst successfully implants into the wall of the uterus and continues development. The second usage does not include the pre-implantation cellular formations within the meaning of “embryo”.

This brief adheres to the precise scientific language used to describe the biology of human development. Specifically, the terms “early stem cell” and “blastocystic stem cell” refer to stem cells isolated from a blastocyst created in a laboratory that is not implanted. The terms “embryonic stem cell” and “fetal stem cell” refer to stem cells isolated after the point at which the blastocyst implants in the uterus *and* after the developing embryo or fetus is aborted either spontaneously or electively. “Umbilical cord stem cell” and “placental stem cell” refer to stem cells isolated from the blood and tissues of the umbilical cord and placenta. The terms “mature stem cell” and “adult stem cell” refer to stem cells isolated from tissues of the body at any time after birth and until death.

Use of this terminology is intended to facilitate clarity and consistency within this public debate; however, the Center recognizes that use of precise terminology does not resolve ethical questions regarding the moral status of very early human life forms.



## WHAT IS THE SCIENCE?

### THE HISTORY OF STEM CELL RESEARCH

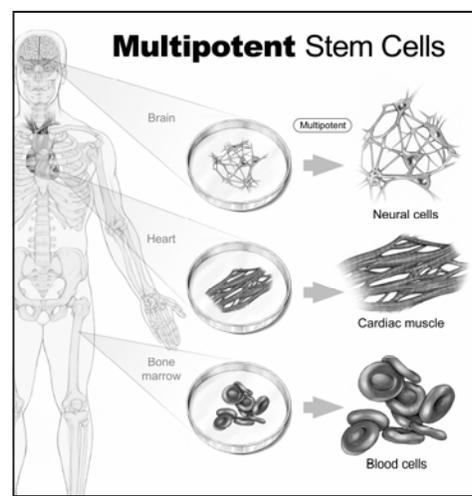
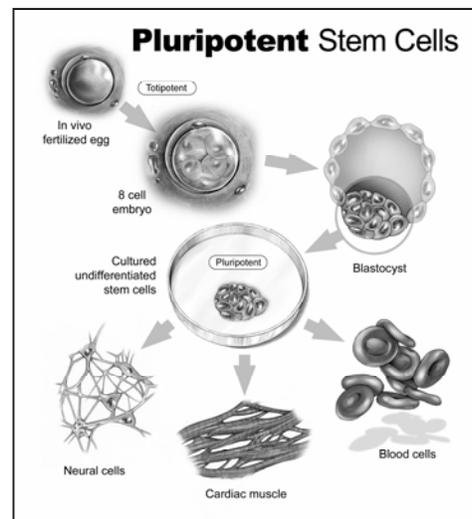
For more than 40 years, knowledge about stem cells has been accumulating worldwide. In the 1960s, researchers discovered that certain mouse cells could form multiple tissues, and in 1971, the first stem cells were identified in mice.

In humans, limited adult stem cell therapies are already in use. In the 1960s, researchers discovered that stem cell transplants of bone marrow for cancer patients could help patients restore tissue destroyed during chemotherapy and radiation therapy. According to the National Institutes of Health (NIH),<sup>1</sup> more advanced techniques of collecting and utilizing mature stem cells are now helping to treat leukemia, lymphoma, and several inherited blood disorders. The clinical potential of mature stem cells has also been demonstrated in the treatment of other human diseases, including diabetes, advanced kidney cancer, and heart disease. However, these newer uses have involved studies with a very limited number of patients and have yet to be confirmed in follow-up studies.

The discoveries in early human stem cell research are more recent. In November 1998, a team of researchers from the University of Wisconsin performed the first isolation, culture, and partial characterization of stem cells isolated from human blastocysts.<sup>2</sup> In February 2004, researchers from South Korea's Seoul National University conducted the first successful somatic cell nuclear transfer (SCNT) that created a human blastocyst from an unfertilized egg and produced a pluripotent stem cell line.<sup>3</sup>

"In FY 2004, the U.S. federal government supported \$24 million for early stem cell research as compared to \$203 million for all other types of stem cell research."

— James Battey, MD, PhD  
National Institutes of Health



Illustrations by Robert F. Morreal  
Provided courtesy of  
The Stem Cell Research Foundation

### POTENTIAL USES OF STEM CELL RESEARCH

Despite the biomedical research advances of the last 50 years, much is still left to be discovered in human biology. Early stem cell research is viewed as a key to understanding many of the most fundamental questions in basic and clinical biology that can lead to treatments and cures.

