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Name: Natasha Bingham

College: Arts and Sciences Department: Political Science

Faculty Mentor: Kara Stooksbury

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I have reviewed this completed senior honors thesis with this student and certify that it is a project commensurate with honors level undergraduate research in this field.

Signed: Kara Stooksbury, Faculty Mentor

Date: May 3, 2004

Comments (Optional):

Natasha Bingham

**Political and Ethical Implications of Embryonic Stem Cell Research in
Comparative Perspective**

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Introduction

Celebrities get involved in many causes, ranging from juvenile diabetes to Alzheimer's. Through their involvement and subsequent media attention, people get their first glimpse into serious issues. One of the first notions of stem cell research came into people's minds due to the ongoing struggles of Michael J. Fox with Parkinson's disease and Christopher Reeves with his spinal cord injury. These two and a number of others have been advocates for the research due to the potential health benefits. On the other hand, people have also been bombarded with information about the sacredness of life, especially the human embryo. In addition, the allowance of human embryonic stem cell research will lead to the slippery slope of more abortion and ultimately cloning. With these two arguments circulating around the United States and international communities, a clear-cut decision has not been made across the board concerning embryonic stem cell research: its application and its funding.

This paper will discuss the background behind stem cell research that has occurred from the 1960s through today. It will further examine the importance and types of stem cell research along with executive, congressional, and legal responses to such research. Ethical issues, such as cloning, abortion, freedom to research, and the status of the embryo are issues that arise through the discussion of embryonic stem cell research. The question of federal funding for embryonic stem cell research will be debated in this paper. A brief assessment of international stances on human embryonic stem cell research will be discussed.

Stem cells are cells which are not differentiated and therefore have the ability to generate into other cell types and a stem cell line is a collection of cells coming from the original, therefore having the original's

genetic characteristics.¹ This collection of cells can then be divided from the cell line and dispersed to other researchers. Morphogenesis is differentiation that generates just one type of cell. Transdifferentiation, however, is differentiation that transforms one type of stem cell into another type.² Consequently, medical scientists hope they can be applied to the repairing of certain tissues or to form organs. Three categories of stem cells exist: totipotent, pluripotent, and multipotent. A totipotent stem cell can develop into a complete organism. Pluripotent stem cells cannot develop into an entire organism, but they can develop into any cell type in the body. Multipotent stem cells can simply develop into specific cell types, i.e. blood cells or bone cells.³

Embryonic stem cells have the most potential because they have the capacity to grow into any of the 200 bodily cell types. They can split to generate more stem cells or differentiate into various cell types, such as nerve and muscle. Embryonic stem cells come from one week old embryos or blastocysts produced through in vitro fertilization to treat infertility, five to nine week old embryos or fetuses acquired via elective abortion, and embryos generated from cloning or somatic cell nuclear transfer.⁴ Some of the participants in these treatments choose to donate these leftover embryos to research. Embryonic stem cells for research are fashioned from the inner cell mass of a week-old embryo. They are attained from a cloned embryo, which is formed by combining a de-nucleated egg cell with a patient's cell. The embryo is permitted to develop, and then stem cells are removed. With the correct cultivation, these embryonic stem cells can develop and split indefinitely. Since the embryonic stem cells are acquired from a clone, they are

¹ University of Wisconsin, *Embryonic Stem Cells* (The Board of Regents of the University of Wisconsin System, 2003, assessed 13 April 2004); available from <http://www.news.wisc.edu/packages/stemcells/facts.html>; Internet.

² University of Wisconsin.

³ University of Wisconsin.

⁴ Suzanne Holland and others, *The Human Embryonic Stem Cell Debate* (Cambridge, Mass: MIT Press, 2001), 18.

genetically similar to the patient.⁵

Since adult cells are already specialized, their ability to renew damaged tissue is inadequate, i.e. skin cells only develop into skin and cartilage cells only develop into cartilage. No adult stem cells have demonstrated pluripotent features. Adult stem cells reproduce on a daily basis to supply specific specialized cells, i.e. 200 billion red blood cells are produced daily.⁶ Another restriction is adult stem cell's incapacity to reproduce in culture. They are hard to produce in the laboratory, and their possibility to replicate lessens with continued maturity contrasting with embryonic stem cells, which can reproduce in the laboratory indefinitely. Consequently, attaining considerable medical quantities of adult stem cells might prove to be problematical.⁷

