Montana State Legislature

Exhibit Number: 18

This exhibit exceeds 10-page maximum; therefore only a small portion of the exhibit is scanned for your research. The original exhibit is on file at the Montana Historical Society and may be viewed there

Montana Historical Society Archives, 225 N. Roberts, Helena, MT 59620-1201; phone (406) 444-4774. For minutes in paper format, please contact the Montana State Law Library, Justice Building, 215 N. Sanders, Helena, MT 59620; (406) 444-3660. Tapes and exhibits are also available at the Historical Society (tapes are retained for five years). Scanning done by: Susie Hamilton

HAS RESEARCH USING ADULT STEM CELLS EVER ACCOMPLISHED ANYTHING?

Thousands of lives have been saved by adult stem cells—most often in the form of "bone marrow transplants" for leukemia and other conditions (where the active ingredient in the bone marrow is stem cells). Today, adult stem cells have been used to help people with Parkinson's disease, spinal cord injury, sickle-cell anemia, heart damage, corneal damage, and dozens of other conditions. The danger is that this progress toward cures will be halted or slowed by campaigns that divert attention and resources toward embryonic stem cell research.

CAN STEM CELLS BE STORED IN A BANK?

Yes, like donated blood or bone marrow, they can be frozen and banked. In 2003, for example, Congress approved funds to help create a nationwide umbilical cord blood stem cell bank, in light of the many clinical benefits being discovered from these cells now usually discarded after live births. Many of the embryonic stem cell samples eligible for federally funded research under the current policy also remain frozen in banks, to be thawed and turned into stem cell lines when needed.

WHAT IS A STEM CELL LINE?

It is an ongoing, living colony of stem cells in a laboratory, from which cells can be obtained for research or other uses. Sometimes these are called "immortal" cell lines, but that is misleading because they do eventually deteriorate. Embryonic stem cells are said to be easier to grow in a stem cell line, but they also tend to develop serious genetic abnormalities associated with cancer.

WHAT ARE THE ADVANTAGES OF HARVESTING DONOR CELLS FROM THE INTENDED RECIPIENT OF THE STEM CELL THERAPY?

Because these cells come from the patient, they are an exact match and will not be rejected by the body as foreign tissue. Also, because no foreign substance is placed in the body, there are fewer regulatory barriers to their medical use.

WHO IS FUNDING STEM CELL RESEARCH? WHAT ROLE IS FEDERAL FUNDING PLAYING IN DETERMINING RESEARCH PRIORITIES?

Many private foundations and for-profit biotechnology companies fund stem cell research, but the federal government (especially through the National Institutes of Health) remains the largest source of funds. The government's funding priorities have a large influence on the direction that medical research takes. Since available research funds began being diverted toward exploring embryonic stem cell research, some very promising adult stem cell avenues for treating juvenile diabetes, spinal cord injury, Parkinson's disease, etc. have been underappreciated and underfunded. Many advances in these fields have emerged from other countries.

WHAT IS HUMAN CLONING AND HOW IS IT RELATED TO STEM CELL RESEARCH?

In human cloning, the DNA from the nucleus of a person's body cell is inserted into an egg whose own genetic material has been removed, and the egg is then stimulated to begin embryonic development. The resulting cloned embryo would genetically be an almost identical twin to the person supplying the body cell. This research overlaps with the stem cell issue. That is, human cloning might be done to create an embryo who will be destroyed to provide stem cells genetically matched to a patient, so the cells will not be rejected as foreign tissue. But some cloning research is done for other purposes—for example, to create embryos with devastating illnesses from the body cells of sick patients, to study the early progress of that disease. Most embryonic stem cell research involves embryos created by in vitro fertilization, not cloning.

WHY DOES THE CHURCH OPPOSE HUMAN CLONING?

Cloning is a depersonalized way to reproduce, in which human beings are manufactured in the laboratory to preset specifications. It is not a worthy way to bring a new human being into the world. When done for stem cell research, it involves the moral wrong of all embryonic stem cell research (destroying an innocent human life for possible benefit to others) plus an additional wrong: It creates human beings solely in order to kill them for their cells. This is the ultimate reduction of a fellow human being to a mere means, to an instrument of other people's wishes.