Supporters of early stem cell research believe it can help scientists to better understand how early human cells become differentiated and drive normal functioning in adults. With a better understanding of early cell development, researchers expect to increase their knowledge of why cells behave abnormally and produce diseases such as cancer. Research on early human stem cells may also reduce a number of barriers posed by animal studies.

Supporters contend that pluripotent stem cells in particular could be used to create an unlimited supply of cells, tissues, or even organs that could be transplanted to restore function lost to disease and injury. While early human stem cell research is still in its infancy and specific treatments have not yet been developed, many experts expect treatments will be possible in the future for the following types of illnesses, injuries, and diseases: Type 1 Diabetes in children; nervous system diseases, such as Parkinson's and Alzheimer's, and spinal cord injuries; primary immunodeficiency disease; diseases of bone and cartilage; and cancer.

## EARLY/BLASTOCYSTIC STEM CELLS

### Timing

- Isolated from the inner cell mass of a blastocyst in a laboratory after approximately five days of cell division

### Sources

- Blastocyst created by *in vitro* fertilization (IVF) — either donated by consenting adults for research purposes once the blastocysts are no longer needed for reproductive purposes or created for the sole purpose of research
- Blastocyst generated in a lab without fertilization by somatic cell nuclear transfer (SCNT)

### Characteristics

- *Pluripotent*: Retain the special ability to develop into nearly any cell type
- Easy to grow in cell culture and multiply into many stem cell lines that can be maintained for long periods of time

### Potential Use

- Unlimited source of potentially all types of clinically relevant cells

## MATURE/ADULT STEM CELLS

### Timing

- Isolated from mature tissues after birth and until death

### Sources

- Mature tissues including brain, bone marrow, blood vessels, skeletal muscles, skin, and liver — the specific sources within each tissue type are not well understood yet

### Characteristics

- *Multipotent*: Can develop into the cell types of the tissue or organ from which they originate (There is some evidence that certain mature stem cells may have more pluripotent characteristics than earlier research has shown.<sup>4</sup>)
- Primary role is to maintain and repair the tissue in which they are found
- Difficult to isolate from adult tissues and grow in cell culture for long periods of time

### Potential Use

- Source of specific, clinically relevant cells

## PLURIPOTENT STEM CELL SOURCES

**P**luripotent stem cells are primarily derived from blastocysts created by the *in vitro* fertilization (IVF) process. However, pluripotent stem cells were first derived from SCNT-blastocysts in 2004, and research is ongoing on the pluripotent characteristics of stem cells associated with embryonic/fetal germ cells, as well as the umbilical cord and placenta.

### IVF-Blastocysts

Blastocysts, produced via IVF, are the predominant sources of pluripotent stem cells. When used for reproductive purposes, these early forms of life — sometimes called preembryos — are typically implanted or frozen at two to three days of cell division. Numerous fertility clinics report that recent

developments in IVF methodology allow these cells to develop *in vitro* an additional two days. Implanting the preembryo at the blastocyst stage is expected to increase success rates and reduce multiple births, but use of this technique is not yet widespread.

The IVF process often creates more preembryos than a couple chooses to implant. In 2003, a study conducted for the Society for Assisted Reproductive Technology and the RAND Corporation documented nearly 400,000 frozen preembryos in the United States.<sup>5</sup> Persons with excess preembryos currently have the option of donating them to other infertile couples, destroying them, or donating them for research purposes.

### SCNT-Blastocysts

SCNT is a laboratory procedure that produces a blastocyst from an unfertilized egg and an ordinary adult somatic cell (e.g., from a single skin cell). SCNT substitutes the nucleus of a somatic cell (which contains all the genetic information of the patient) for the nucleus of a donated egg that has *not* been fertilized. In cell culture, this customized egg is then coaxed with an electronic or chemical catalyst to develop into a zygote as if it had been fertilized. The zygote begins cell division and develops into a ball of cells called the morula and then into the blastocyst at approximately five days. The inner cell mass of the blastocyst is then removed to generate a pluripotent stem cell line. After

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## WHAT IS THE SCIENCE?

### PLURIPOTENT STEM CELL SOURCES

*Continued from page 5*

the inner cell mass is removed, the blastocyst is no longer capable of further development.

The SCNT methodology is still in its infancy. Researchers hypothesize that when the genetic information from the cells of a patient are used, the pluripotent stem cells will be able to make customized tissue that will not be rejected by the patient. SCNT researchers contend that the knowledge gained about developmental biology via the SCNT methodology will allow future researchers to create individualized pluripotent stem cell lines without needing IVF-blastocysts or eggs as sources.