President Bush's resolution, which allowed federal funding only for embryonic stem cell lines derived before August 9, 2001, has not interrupted the debate over embryonic stem cell research but has managed to hinder critical research advances from being made to help millions of Americans suffering from debilitating diseases and conditions. With his limited policy, he has made a life and death decision for all those suffering from debilitating illnesses. Research dating back many years has stated that stem cells hold the most potential for those diseases where injured and malfunctioning cells have the possibility of being replaced, such as Parkinson's disease, juvenile diabetes, stroke, spinal cord injuries, and heart muscle damage that comes after a heart attack⁸; this will be discussed in greater detail later in the paper.

However, embryonic stem cells are the most controversial type of stem cells, for the reason that their use entails the destruction of human

⁵ Holland, 18.

⁶ University of Wisconsin.

⁷ Holland, 21.

⁸ University of Wisconsin.

embryos, which will be discussed in greater detail later in the paper. Some people and 'Pro-Life' groups consider embryos human beings, and as a result destroying them is murder. They advocate the use of adult stem cells for research purposes. Many scientists support embryonic stem cell research because of all the medical benefits that it provides, and plus many researchers state that many of the embryos would have been destroyed nonetheless. Another controversy is therapeutic cloning, which includes the early embryo cloning from which stem cells are collected. This offers a greater supply of cells. Therefore, many people see this as leading to human cloning.⁹ However, most of the stem cell cultures that are currently operational resulted from unused embryos from in vitro fertilization. The National Bioethics Advisory Commission has recommended that federal funding only apply to cell lines resulting from aborted fetuses and embryos after infertility treatments.¹⁰ The European Group on Ethics in Science and New Technologies, which is an advisory committee to the European Union, resolved to allow individual countries to decide their own policy on embryonic stem cell research. It came to a decision that if a country permitted research on embryos created from in vitro fertilization treatments that there was no reason not to allow embryonic stem cell research intended for treatment of severe ailments. However, the group did resolve that embryos were not to be formed for the intention of research. Different countries' stances on embryonic stem cell research run the gamut from strict as in the case of Germany to the liberal as in the case of the United Kingdom.¹¹ In the global community, embryonic stem cell research remains a glimmer of hope to injured and ill individuals. But primarily in the United States, the subject remains

⁹ University of Wisconsin.

¹⁰ The President's Council on Bioethics, *Monitoring Stem Cell Research* (2004, assessed 13 April 2004); available from <http://www.bioethics.gov/reports/stemcell/chapter2.html>; Internet.

¹¹ Lasker Foundation, *Stem Cell Research: History* (Lasker Medical Research Network, 2004, assessed 13 April 2004); available from <http://www.laskerfoundation.org/news/stemcell/history.html>; Internet.

controversial and divisive among the population. Even from the beginning, this line of research was and remains groundbreaking yet unnerving to most Americans because of the medical, ethical, political, and social implications that follow.

Background

In the mid 1800s, scientists started to understand that cells were the fundamental building blocks of life, and that cells produce cells. In the early 1900s, European scientists recognized that one specific stem cell produced all other blood cells. Researchers began to finally anticipate discovering cures to cancer, heart disease and mental illness once the invention of penicillin and the polio vaccine arose, but progress towards this end has been slow.¹² The view of a 'master cell' that might induce various types of tissue growth gained prevalence in the 1960s, with the discovery that cancerous cells in mice could develop into several sorts of tissue. Subsequently biologists researching mice started to hypothesize how master cells in embryos could produce various kinds of tissue. However, these scientists were not able to separate the cells. The research had limited applications, and scientists for almost two decades were not capable of generating non-cancerous, self-repairing stem cells from mouse embryos. In the meantime, other styles of fetal research generated a measles vaccine and enhanced therapies of blood ailments.¹³

Studies of embryos accelerated in the 1970s and subsequently became a part of public domain. With the U.S. Supreme Court's decision that abortion was a constitutional right in *Roe v. Wade* (1973), the U.S. Department of Health and Human Services permitted studies on dead fetuses and their tissues

¹²Adriel Bettelheim, *Embryo Research* (CQ Press, 1999, assessed 13 April 2004); available from <http://library.cqpress.com/cqresearcher/document.php?id=cqresrre1999121700&type=hitlist&num=0&>; Internet, 1076.