DOES OPPOSITION TO CLONING AND EMBRYONIC STEM CELL RESEARCH COME ONLY FROM ONE THEOLOGICAL OR POLITICAL VIEW?

No. Serious moral concerns about these practices have been raised by an array of both religious and secular groups, including some who disagree with the Catholic Church about abortion—Friends of the Earth, the United Methodist Church, etc. The human cloning ban supported by the Church has been approved by the House of Representatives by an overwhelming bipartisan majority. Many other countries (including Canada, France, Australia, Germany and Norway) have passed similar bans. Opposition to the idea of treating early human life as a mere object or commodity in the laboratory transcends religious and political divisions.

For more information, visit our website at `www.usccb.org/prolife/issues/bioethic`.

`Stem Cell Research and Human Cloning: Questions and Answers` was developed as a resource by the Secretariat for Pro-Life Activities of the United States Conference of Catholic Bishops (USCCB). It was reviewed by the committee chairman, Cardinal William Keeler, and has been authorized for publication by the undersigned.

Msgr. William P. Fay
General Secretary, USCCB

Cover photos: First left and background © Imagemore/Superstock, Inc.; second © Powerstock/Superstock, Inc.; third © Digital Vision.

Copyright © 2004, United States Conference of Catholic Bishops, Washington, DC. All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing from the copyright holder.

To order these resources or to obtain a catalog of other USCCB titles, call toll-free 800-235-8722. In the Washington metropolitan area or from outside the United States, call 202-722-8716. Visit the bishops' Internet site at www.usccb.org. Para pedidos en español, llame al 800-235-8722 y presione 4 para hablar con un representante del servicio al cliente en español.

Publication No. 5-665
USCCB Publishing
Washington, D.C.
ISBN 1-57455-665-7

STATE PUBLIC HEALTH, WELFARE & SAFETY
EXHIBIT NO. 18
DATE 2-1-05
BILL SJR 18

STEM CELL RESEARCH AND HUMAN CLONING

Questions and Answers

WHAT IS A STEM CELL?

A stem cell is a relatively unspecialized cell that, when it divides, can do two things: make another cell like itself, or make any of a number of cells with more specialized functions. For example, just one kind of stem cell in our blood can make new red blood cells, or white blood cells, or other kinds—depending on what the body needs. These cells are like the stem of a plant that spreads out in different directions as it grows.

IS THE CATHOLIC CHURCH OPPOSED TO ALL STEM CELL RESEARCH?

Not at all. Most stem cell research uses cells obtained from adult tissue, umbilical cord blood, and other sources that pose no moral problem. Useful stem cells have been found in bone marrow, blood, muscle, fat, nerves, and even in the pulp of baby teeth. Some of these cells are already being used to treat people with a wide variety of diseases.

WHY IS THE CHURCH OPPOSED TO STEM CELL RESEARCH USING THE EMBRYO?

Because harvesting these stem cells kills the living human embryo. The Church opposes the direct destruction of innocent human life for any purpose, including research.

IF SOME HUMAN EMBRYOS WILL REMAIN IN FROZEN STORAGE AND ULTIMATELY BE DISCARDED ANYWAY, WHY IS IT WRONG TO TRY TO GET SOME GOOD OUT OF THEM?

In the end we will all die anyway, but that gives no one a right to kill us. In any case, these embryos will not die because they are inherently unable to survive, but because others are choosing to hand them over for destructive research instead of letting them implant in their mother's womb. One wrong choice does not justify an additional wrong choice to kill them for research, much less a choice to make taxpayers support such destruction. The idea of experimenting on human beings because they may die anyway also poses a grave threat to convicted prisoners, terminally ill patients, and others.

HAVEN'T DOCTORS, SCIENTISTS, AND COMMENTATORS SAID THAT EMBRYONIC STEM CELL RESEARCH WILL LEAD TO THE CURE OF MANY DISEASES?

Some have made this claim, but in fact this is largely speculation. Embryonic stem cells have never treated a human patient, and animal trials suggest that they are too genetically unstable and too likely to form lethal tumors to be used for treatment any time soon. Years ago it was said that stem cells from embryos would be the most useful because they are so fast-growing and versatile, able to make virtually any kind of cell. But those advantages become disadvantages when these cells make tumors, creating a condition worse than the disease. Yet many supporters remain wedded to this approach, having invested a great deal of money and effort and hoping they can still make it work. This kind of exaggerated "promise" has misled researchers and patient groups before—most obviously in the case of fetal tissue from abortions, which a decade ago was said to promise miracle cures and has produced nothing of the kind.