#### Embryonic/Fetal Germ Cells

Embryonic/fetal stem cells are isolated from the germ cells within the gonadal tissues (i.e., what will become the ovaries or testicles) of an embryo or fetus spontaneously or electively aborted at approximately five to nine weeks of gestation. These stem cells are considered pluripotent with some limitations — they

retain the special ability to develop into any cell type but not to the same level as early stem cells. Research is limited in this area and the related stem cells are not well understood.

#### Umbilical Cord and Placenta

Stem cells from blood and tissues associated with the umbilical cord and placenta are potentially useful in research and the treatment of severe blood disorders and cancer. However, these research areas are still largely investigational. To date, umbilical cord blood has been the primary focus of this type of stem cell research. Indeed, many parents of newborns are now saving it in cord blood banks for future use.

Researchers suggest that stem cells from

cord blood offer important advantages over mature stem cells retrieved from bone marrow.

A recent study revealed that stem cells can also be isolated from the Wharton's Jelly, a soft connective tissue associated with the umbilical cord.<sup>6</sup> Umbilical cord blood is thought to contain a small number of stem cells, whereas, the Wharton's Jelly and the placenta have been shown to have much larger quantities. Research is demonstrating that the placenta's stem cells have pluripotent characteristics.<sup>7,8</sup> However, it is unclear whether these stem cells are as pluripotent as early stem cells. Research on stem cells isolated from the umbilical cord and placenta moments after birth is limited, and behavior of these cells in the laboratory is not well understood.

"I would like to see in every hospital a bank of stem cells... both early and adult. One might be better for one disease, one for another. Like a blood bank, a doctor could call for seven grams of stem cells, perhaps differentiated towards a nervous or cardiac therapy...it would be there for use by every patient."

— Anne McLaren, DBE, DPhil, FRS

*The Wellcome Trust/Cancer Research Institute, University of Cambridge (UK)*



### CAN MATURE STEM CELLS BE PLURIPOTENT?

Unlike early stem cells, there is no evidence to date that any mature stem cells are capable of forming *all* cells of the body. However, recent studies<sup>4</sup> have demonstrated that mature stem cells may be more flexible than previously thought. More studies are necessary to validate these results.

What is known to date is that mature stem cells are primarily multipotent and can be found in many of the tissues of the human body, if not all. The mature stem cell is an undifferentiated (unspecialized) cell that is found in a differentiated (specialized) tissue. Mature stem cells can renew themselves for a lifetime and become specialized to yield all of the cell types of the tissues from which they originate. Sources of mature stem cells have been found in the bone marrow, blood stream, cornea and retina of the eye, the dental pulp of the tooth, liver, skin, gastrointestinal tract, and pancreas. The mature stem cells associated with those that form blood in bone marrow are the most common type of stem cell used to treat human diseases today.

## EARLY VS. MATURE STEM CELL RESEARCH

At this point, the research community does not view early and mature stem cells as interchangeable. The research efforts are considered complementary, and both are needed to further regenerative medicine and find cures to devastating diseases and injuries. Both types of stem cells offer advantages and disadvantages.

EARLY STEM CELL RESEARCH		MATURE STEM CELL RESEARCH	
Advantages	Disadvantages	Advantages	Disadvantages
<b>Immortal:</b> Cell line remains intact for long periods of time, producing an endless number of cells.	<b>Immune rejection:</b> The immune profile of a stem cell derived from an IVF-blastocyst does not match that of the potential recipient and may be rejected.	<b>Immune:</b> If patients receive their own stem cells, an immune response is unlikely.	<b>Limited longevity:</b> Difficult to maintain in cell culture for long periods of time.
<b>Easy to isolate:</b> In a laboratory, stem cells are relatively easy to extract from the blastocyst's inner cell mass.	<b>Difficult to control:</b> Require many intermediate steps to coax into the desired cell type.	<b>Some availability:</b> Some types, like blood stem cells, are easy to find.	<b>Difficult to isolate:</b> Many types are difficult to find and extract from mature tissues.
<b>Very flexible:</b> Can make any body cell.		<b>Partly specialized:</b> Requires less coaxing to create specialized cells.	<b>Unknown:</b> Not all types of mature stem cells have been found yet.
<b>Readily available:</b> IVF-blastocysts no longer needed for reproductive purposes are plentiful worldwide; SCNT methodology opens up new sources.			<b>Limited flexibility:</b> Cannot develop into any cell type to date.
<b>Immune:</b> SCNT methodology eliminates immune rejection potential since patient's tissues are used to create stem cells.			<b>Uncommon:</b> Not very common, and grow more scarce with age.
<b>Opportunities:</b> Provides insight into early cell development.			<b>Questionable quality:</b> Genetic defects may occur after exposure to sunlight or toxins; or targeted disease may be present in stem cell genes.