¹³ Bettelheim, 1076.

in accordance with state law in 1975.¹⁴

Researchers carried on with their analyses in the 1980s. Scientists at the University of Cambridge in England and the University of California at San Francisco obtained stem cells from mouse embryos at an early, 100-cell period in 1981, which permitted researchers to experiment with cultures that aided in cell multiplication. This also allowed them to instigate growths of cultures in laboratories to stimulate the creation of tissues from stem cells.¹⁵ Scientists were capable of blending mouse stem cells with individual embryos, upon which generated a genetically hybrid mouse. The researchers discovered the developmental and biological differences between mice and humans; as a result they began examinations on higher mammals. University of Colorado scientists accomplished the initial fetal tissue transplant on a Parkinson's patient in 1988.¹⁶

New findings illustrated a comprehensive analysis of early human development and, in the process, incited ethical debates in the 1990s. In 1993, University of Toronto scientists revealed that they produced a mouse from stem cells removed from mouse embryos. The research provided evidence stem cells could possibly produce a complete, healthy being. A University of Wisconsin researcher James Thomson in 1995 was able to isolate monkey stem cells. He observed that stem cells from a primate immediately turned into different tissues except for when they were cultivated with a particular type of mouse cell called a 'feeder cell', which did not allow them to specialize, in tissue culture dishes.¹⁷ Researchers, however, did not yet realize how feeder cells operated. Nonetheless, Thomson employed his primate stem cell removal research to unused embryos from fertility clinics, which facilitated him being able to achieve the first successful human stem cell extraction in

¹⁴ Bettelheim, 1076.

¹⁵ Bettelheim, 1077.

¹⁶ Bettelheim, 1077.

¹⁷ Bettelheim, 1077.

February 1998. Around the same time, Johns Hopkins' Gearhardt had also isolated and cultured human stem cells.¹⁸ Gearhardt's work came from two decades of research concerning how genetic faults led to Down's syndrome, an affliction that happens when one of an embryo's chromosomes duplicates itself one time to many. Scientists at the University of Wisconsin and Johns Hopkins University proclaimed that they had isolated human embryonic stem cells for the first time in November 1998.¹⁹ The University of Wisconsin and Johns Hopkins each copyrighted their individual methods, and then licensed them to Geron, the biotech company which thought that stem cells might be utilized to produce anti-aging products. On May 4, 1999, Geron Corporation and Roslin Institute of Scotland aligned together to merge stem cell research with cloning technology that created Dolly the sheep in 1997. The National Bioethics Advisory Commission suggested that federally supported scientists be permitted to remove human embryonic stem cells, in addition to being able to perform experimentation on embryos resulting from other embryos on June 28, 1999.²⁰ The American Association for the Advancement of Science approved private and public analysis on stem cells, referring to the prospective medical benefits to individuals on August 18, 1999. In 1999 and 2000, researchers started to find that manipulation of adult mouse tissues could occasionally generate certain cell types, for instance some bone marrow cells could be converted into nerve or liver cells and that brain stem cells seem to have the capability of developing into different kinds of cells.²¹

It has not been until lately that most scientists have begun accepting the concept that transplanting brain cells might possibly heal serious head injuries or neurological disorders, such as Alzheimer's and Parkinson's. At the moment, they are reassessing the possibilities in view of the fact that

¹⁸ Bettelheim, 1077.

¹⁹ Bettelheim, 1077.

²⁰ Bettelheim, 1077.

²¹ Bettelheim, 1077.

researchers in Sweden and the United States over the past year have exposed pathways wherein the brain makes minor but steady amounts of additional nerve cells, conflicting with the original view that the adult brains of humans and other primates could merely exhaust cells, not gain them. The focal point of the action is neural stem cells that can develop into an extensive assortment of brain cells.