IS THE CHURCH TELLING US TO CHOOSE THE LIVES OF EMBRYOS OVER THE LIVES OF SUFFERING PATIENTS?

No. It is calling us to respect both, without discrimination. We must help those who are suffering, but we may not use a good end to justify an evil means. Moreover, treatments that do not require destroying any human life are at least as promising—they are already healing some conditions, and are far closer to healing other conditions than any approach using embryonic stem cells. The choice is not between science and ethics, but between science that is ethically responsible and science that is not.

IS EMBRYONIC STEM CELL RESEARCH ADVANCING SO SLOWLY BECAUSE THIS RESEARCH IS BANNED IN THE UNITED STATES?

No. Embryonic stem cell research is fully allowed in the United States—there is no federal law (and almost no state law) against it. The government has only set some limits on the number of embryonic stem cell lines eligible for federal funding. Supporters disappointed at failures using these cells sometimes blame this stem cell research "ban" (which is not really a ban at all). But as noted above, the much more serious obstacle lies in the nature of the cells, which are not working out as some predicted.

DID THE FEDERAL GOVERNMENT IN 2001 FORBID FUNDING ANY EMBRYONIC STEM CELL RESEARCH?

No. In fact, the federal government gave $25 million to human embryonic stem cell research last year. But on August 9, 2001, President Bush said that federally funded research would use only embryonic stem cells already in existence (obtained by destroying embryos prior to that date). In this way, he reasoned, federal funds could be used to explore this research, without encouraging researchers to destroy new embryos in order to obtain federal grants. Some of these existing stem cell samples have been used to create more than 20 cell lines for research, and others remain in storage for possible use in creating new cell lines in the future. There is no legal limit on the amount of funding that can be used for this avenue; if the total funding for it is relatively small, that is chiefly because researchers are not requesting the funds as they are finding other avenues more promising.

the damaged part of the woman's spinal cord. Work was done by Chosun University professor Song Chang-hun and Seoul National University professor Kang Kyung-susn.

Adult stem cells

Stem cells can be found in all adult and young adult beings. **Adult stem cells** are undiferentiated cells that reproduce daily to provide certain specialized cells—for example 200 billion red blood cells are created each day in the body from hemopoietic stem cells. Until recently it was thought that each of these cells could produce just one particular type of cell—this is called *differentiation* (see Morphogenesis). However in the past few years, evidence has been gathered of stem cells that can transform into several different forms. Bone marrow stromal stem cells are known to be able to transform into liver, nerve, muscle and kidney cells.

Adult stem cells may be even more versatile than this. Researchers at the New York University School of Medicine have extracted stem cells from the bone-marrow of mice which they say are pluripotent. Turning one type of stem cell into another is called *transdifferentiation*.

In fact, useful sources of adult stem cells are being found in organs all over the body. Researchers at McGill University in Montreal have extracted stem cells from skin that are able to differentiate into many types of tissue, including neurons, smooth muscle cells and fat-cells. These were found in the dermis, the inner layer of the skin. These stem cells play a pivotal role in healing small cuts. Blood vessels, the dental pulp, the digestive epithelium, the retina, liver and even the brain are all said to contain stem cells.

An advantage of adult stem cells is that, since they can be harvested from the patient, potential ethical issues and inmunogenic rejection are averted. There are, however, at least presently, limitations to using adult stem cells. Although many different kinds of multipotent stem cells have been identified, adult stem cells that could give rise to all cell and tissue types have not yet been found. Adult stem cells are often present in only minute quantities and can therefore be difficult to isolate and purify. There is also limited evidence that they may not have the same capacity to multiply as embryonic stem cells do. Finally, adult stem cells may contain more DNA abnormalities—caused by sunlight, toxins, and errors in making more DNA copies during the course of a lifetime.

Embryonic stem cells

Stem cells which derived from the inner mass cells of a blastocyst (an early embryo) have pluripotent properties—they are able to grow into any of the 200 cell types in the body. Embryonic stem cells can be obtained from a cloned blastocyst, created by fusing a denucleated egg cell with a patient's cell. The blastocyst produced is allowed to grow to the size of a few tens of cells, and stem cells are then extracted. Because they are obtained from a clone, they are genetically compatible with the patient.