“The contest is not between early stem cells and adult stem cells. The contest is between society and disease. We should be moving forward on all fronts: adult *and* early stem cell research. Whatever pays off the best is what we should be using.”

— Steven Teitelbaum, MD  
Washington University—St. Louis





## WHAT ARE THE ETHICAL ISSUES?

Medical advances often raise as many new questions as they answer. Stem cell research is no exception. Research with early human stem cells is particularly challenging because it places two basic ethical duties in tension: the duty to heal and relieve suffering and the duty to pursue promising research in ways that respect and protect human life.

For some, stem cell research evokes little ethical concern because the human material from which the stem cells are harvested is considered little more than a “ball of cells in a Petri dish.” The opportunity to use these cells to find cures for serious, debilitating disease is the overriding duty.

For others, the “ball of cells” is a potential human life that should not be compromised, regardless of the benefit to humankind, and especially by a science in its infancy.

In the middle are those who recognize the blastocyst as a potential human life, but argue that its destruction can still be justified ethically if research is regulated to ensure respectful treatment of these early human life forms. Many observers also recognize that most excess IVF-blastocysts are destined for destruction anyway, and argue pragmatically that they should be used for stem cell research.

The following ethical issues are central to this debate:

- Moral status of developing human life
- Informed consent for IVF-blastocyst and egg procurement
- The role of public funding
- Just distribution of potential new therapies

## MORAL STATUS OF DEVELOPING HUMAN LIFE

Theologians and ethicists have debated the moral status of the earliest forms of human life within and outside the early stem cell research debate. The range of perspectives are represented generally by three positions:

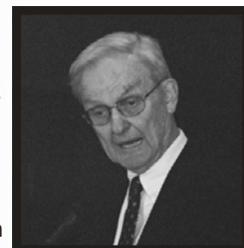
**Full Status:** From the moment of conception the self-directed, developing cell mass that leads to an embryo and ultimately a fetus possesses full moral status and deserves full protection.

**Developmental (Partial) Status:** As the organism evolves biologically, it incrementally gains moral status. The early stages do not warrant the same moral protections as that of a viable fetus or newborn.

**No Status:** Very early forms of the human being possess no moral status.

“Is the blastocyst...from the get-go one of us? The blastocyst is more than a yard lot of building materials. It is a cluster of cells moving toward, if implanted, nourished and protected, a human life. In removing it through research from the circle of life, we cannot remove it from the circle of human indebtedness.”

— William F. May, PhD  
University of Virginia



## CAN BIOLOGICAL MARKERS GIVE US GUIDANCE?

The development of the *primitive streak* in the embryo at about 14 days is considered by many to be an important biological marker. It indicates the development of the vertebral column, meaning that the human organism may now be able to feel pain and is fully individuated — further division into an identical twin is no longer possible.

Many proponents of early stem cell research believe embryos gain partial moral status at this point and deserve special respect, although not the same level of protections afforded to living human subjects. Since stem cells are isolated from the blastocyst prior to 14 days of development, they consider this form of research ethically acceptable.

## WHAT DUTIES DO WE OWE DEVELOPING HUMAN LIFE?

Many people agree the earliest forms of the human organism deserve some form of respect, however, several questions remain:

- What does it mean to respect developing, potential life and what form should that respect take?
- What actions and levels of protection convey respect toward the organisms in the earliest stages of human development?
- Are some early forms of human organisms — because of their circumstances, origins, or prospects — to be treated the same or differently from others?

### INFORMED CONSENT FOR IVF-BLASTOCYST AND EGG PROCUREMENT

Like organ donation, the practice of obtaining informed consent from donors of unused IVF-blastocysts and eggs for SCNT is central to whether the materials for stem cell research can be made available in an ethical manner.