"Doctors might . . . be able to stimulate stem cells to migrate into areas where they usually do not go and to mature into the specific kinds of nerve cells required by a given patient," neuroscientists Gerd Kempermann and Fred H. Gage of the Salk Institute for Biological Studies in La Jolla, Calif., wrote recently in *Scientific American*. "Although the new cells would not regrow whole brain parts or restore lost memory, they could, for example, manufacture valuable amounts of dopamine [the neurotransmitter whose depletion is responsible for the symptoms of Parkinson's disease] or other substances."²²

Researchers investigating fully developed macaque monkeys noticed that stem cells seemed to incite formation of new nerve cells in the fluid-filled ventricles hidden in the brain. The newly formed cells, then journey in excess of a week or more to the cortexes, where they subsequently emit connections to other nerve cells. Currently, scientists are aiming to disrupt creation of the new cells in order to observe whether or not the animal's behavior is altered.²³

Although there is still hope, researchers remain cautious, and hence believe that at the present time that the brains of Alzheimer's and stroke patients do not seem to attempt to mend themselves, signifying that regenerative abilities may possibly not be sufficient to conquer the most grave brain injuries. Contemporary studies illustrate that a cancer treatment comprised of high doses of chemotherapy followed by stem cell transplants is perhaps no better treatment than regular chemotherapy for women with later

²² Bettelheim, 1077.

²³ Bettelheim, 1077.

stages of breast cancer.²⁴ Although these are setbacks, it should be reiterated that it has not been until recently that cell sources that might be employed to redevelop organs have become obtainable. Scientists are still investigating the sources and the prospective capabilities of these embryonic stem cells.

Importance of Embryonic Stem Cell Research

Many scientists consider embryonic stem cell research the promise for the future of medicine and science. One reason for that is the fact that embryonic stem cells are capable of growing into practically any human cell or human tissue unlike adult cells which are already specialized, and therefore their ability to regenerate injured tissue is restricted. Another reason is that only embryonic stem cells have the possible capacity to restore vital organs because several essential organs in adults do not contain stem cells and therefore scar tissue forms when these tissues are damaged. Due to these causes, researchers believe that embryonic stem cell research could ultimately produce remedies for ailments and illnesses that trouble roughly 128 million Americans.²⁵

Embryonic stem cells could bolster more insight into basic biology and human development. The initial periods of human development have been problematical to research, for that reason human embryonic stem cells present insight into developmental stages that cannot be analyzed in utero or completely comprehended with animal models. The knowledge of genes and molecules, such as growth factors and nutrients, which operate throughout embryo development perhaps, could be utilized to produce stem cells in the laboratory that could become specific cell types. Birth defects, infertility, and miscarriages could be thwarted or at least treated if these initial

²⁴ Bettelheim, 1078.

²⁵ University of Wisconsin.

developmental stages were understood completely.²⁶ For example, the risk of drug-related birth defects could be diminished if these certain drugs were experimented on cultured human embryonic stem cells. Furthermore, embryonic stem cell research could provide data to how particular diseases occur and propose therapies in order to prevent or remedy irregular human development. It could, additionally, provide more information about normal human development and certain genetic and molecular controls of these processes, such as cell differentiation and proliferation. Since certain medical conditions, such as cancer, result from abnormal cell division and separation.²⁷

New medicines could be reviewed more safely and efficiently using embryonic stem cell research. The first function is in the field of drug invention, meaning that chemical compounds could be tested on unadulterated populations of specialized cell types.²⁸ Treating specific cell types with different chemicals and assessing their reaction offers a more efficient means of discovering what chemicals could be employed to remedy the illnesses that concern those certain types of cells, hence, allowing the rapid screening of numerous chemicals that are currently being examined through lengthy procedures.²⁹

Embryonic stem cell research could promote the treatment of cell-centered diseases since embryonic stem cells can develop into any human tissue and as a result vital tissues, such as neural tissue and muscle tissue as well as bone marrow, can be produced for transplants. Juvenile onset diabetes mellitus and Parkinson's disease happen due to an error in one

²⁶ University of Wisconsin.

²⁷ University of Wisconsin.

²⁸ International Bioethics Committee, *The Use of Embryonic Stem Cells in Therapeutic Research* (Paris: United Nations Educational, Scientific and Cultural Organization, 2001, assessed 13 April 2004); available from http://portal.unesco.org/shs/en/file_download.php/64b74abda57372bdc22570b42c1718f1StemCells_en.pdf; Internet, 2.