The breakthrough in embryonic stem cell research came in 1998 when a group led by James Thomson at the University of Wisconsin first developed a technique to isolate and grow the cells. Embryonic stem cell researchers are currently attempting to grow the cells beyond the first stages of cell development, to overcome difficulties in host rejection of implanted stem cells, and to control the multiplying of implanted embryonic stem cells, which otherwise multiply uncontrollably, producing cancer.

A major development in research came in May 2003, when researchers announced that they had successfully used embryonic stem cells to produce human egg cells. These egg cells could potentially

Backgrounder on Stem Cells

Stem cells are primal, undifferentiated cells which have the unique potential to produce any kind of cell in the body. Medical researchers believe stem cells have the potential to change the face of human disease by being used to repair specific tissues or to grow organs.

Types

There are three types of stem cells:

- A single **totipotent** stem cell can grow into an entire organism and even produce extra-embryonic tissues. Blastomeres have this property.
- **Pluripotent** stem cells cannot grow into a whole organism, but they are able to differentiate into cells derived from any of the three germ layers.
- **Multipotent** (also called unipotent) stem cells can only become some types of cells: e.g. blood cells, or bone cells.

Stem cells are also categorized according to their source, as either adult or embryonic.

> **Adult stem cells** are indifferentiated cells found among differentiated cells of a specific tissue and are mostly multipotent cells. They are already being used in treatments for over one hundred diseases and conditions.
> **Embryonic stem cells** are cultured cells obtained from the inner mass cells of a blastocyst. Embryonic stem cell research is still in the basic research phase. Research with embryonic stem cells derived from humans is controversial because, in order to start a stem cell 'line' or lineage, it requires the destruction of a blastocyst (an embryo that has not yet grown beyond a certain size).

Sources of stem cells

Cord blood stem cells

Blood from the placenta and umbilical cord that are left over after birth is one source of adult stem cells. Since 1988 these cord blood stem cells have been used to treat Gunther's disease, Hunter syndrome, Hurler syndrome, Acute lymphocytic leukaemia and many more problems occurring mostly in children. It is collected by removing the umbilical cord, cleansing it and withdrawing blood from the umbilical vein. This blood is then immediately analyzed for infectious agents and the tissue-type is determined. The Cord blood is processed and depleted of red blood cells before being stored in liquid nitrogen for later use, at which point it is thawed, washed of the cryoprotectant, and injected through a vein of the patient. This kind of treatment, where the stem cells are collected from another donor, is called *allogeneic* treatment. When the cells are collected from the same patient on whom they will be used, it is called *autologous* and when collected from identical individuals, it is referred to as syngeneic. Xenogeneic transfer of cells between different species is very underdeveloped and is said to have little research potential.

Researchers in South Korea announced in November 2004 that they had successfully used multipotent cord blood (adult) stem cell treatments to enable a paralyzed woman to walk with the aid of a walker. This was achieved by isolating the stem cells from the umbilical cord blood and injecting the cells into

of neurons. Researcher Su-Chun Zhang (*http://www.waisman.wisc.edu/faculty/zhang.html*) described the process as "you need to teach the [embryonic stem cells] to change step by step, where each step has different conditions and a strict window of time."

Transforming embryonic stem cells into motor neurons had eluded researchers for decades, until now. The next step will be to test if the newly generated neurons can communicate with other cells when transplanted into a living animal. The team will first test the neurons in chicken embryos. Lead researcher Su-Chun Zhang said their trial-and-error study helped them learn how motor neuron cells, which are key to the nervous system, develop in the first place.

Stem cell injection restores ability to walk

A team of Korean researchers reported on November 25, 2004, that they had transplanted multi-potent adult stem cells from umbilical cord blood to a patient suffering from a spinal cord injury and she can now walk on her own. The patient could not even stand up for the last 19 years. The team was co-headed by researchers at Chosun University, Seoul National University and the Seoul Cord Blood Bank (SCB). For the unprecedented clinical test, the scientists isolated adult stem cells from umbilical cord blood and then injected them into the damaged part of the spinal cord.