The practices of U.S. fertility clinics are currently not governed by federal regulations, though the American Society of Reproductive Medicine (ASRM)<sup>9</sup> and the American Association for the Advancement of Science (AAAS)/Institute for Civil Society (ICS)<sup>10</sup> have published detailed ethics guidelines for obtaining IVF blastocysts for research purposes. There is general agreement on several matters. To protect against inappropriate pressures, decisions to donate IVF-blastocysts for research should be made after couples or women decide to no longer store them for reproductive purposes; when possible, someone other than the fertility specialist should obtain consent for research donation; the specific purposes of the research study should be disclosed; and there should be no payment for the IVF-blastocysts or reduced fees for their infertility procedures if they are willing to donate the excess IVF-blastocysts to research.

Recent successes in using SCNT to create blastocysts for early stem cell research have raised questions about ensuring informed consent for donated eggs as well. Some have expressed concern that pressure to obtain eggs for use in SCNT may lead to coercive and exploitative practices. These pressures may stem from the life and death situations of loved ones in need of donated eggs to produce individualized therapeutic stem cells with SCNT, or payments for eggs to meet the needs of the scientific community more generally. Others are less concerned, arguing that there are enough well-informed women willing to donate eggs. Either way, most observers acknowledge that regulations to protect the integrity of the informed consent process will be necessary.

“A critical question for us to think about is what kinds of individuals and communities do we become if we are willing to sacrifice incipient human life for our own benefit, for our own ends, even though those ends are extremely good ends.”

— Ron Hamel, PhD  
Catholic Health Association



### THE ROLE OF PUBLIC FUNDING

There is considerable consensus within the scientific community that without support from the NIH or another source of public funding, progress in creating viable and diverse early stem cell lines will be constrained severely. There are also concerns that without public funding, the federal and state governments may lose an opportunity to regulate and monitor the development of the research, and ensure an open scientific exchange, peer review, and public involvement and oversight.

Critics charge that taxpayer dollars should not be used to fund controversial research, and funding early stem cell research will divert funds for mature stem cell research. However, federal funding for mature stem cell research is significantly higher than what is provided to support early stem cell research.

“Perhaps one of the greatest ways we can demonstrate respect for the sanctity of life is to allow those blastocysts, which will not be used to create children, to be used for other purposes from which there can be benefit to mankind.”

— Greg Koski, MD, PhD  
Massachusetts General Hospital, Harvard Medical School





## WHAT ARE THE ETHICAL ISSUES?

### JUST DISTRIBUTION OF POTENTIAL NEW THERAPIES

There are serious ethical concerns that the potential benefits of stem cell research will not be distributed justly. Barriers to ethical distribution among U.S. citizens with healthcare insurance include the potential high cost of individualized stem cell-based therapies and reluctance by healthcare insurers to cover such novel treatments. More deeply entrenched barriers exist for the nearly 45 million U.S. citizens who lack healthcare insurance altogether. The restriction or elimination of public funding at the state and national levels will further entrench these barriers. At the global level, even more challenging problems of access are evident.

Each medical advance that adds to the ever expanding arsenal of high tech U.S. healthcare treatments raises questions of justice because of the nation's failure to address equitable access to basic care. Stem cell research of any type is no exception. This failure is a serious ethical issue that has received little public discussion or media coverage.

"We live in a culture that is enamored by scientific progress. Yet despite high levels of funding for research and healthcare, we still haven't overcome the many barriers to distributing the benefits of the results to all that need them."

— MC Sullivan, RN, MTS, JD  
Center for Practical Bioethics



## DOES SCNT SOLVE ANY OF THE ETHICAL DILEMMAS?

New approaches to early stem cell research like SCNT do not require the destruction of a developing fertilized egg. Although this solves the ethical challenges for some, others contend that SCNT is not without ethical questions.

### What is the SCNT-blastocyst?

For some, SCNT does not yet dispel concerns about creating a form of "life" for the express purpose of destroying it for research use. Some critics charge that even though the SCNT-blastocyst is not derived via fertilization, it nonetheless creates a potential human being. Others contend that no new life is created by SCNT — the SCNT-blastocyst is "alive" and human, but not "a life." They assert that the procedure works entirely with the ordinary body cells of a living person and no more creates new human life than does growing someone's skin cells in tissue culture.

### Will SCNT enable the cloning of humans?

Critics charge that advances made in the laboratory with SCNT methodology will be used for reproductive purposes in humans. SCNT is the technique that was used to create "Dolly," the cloned sheep,<sup>11</sup> and some worry will be expanded for use in humans. Currently, there is no evidence of SCNT being used successfully to

produce a healthy, viable human child. Even in animal models, genetically sound cloned animals have not been produced.