²⁹ International Bioethics Committee, 2.

particular cell type.³⁰ Therefore substituting defective cells with healthy ones presents a likelihood of lifelong therapies, such as replacing damaged dopamine-producing neurons in a Parkinson's patient's brain and transplanting insulin-creating pancreatic beta cells into patients afflicted with diabetes. Likewise, damaged organs, hypothetically, could be inserted with healthy cells that would replace injured or unhealthy ones.³¹ The damaging of heart muscle cells due to infarction, which stops blood flow through coronary arteries, could be replaced with cardiac smooth muscle cells that were created by in vitro separating embryonic stem cell lines. Osteoarthritis and other such afflictions, which entail cartilage injury, could be fixed by cell injection to the damaged area, which would promote restoration of the area. People who have bone missing, as a result of a trauma or a surgery may possibly be able to have it restored with newly-created bone cells.³²

Furthermore, the employment of embryonic stem cells might revolutionize how diseases, such as Parkinson's, Alzheimer's, Multiple Sclerosis and additional neuro-degenerative disorders are tackled since many of these conditions cannot presently be managed or the treatments that are accessible are difficult and yield unsatisfactory results.³³ Embryonic stem cell lines could produce tissue, which could replace the lost or damaged nervous tissue cells that result from these disorders. There is also the prospect that neurons could be transplanted in the brain or spinal cord, that glial cells could be transplanted that generate the myelin coating covering the nerves, and that neurotransmitters could be formed that are absent. Introductory research involving animals has provided hopeful findings.³⁴

Cancer treatment could become more effective if blood and immune cell transplantations of bone marrow and cord blood along with the rigorous

³⁰ International Bioethics Committee, 2.

³¹ International Bioethics Committee, 2.

³² International Bioethics Committee, 2.

³³ International Bioethics Committee, 2.

³⁴ International Bioethics Committee, 2.

utilization of cytotoxic anticancer drugs were exchanged with insertions of hematopoietic stem cells resultant from embryonic stem cells, which had distinct immuno-genetic promise for the patient. Restoration of the immune system using this procedure would be valuable in the treatment of immunodeficiency disorders, such as AIDS, or autoimmune illnesses such as Lupus or Multiple Sclerosis.³⁵

Executive, Congressional, and Legal Action

Health and Human Services

Political and legal policies continue to be amended as questions surface about the research. In 1975, the Department of Health and Human Services prohibited research on live fetuses but permitted research on dead fetuses if allowable by state law. Health and Human Services required a suspension on federal funding that involved fetal tissue transplant research in 1988.³⁶

In 1998, the National Institute of Health asked for a legal opinion from the General Counsel of Health and Human Services, Harriet Rabb, on the issue of federal funding for human stem cells coming from embryos or fetal tissue.³⁷ She stated that the then law which did not allow funds for human embryo research would not be relevant to research using stem cells because stem cells were not a human embryo as defined by the statute. She stated that the definition of an embryo is one of an "organism" that when implanted in the uterus is able to develop into a human being. Pluripotent stem cells are not and cannot become an organism. Therefore, Health and Human Services decided that the National Institute of Health could finance stem cell

³⁵ International Bioethics Committee, 3.

³⁶ Bettelheim, 1078.

³⁷ Diane T. Duffy, *Background and Legal Issues Related to Stem Cell Research* (Congressional Research Service, 2002, assessed 13 April 2004); available from http://www.policyalmanac.org/health/archive/crs_stem_cell.shtml; Internet.

research derived from the embryo as a result of private funds.³⁸

President Clinton

Prior to the Clinton and Bush administrations, federal law did not allow Health and Human Services to finance human embryonic research. Human embryonic research was financed through private funding. In December 1994, President Clinton, via an executive order, banned federal funding on research that backed the formation of human embryos for research and order the National Institute of Health to not distribute funds for this type of research.³⁹

The Clinton administration, in 1999 and 2000, stated that researchers could receive funding if the human embryos were left over from in vitro fertilization that was intended for reproduction, donated with informed consent, and free of monetary incentives.⁴⁰ The administration claimed that the possible benefits of stem cell research merited that publicly funded research should proceed if these particular standards were met. The Clinton administration depicted certain guidelines, but they were finished right before the conclusion of the administration. The guidelines never were put into carried out, and as a result no funding was ever allocated to researchers. In August 2000, President Clinton remarked:

"Human embryo research [as approved for funding by the NIH guidelines] deals only with those embryos that were, in effect, collected for in-vitro fertilization that never will be used for that. So I think that the protections are there; the most rigorous scientific standards have been met. But if you just--just in the last couple of weeks we've had story after story after story of the potential of stem cell research to deal with these health challenges. And I think we cannot walk away from the potential to save lives and improve lives, to help people literally to get up and walk, to do all kinds of things we could never have imagined, as long as we meet rigorous ethical

³⁸ Duffy.