Using stem cells, the tests were able to avoid triggering a negative bodily reaction, which are common in other transplantations, according to Han Hoon, one of the researchers. "We don't need a strict match between cord blood stem cell type and the immune system of a patient because the latter accepts the former pretty well thanks to its immaturity," Han said.

Muscle damage

Adult stem cells are also apparently able to repair muscle damaged after heart attacks. Heart attacks are due to the coronary artery being blocked, starving tissue of oxygen and nutrients. Days after the attack is over, the cells try to remodel themselves in order to become able to pump harder. However, because of the decreased blood flow this attempt is futile and results in even more muscle cells weakening and dying. Researchers at Columbia-Presbyterian found that injecting bone-marrow stem cells, a form of adult stem cells, into mice which had had heart attacks induced resulted in an improvement of 33 percent in the functioning of the heart. The damaged tissue had regrown by 68 percent.

Human hearts repaired using patient's own stem cells

Using the patient's own bone marrow derived stem cells, Dr. Amit Patel at the University of Pittsburgh, Mcgowan Institute of Regenerative Medicine MIRMhas (*http://www.mirm.pitt.edu*) shown a dramatic increase in injection fraction for patients with congestive heart failure. Working with critically ill heart patients, researchers in Vienna have successfully used Mesenchymal stem cells to regenerate healthy new heart tissue. The adult stem cells were harvested from the patient's own bone marrow and injected into the ventricle. The heart is stopped for approximately two minutes to allow the adult stem cells to attach to the existing heart tissue. The patient is only under local anesthesia so that the surgeons can monitor how the lack of cerebral oxygen is affecting the patient. The heart is then restarted and incisions closed. The procedure is minimally invasive, as far as heart surgeries are concerned.

All of the patients that received the new treatment experienced repaired scar tissue and most had nearly complete return of proper heart function. As stated previously in the article, autologous stem cell implants such as these could alleviate legal and moral issues revolving around stem cell therapies.

Neurology

be used in turn to produce new stem cells. If research and testing proves that artificially created egg cells could be a viable source for embryonic stem cells, they noted, then this would remove the necessity of starting a new embryonic stem cell line with the destruction of a blastocyst. Thus, the controversy over donating human egg cells and blastocysts could potentially be resolved, though a blastocyst would still be required to start each cycle.

Treatments

Current treatments

For over 30 years, bone marrow (adult) stem cells have been used to treat cancer patients with conditions such as leukemia and lymphoma. During chemotherapy, most growing cells are killed by the cytotoxic agents. These agents not only kill the leukemia or neoplastic cells, but also the stem cells needed to replace the killed cells as a patient recovers. However, if the stem cells are removed before chemotherapy, and then reinjected after treatment is terminated, the stem cells in the bone marrow produce large amounts of red and white blood cells, to keep the body healthy and to help fight infections.

Since the 1980s stem cells have been taken from the blood instead of the bone-marrow, making the procedure safer for older people. Although normally scarce, the number of peripheral blood cells can be increased by a course of drugs, which release the stem cells from the bone-marrow. These are removed before chemotherapy, which kills most of them, and are re-injected afterwards.

Adult stem cells have also been successfully used to treat paralysis due to spinal cord injuries, Parkinson's disease and other illnesses.

Potential treatments

Cancer

Research injecting neural (adult) stem cells into the brains of rats can be astonishingly successful in treating cancerous tumors. With traditional techniques brain cancer is almost impossible to treat because it spreads so rapidly. Researchers at the Harvard Medical School injected adult stems cells genetically engineered to convert a separately injected non-toxic substance into a cancer-killing agent. Within days the adult stem cells had migrated into the cancerous area and the injected substance was able to reduce tumor mass by 80 percent.

Spinal cord

Embryonic stem cells switched to neurons

In Jan. 2005, using stem cells science made major progress in understanding the process of how mammalian stem cells differentiate to form specific types of brain cells. This could lead to new treatments and cures for diseases like Lou Gehrig's disease, muscular dystrophy, and spinal cord injuries.

Researchers at the University of Wisconsin-Madison coaxed human embryonic stem cells into becoming neural stem cells, then into the beginnings of motor neurons before finally differentiating into spinal motor neuron cells, the cell type that, in the human body, transmits messages from the brain to the spinal cord. The newly generated motor neurons exhibited electrical activity, the signature action

Policy debate in the U.S.