Numerous SCNT researchers question the ability of SCNT to lead to a healthy, genetically sound cloned human being because of the vast complexities of the human organism and the genetic changes that take place when the somatic cell nucleus is placed in the denucleated egg, a process they contend renders normal development unlikely. In general, there appears to be moral consensus in the public and scientific community that cloning humans is unethical and should be banned.

### Will the costs of SCNT-based treatments be prohibitive?

Despite the promise of SCNT to make patient-specific stem cells, there are concerns that the use of SCNT-based treatments will be cost prohibitive in a clinical setting. Many researchers acknowledge this limitation. However, they suggest that the knowledge gained from SCNT methodology will eventually enable them to circumvent the costly aspects and allow individualized therapies at a more reasonable cost. They also hope to learn enough about the unique environment provided by the egg to no longer need fertilized and unfertilized eggs as an incubator for pluripotent stem cells.



## WHAT ARE THE PUBLIC POLICY CONSIDERATIONS?

Public policy on early stem cell research is being developed at many levels, from national commissions, to state taskforces, to professional guidelines, as well as in the halls of the U.S. Congress and the state legislatures. At the executive level, both Presidents Bill Clinton and George W. Bush relied on their respective commissions and councils on bioethics to provide guidance.

In August 2001, President George W. Bush issued an executive order on early stem cell research that limited federal funding to only research on stem cell lines created prior to August 9, 2001. Up until that time, early stem cell research had been ineligible for federal funding per a 1995 appropriations bill.

Defenders of the policy herald it as an appropriate compromise that avoids future destruction of developing human life with public money, but allows this promising research to continue. Critics of the Bush policy argue that it is arbitrary, unsustainable, and inconsistent.

Many critics point to the question of whether the existing early stem cell lines eligible for federal funding are capable of supporting the research scientists desire to perform. In August 2001, it was thought that 65 viable stem cell lines existed and would be eligible for federal research funds. However, since that time, only approximately 22 stem cell lines have proven viable. A study published in January 2005<sup>12</sup> indicated that many of the approved stem cell lines have been contaminated by the animal-based cell cultures in which they are grown. The contamination makes them likely to be incapable of supporting clinical studies in humans, which presents a major barrier to developing therapies for clinical application.

### WHAT IS THE ROLE OF RELIGIOUS BELIEFS IN PUBLIC POLICY?

Because stem cell research is objectionable to some on religious grounds, it poses an especially difficult challenge to policymakers in pluralistic democracies, such as the United States. Public policy within these types of democracies aims to protect and promote basic values essential to civic order and the pursuit of widely different conceptions of good, as represented by the many diverse religious faiths and belief systems within society. Basing public policy explicitly on a particular religious perspective, especially when widespread moral disagreement exists, is neither practical nor desirable.

At the federal and state levels, a range of legislation has been proposed. The U.S. Congress is considering bills that would loosen President Bush's executive order, as well as those that would prohibit various forms of the research, some of which go as far as criminalizing it. At the state level, a similar range of legislation has been put forward for consideration, including bills that would provide extensive state funding for early stem cell research.

While not directly aimed at regulating early stem cell research, the legislative proposals that ban human cloning potentially affect the use of SCNT as a means to isolate early stem cells. Specifically in these legislative proposals, the use of SCNT for therapeutic purposes is often not distinguished clearly from reproductive cloning of humans. The vague wording has drawn the scientific community into this debate, calling for clearer language and voicing concerns about the anti-science precedent set by banning therapeutic cloning. They have suggested that banning SCNT for therapeutic research purposes casts a shadow over a state's ability to be considered a center of excellence in the sciences and attract world class scientists.

The remainder of this section addresses the following three policy questions:

- What is the role of religious beliefs in public policy?
- How does U.S. stem cell policy compare to other countries?
- How are U.S. states approaching stem cell research policy?

"There are a lot of ways in which a democratic society can operate without a full moral consensus. If we wait for moral consensus on these tough ethical questions then that is a recipe to freeze ourselves in our tracks. But if we have achieved a level of respect for those who have made a powerful argument, while agreeing to disagree, we can move forward."



— Jonathan D. Moreno, PhD  
University of Virginia



## WHAT ARE THE PUBLIC POLICY CONSIDERATIONS?

### HOW DOES U.S. STEM CELL POLICY COMPARE TO OTHER COUNTRIES?

Whether or not the United States permits early stem cell research of any sort, this research will continue in other countries. The research community is concerned that bans on early stem cell research at the state and national levels will leave talented U.S. scientists with no choice but to conduct their research abroad.