³⁹ Duffy.

⁴⁰ Duffy.

standards."⁴¹

Proponents stated that public funds would be used to support the destruction of human embryos. Therefore, stating research that destroys human embryos should be supported for medical progress. Supporters contended that the support for this research because of its possible medical applications, was a proper governmental action.

President Bush

President Bush, in January 2001, stated that he would evaluate the stem cell research matter and directed the Department of Health and Human Services to assess the guidelines that the Clinton administration had given to the National Institutes of Health.⁴² He stated that the administration sought a direction, which would allow some beneficial research to continue while maintaining the Dickey Amendment. The National Institutes of Health halted researcher applications that requested federal funds to do human embryonic stem cell research for the duration of this assessment period.⁴³

On August 9, 2001, President Bush revealed that his policy would allow federal funds to only assist restricted human embryonic stem cell research. He stated:

"As a result of private research, more than 60 genetically diverse stem cell lines already exist" I have concluded that we should allow federal funds to be used for research on these existing stem cell lines " where the life and death decision has already been made", This allows us to explore the promise and potential of stem cell research" without crossing a fundamental moral line by providing taxpayer funding that would sanction or encourage further destruction of human embryos that have at least the potential for life." ⁴⁴

⁴¹ Duffy.

⁴² The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

⁴³ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

⁴⁴ Office of the Press Secretary, *Embryonic Stem Cell Research* (2001, assessed 13 April 2004); available from <http://www.whitehouse.gov/news/releases/2001/08/20010809-1.html>; Internet.

Federal research is restricted to the 64 currently present stem cell lines, which are currently in the United States, Australia, India, Israel, and Sweden, that resulted from the informed consent of the donors, leftover embryos that were formed exclusively for reproduction, and not including any monetary incentives to the donors.⁴⁵ Therefore, no federal funds can be intended for the developing of stem cell lines from newly destroyed embryos, generating human embryos for research, or cloning of human embryos. The reason the President allowed the 64 existing stem cell lines to receive federal funding was because he had said "these embryos, from which the existing stem cell lines were created, had been destroyed previously and could not develop as human beings." He further stated,

"Federal funding of medical research on these existing stem cell lines will promote the sanctity of life without undermining it and will allow scientists to explore the potential of this research to benefit the lives of millions of people who suffer from life destroying diseases."⁴⁶

Now, federal agencies, in particular the National Institute of Health (NIH), consider researcher-funding applications if specified standards or adequate measures exist. The President instructed the NIH to investigate the origin of all present stem cell lines and make a catalog of those stem cell lines. The list of stem cell lines that meet the President's standards and as a result are capable of receiving federal funds is called the Human Embryonic Stem Cell Registry.⁴⁷

Also, President Bush's policy involves the formation of the President's Council on Bioethics to research stem cells, embryo exploration, and such. It is overseen by Dr. Leon Kass, a specialist in biomedical ethics and a

⁴⁵ Office of the Press Secretary.

⁴⁶ Office of the Press Secretary.

⁴⁷ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

University of Chicago professor.⁴⁸ The Council examines the human and ethical implications of biomedical and behavioral science and technology expansion. The Council also investigates issues such as, embryonic and adult stem cell research, assisted reproduction, cloning, genetic screening, gene therapy, euthanasia, psychoactive drugs, and brain implants.⁴⁹ The President also confirmed that the government would spend \$250 million on research for stem cells from other places, such as the umbilical cord, placenta, adult tissues, and animal tissues.⁵⁰

Congress

In 1993, Congress passed the National Institute of Health Revitalization Act, which repealed the obligation that research procedures had to be sanctioned by the non-existent Ethics Advisory Board. This act provided for the possibility of funding for human embryonic research using in vitro fertilization embryos.⁵¹ The subsequent year, the National Institute of Health assembled a Human Embryo Research Panel to evaluate the questions that enclose this research and to recommend guidelines for funding. The panel stated that the formation of human embryos for research should be backed under certain conditions. President Clinton rejected embryo creation for research, but he accepted the panel's other proposals and allowed the NIH to consider funding applications from research that utilized leftover embryos from in vitro fertilization.⁵²

Congress, on the other hand, did not support this option. So, in 1996, Congress added a statement to the Departments of Labor, Health and Human Services, and Education, and Related Agencies Appropriations Act, which is the budget bill that finances Department of Health and Human Services and the

⁴⁸ Office of the Press Secretary.