In 1995, Congress passed the Dickey Amendment, prohibiting federal funding of research that involves the use of a human embryo. Privately funded research lead to the breakthrough which made embryonic stem cell research possible in 1998, however, prompting the Clinton Administration to develop federal regulations for its funding. Preparations for this funding were completed in 2001. President George W. Bush announced, on August 11, 2001, that for the first time federal funds would be used to support research on human embryonic stem cells, but that funding would be limited to "existing (embryonic) stem cell lines where the life and death decision has already been made". President Bush also stated that the federal government would continue to support research involving stem cells from other sources, such as umbilical cord blood, placentas, and adult and animal tissues. Some felt the restrictions should have been stronger, while some scientists felt frustrated with the restrictions.

In 2002, President Bush appointed the Council on Bioethics, an advisory group composed of 18 doctors, legal and ethical scholars, scientists and a journalist. In February, 2004 Bush removed from the council two advocates of embryonic stem cell research, professor of ethics William May and biologist Elizabeth Blackburn. In their place, he appointed pediatric neurosurgeon Dr. Benjamin Carson, political scientist Dr. Diana Schaub, and professor of government Dr. Peter Lawler, all of whom have expressed a more cautionary view towards embryonic stem cell research.

The Bush administration's decision does not prohibit *private* embryonic stem cell research. Pharmaceutical companies and biotechnology companies initially expressed little interest because they consider therapies based on cells, which might have to be tailored to each patient, to be less profitable than one-size-fits-all drugs. However, there are many start-up biotechs that are now entering the field. They include: StemCells Inc. and Aastrom Biosciences. Others are reluctant to enter the market because they fear government restrictions preventing them from capitalizing on the research. However, individual medical treatments are being financed by private research groups such as pharmaceutical and biotechnology companies. These are the groups that have financed all of the medical treatments outlined in this article.

As a result of the federal funding restrictions, embryonic stem cell research in the US is commonly acknowledged to have been hampered in comparison with other countries, such as South Korea, which successfully cloned human embryos in early 2004 and extracting embryonic stem cells from them. However, the leading stem cell researchers in South Korea have a developed a stem cell bank that only holds adult stem cells from individuals. The Seoul Cord Blood Bank (SCB) currently retains blood from about 45,000 umbilical cords, which are enough to cover all Koreans, amply demonstrating the immeasurable potential of new adult stem cell therapies, e.g., the spiral cord treatment outlined above. The United Kingdom created the world's first embryonic stem cell bank in May 2004. However, there are hundreds of private adult stem cell banks worldwide, e.g., cord blood banks (*http://www.cordblood.com/cord_blood_news/stem_cell_news/a_paralyzed.asp*). Because other countries have moved forward with their embryonic stem cell research programs, some in the US have questioned the funding restriction.

In April 2004, 206 members of Congress, including many moderate Republicans and some other prominent public figures, signed a letter urging President Bush to relax the policy. The 2004 Democratic presidential candidate, Senator John Kerry (D, MA), had promised to support all types of stem cell research if elected President. His defeat in the U.S. presidential election, 2004 means that embryonic stem cell research in the US will potentially develop at the state level, especially in California, due to the passing of California's Prop. 71. Some scientists are concerned that stem cell

In the same way that organs can be transplanted from cadavers, researchers at the Salk Institute in California have found that these could be used as a source of adult stem cells as well. Taking adult stem cells from the brains of corpses they were able to coax them into dividing into valuable neurons. However, whether they will function correctly when used in treatment has not yet been determined.

Blood supplies

For many years, researchers have hoped to develop red blood cells from stem cells. In December 2004, researchers at the University of Paris developed a way to produce large numbers of red blood cells. The three-stage process involves combining adult stem cells with another group of cells called stromal cells and then adding a growth factor to stimulate them. The study is outlined in *Nature Biotechnology*. The Paris University team, lead by Professor Luc Douay, devised a technique which involves three steps: 1. Take haematopoietic stem cells, which are known to evolve into blood cells and treat them with a liquid to make them proliferate, 2. Create an environment to mimic the conditions found in bone marrow by using stromal cells, which provide the structure inside bone marrow, and 3. Add a growth factor called erythropoietin, which provides a signal to the stem cells to begin the transformation into red blood cells. The stem cells can be autologous, which is the safest form of blood transfusion.