Prohibit all early stem cell research	Permit research only on existing early stem cell lines	Permit creation of and research on <i>only</i> early stem cells derived from excess IVF-blastocysts	Permit only creation of and research on early stem cells derived by SCNT-blastocysts	Permit creation of and research on early stem cells derived via excess IVF-blastocysts and SCNT-blastocysts
Austria, Ireland, Italy, Lithuania, Norway, Poland, Portugal, Slovak Republic	France, Germany ( <i>limited to imported stem cell lines</i> )	Australia, Brazil, Canada, Czech Republic, Denmark, Estonia, Greece, Hungary, Iceland, Iran, Latvia, Russia, Slovenia, Spain, Sweden, Switzerland, Taiwan	Finland	Belgium, China, India, Israel, Japan, South Korea, The Netherlands ( <i>moratorium on SCNT</i> ), United Kingdom

International Policy Sources: Roundtable meeting presentations by Anne McLaren, DBE, DPhil, FRS, Wellcome Trust/Cancer Research Institute, University of Cambridge (UK) and Jonathan D. Moreno, PhD, University of Virginia; Walters, L. 2004. Human Embryonic Stem Cell Research: An Intercultural Perspective. *Kennedy Institute of Ethics Journal* 14(1): 3-38.

### HOW ARE U.S. STATES APPROACHING STEM CELL RESEARCH POLICY?

Fifteen states currently have laws that range from the prohibition to the support of all or some types of early stem cell research and in some cases significant state funding for that research. Of the 35 states with no laws regulating the use of early stem cells for research purposes, 24 are considering a similar range of proposals in 2005.

Current Law	Prohibit all early stem cell research	Prohibit creation of and research on SCNT-blastocysts; silent on IVF-blastocysts	Permit creation of and research on early stem cells derived from excess IVF- and SCNT-blastocysts
	Florida, Iowa, Louisiana, Maine, Massachusetts, Michigan, Minnesota, North Dakota, Pennsylvania, Rhode Island, South Dakota	Arkansas, Virginia	California (\$350M per year funding), New Jersey
Pending Legislation	Prohibit all early stem cell research	Prohibit "human cloning" and includes use of SCNT for research	Permit creation of and research on early stem cells derived from IVF- and SCNT-blastocysts
	Arizona ( <i>limited to board of regents; small business funding</i> ), Kentucky, Michigan, Mississippi, Nebraska, Texas	Alabama, Arizona, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Mississippi, Missouri, Nebraska, New York, Tennessee, Texas, Washington, West Virginia	Connecticut ( <i>funding, but not reproductive cloning</i> ), Florida ( <i>funding, but only within NIH guidelines</i> ) Hawaii, Illinois ( <i>funding, but not for creating IVF-blastocysts for research purposes</i> ), Maryland, Massachusetts, Minnesota, Montana, New York, Pennsylvania, Rhode Island, Virginia

Current Law Sources: Roundtable Meeting presentation by Jonathan D. Moreno, PhD, University of Virginia; Walters, L. 2004. Human Embryonic Stem Cell Research: An Intercultural Perspective. *Kennedy Institute of Ethics Journal* 14(1): 3-38.

Pending Legislation Source: Biotechnology Industry Organization's *State Cloning Legislation 2005*, Updated March 10, 2005.

## TIPS FOR POLICYMAKERS

- Recognize this policy discussion is not an “either/or” situation.
- Take time to educate yourself and your constituents about the science, ethics, and religious perspectives, and the recommended professional guidelines on this type of research.
- Determine what types of early stem cell research are being conducted in your state, if any. Consider establishing a public registry of early stem cell research protocols.
- Call upon a diverse pool of experts from all sides of the debate to provide information and views about the science, ethics, and religious perspectives.
- Ascertain the informed values and positions of your constituents.
- Become knowledgeable about how other jurisdictions (both within and outside the United States) are managing this issue.
- Learn how scientific information is presented in the literature. Avoid relying on single scientific articles, especially those that are recent and may not have been validated yet through the accepted scientific replication process.
- Consider using policy mechanisms such as task forces and commissions to study the issue prior to enacting legislation. Establishing an independent advisory group to provide ongoing counsel and updated information is also recommended.
- Avoid premature legislation, especially when widespread disagreement exists.

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## THE SCIENCE AND ETHICS LITERACY PROJECT

Society is increasingly polarized over advancing technology and the ethical implications these developments present. Debates over these issues have become inflamed with uninformed rhetoric that often confounds any attempt for civil discourse to find common ground.

The Center for Practical Bioethics, in keeping with its mission of raising and responding to ethical issues in health and healthcare, launched the two-year Science and Ethics Literacy Project in early 2005. The goals of the project are to promote informed policymaking at the state level and increase science and ethics literacy across the United States.

Realizing the potential of scientific advances requires a common understanding of the issues involved and the implications and

consequences of our choices. This is especially true of genetic discoveries and stem cell research. Through the Science and Ethics Literacy Project, the Center plans to create a place for communities to work together and discover practical solutions in the life sciences that rest on the bedrock of human dignity.

The two-year project will have four phases that aim to clarify and establish the context for an informed and civil discussion of the ethics and choices involved in the life sciences and scientific research. The four phases of the project will involve roundtable conversations with experts from international, national, and regional perspectives, community forums, and the dissemination of policy briefs nationwide on the following topics:

- Early stem cell research
- Responsible conduct of human research
- DNA screening
- To be determined

In order to maintain flexibility in a rapidly changing environment, the Center will announce the fourth subject for the series in late 2005.



Photo: Participants at the January 14, 2005, Roundtable Meeting

### The Kansas City Roundtable Meeting

The Center for Practical Bioethics' roundtable meeting on stem cell research was held on January 14, 2005. Participants included international, national, and regional experts representing government, leading academic centers, bioethics, theology, the medical and legal professions, and community advocacy. The day-long session included an examination of scientific and ethical issues, a review of policy making in the United States and the United Kingdom, and a presentation of the National Academy of Sciences' recommendations.

#### Participating Thought Leaders

**James F. Battey, MD, PhD** — National Institutes of Health

**Myra J. Christopher** — Center for Practical Bioethics

**William P. Duncan, PhD** — Kansas City Area Life Sciences Institute

**Ron Hamel, PhD** — Catholic Health Association

**Cheryl Jernigan** — Community Advocate

**John F. Kilner, PhD** — Center for Bioethics and Human Dignity

**Greg Koski, MD, PhD** — Massachusetts General Hospital, Harvard Medical School

**William F. May, PhD** — University of Virginia, Institute for Practical Ethics and Public Life

**Anne McLaren, DBE, DPhil, FRS** — The Wellcome Trust/Cancer Research Institute, University of Cambridge (UK)

**Jonathan D. Moreno, PhD** — University of Virginia, Center for Biomedical Ethics

**William Neaves, PhD** — Stowers Institute for Medical Research

**Gary Pettett, MD, FAAP** — Children's Mercy Hospital and Clinics, University of Missouri/Kansas City, Center for Practical Bioethics

**M.C. Sullivan, RN, MTS, JD** — Center for Practical Bioethics

**Steven Teitelbaum, MD** — Washington University—St. Louis

**David J. Waxse, JD (Moderator)** — United States District Court

## ADDITIONAL RESOURCES

Committee on the Biological and Biomedical Applications of Stem Cell Research, Board on Life Sciences National Research Council, Board on Neuroscience and Behavioral Health Institute of Medicine. 2002. *Stem Cells and the Future of Regenerative Medicine*. National Academy Press.

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## THE SCIENCE AND ETHICS LITERACY PROJECT: POLICY BRIEFING SERIES

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For more information on the Science and Ethics Literacy Project Briefing Series or to obtain additional copies, please contact Lorell LaBoube at 816/221-1100 or [llaboube@practicalbioethics.org](mailto:llaboube@practicalbioethics.org).

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Founded in 1984, the Center for Practical Bioethics is an independent organization nationally recognized for its work in practical bioethics. More than a think tank, the Center puts theory into action to help people and organizations find real-world solutions to complex issues in health and healthcare.

The Center is a free-standing practical bioethics center with a vision of a society in which the dignity and health of all people is advanced through ethical discourse and action. Its mission is to raise and respond to ethical issues in health and healthcare, and its core value is respect for human dignity. The Center believes that all people have intrinsic worth, and expresses this belief by promoting both autonomy and social justice in health and healthcare.

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Photos from top left to bottom right: Ron Hamel, William Neaves, Jonathan Moreno, Myra Christopher, Cheryl Jernigan, Greg Koski, John Kilner, William Duncan, Gary Pettett, M.C. Sullivan, Steven Teitelbaum, and James Battey.

**INSIDE:  
EARLY STEM CELL RESEARCH –  
THE SCIENCE, ETHICAL ISSUES,  
AND POLICY CONSIDERATIONS**



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