Baldness

Hair follicles also contain stem cells, and some researchers predict research on these follicle stem cells may lead to successes in treating baldness through 'hair multiplication'/'hair cloning' within three or four years (as of Nov. 2004). This treatment is expected to initially work through taking stem cells from existing follicles, multiplying them in cultures, and implanting the new follicles into the scalp. Later treatments may be able to simply signal follicle stem cells to give off chemical signals to nearby follicle cells which have shrunk during the aging process, which in turn respond to these signals by regenerating and once again making healthy hair. *Hair Cloning Nears Reality as Baldness Cure* (*http://my.webmd.com/content/article/96/103836.htm?z=3734_00000_1000_qd_01*) (Web MD Nov. 2004)

Embryonic stem cell ethical debate

Are blastocysts human beings?

Some ethicists and religious figures are very concerned with the ethical implications of embryonic stem cell research. Some people believe that a human blastocyst is a human being with the same fundamental human rights. Some of these people thus oppose embryonic stem cell research because, in order to start each cell line, it involves destroying a blastocyst.

This view raises other issues, as the blastocysts involved in the research are left over from in vitro fertility therapy, and when not used in additional therapy or in embryonic stem cell research are destroyed or frozen indefinitely by the thousands[2] (*http://www.time.com/time/magazine/article/0,9171,1101040531-641157,00.html*). To some, this does not address the concern that using doomed blastocysts in embryonic stem cell research is viewed as instrumentalizing a developing human being.

research has become a politicized issue instead of a scientific issue in the national mindset, and feel that the politicization distorts representation of the scientific issues.

Adult stem cells have successfully treated over one hundred diseases and conditions. Opponents of embryonic stem cell research have thus argued that embryonic stem cell funding restrictions in the US are not significantly impeding the overall advancement of stem cell research, and that even without the ethical concerns regarding embryonic stem cells, public health funds should focus on extending adult stem cell research successes.

Emerging US state-by-state approach

California voted in Nov. 2004 to create a $3 billion state taxpayer-funded institute for stem cell research, the California Institute for Regenerative Medicine. Providing $300 million a year, the institute is claimed to be the world's largest single backer of research in stem cells, and could potentially increase substantially the pace of embryonic stem cell research.

Several states, in some cases wary of a national migration of biotech researchers to California, have shown interest in providing their own funding support of embryonic and adult stem cell research. These states include Pennsylvania, New York, New Jersey, Florida, Texas [1 (*http://www.dallasnews.com/sharedcontent/dws/news/city/irving/stories/010705dnmetscienceaward.6f9a4.html*)][2 (*http://www.chron.com/cs/CDA/ssistory.mpl/metropolitan/3014287*)], Illinois, Massachusetts, Wisconsin, Washington, and New Hampshire.

Other states, presently have, or have shown interest in, additional restrictions or even complete bans on embryonic stem cell research. These states include Arkansas, Iowa, Louisiana, Michigan, Nebraska, North Dakota, South Dakota, Virginia, Kansas, and Missouri,

- *States play catch-up on stem cells* (*http://www.usatoday.com/news/nation/2004-12-16-stem-cells-usat_x.htm*) (USA Today, Dec. 2004)

International situation

Due to the controversy surrounding embryonic stem cells, many nations around the world have passed legislation regulating research.

In the United Kingdom, the law states that a license may be issued to enable embryos to be created or used for research for certain specified purposes.

The nations spending the most on stem cell research include the US, the United Kingdom, South Korea 1 (*http://www.biomedcentral.com/news/20050125/01/*), China 1 (*http://www.biomedcentral.com/news/20050125/01/*), Australia, Israel, Singapore 1 (*http://www.biomedcentral.com/news/20050125/01/*), Argentina, Uruguay and Sweden. European nations that permit stem cell research also include Switzerland1 (*http://abcnews.go.com/Health/wireStory?id=288565*), Finland, Greece and the Netherlands. The U.K. allows the creation of human embryos for stem cell procurement. Countries with regulations allowing cloning for medical research include the UK, Belgium, Singapore and Japan.