⁴⁹ Office of the Press Secretary.

⁵⁰ Duffy.

⁵¹ Duffy.

⁵² Duffy.

National Institute of Health.⁵³ The statement was that federal funds could not be allowed for research that destroyed or jeopardized human embryos, or produced them solely for research. This was done before the National Institute of Health had accepted any funding. This condition, recognized as the "Dickey Amendment" after its author, former Representative Jay Dickey of Arkansas, has been added to the Health and Human Services appropriations bill every year since 1996.⁵⁴ The provision reads as follows:

None of the funds made available in this Act may be used for:

- "(1) The creation of a human embryo or embryos for research purposes; or
- (2) Research in which a human embryo or embryos are destroyed, discarded, or knowingly subjected to risk of injury or death greater than that allowed for research on fetuses in utero under 45 CFR 46.204 and 46.207, and subsection 498(b) of the Public Health Service Act (42 U.S.C. 289g(b)).
- (b) For purposes of this section, the term 'human embryo or embryos' includes any organism, not protected as a human subject under 45 CFR 46 as of the date of the enactment of the governing appropriations act, that is derived by fertilization, parthenogenesis, cloning, or any other means from one or more human gametes or human diploid cells."⁵⁵

The ban does not forbid fetal tissue research, although there are restrictions. This law disallows federal funds for research that destroyed human embryos, but it did not forbid private funding. Most members of Congress believe that the Amendment articulates their ethical beliefs that human life should be protected against the use and destruction for research, no matter how promising the research, and that the destruction should not be sustained with taxpayer dollars.⁵⁶

⁵³ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

⁵⁴ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

⁵⁵ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

⁵⁶ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

The Dickey Amendment appeared to end the discussion of whether or not federal funds should be given for human embryonic stem cell research. However in 1999, the General Counsel of the Department of Health and Human Services claimed that the law might allow human embryonic stem cell research to be subsidized.⁵⁷ If researchers backed by private funding destroyed embryos, then subsequent research using the stem cells could be entitled to federal funding. The following research would result from previous destruction of human embryos but would not itself require destruction. Therefore, the Department's lawyers proposed that the legal requirement not to finance research wherein embryos were destroyed would theoretically still be followed.⁵⁸

Some members of Congress disagree with ban on federal funding for human embryonic stem cell research. Rep. Maloney presented H. Res. 17 on January 30, 2001, which stated that Congress should give federal funding for pluripotent stem cell research.⁵⁹ Senator Specter presented, on April 5, 2001, S. 723, the Stem Cell Research Act of 2001, which would modify the law and allow the National Institute of Health to subsidize the derivation of stem cells from leftover in vitro fertilization embryos. This research is forbidden in the current Labor/ Health and Human Services appropriation bill rider. The bill was sent to the Senate Committee on Health, Education, Labor, and Pensions. Rep. McDermott presented a companion bill to S. 723, which was H. R. 2059.⁶⁰

In July 2001, Senator Frist proposed a ten-point plan that supported stem cell research. It contained the following five features:

- "(1) Prohibit the creation of human embryos solely for research purposes; (2) strengthen

⁵⁷ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

⁵⁸ The President's Council on Bioethics. *Monitoring Stem Cell Research: Chapter 2.*

⁵⁹ Duffy.

⁶⁰ Duffy.

and codify the ban on federal funding for the derivation of embryonic stem cells; (3) prohibit cloning to prevent the creation and exploitation of life for research purposes; (4) increase federal funding for adult stem cell research; (5) allow federal funding for research using only those embryonic stem cells derived from blastocysts that are left over after in IVF and would otherwise be discarded."⁶¹

Additional bills have been introduced on stem cell research, such as the Responsible Stem Cell Research Act of 2001 (H. R. 2096; companion bill, S. 1349), the Stem Cell Research for Patient Benefit Act (H. R. 2747), the New Century Health Advantage Act (H. R. 2838), and the Science of Stem Cell Research Act (H. R. 4011).⁶²

Congress has passed bills concerning cloning that involve stem cell research. H. R. 2505, the Human Cloning Prohibition Act of 2001, authored by Weldon, was presented in July 2001 and would modify Title 18, U. S. Code, in order to forbid human cloning.⁶³ The bill was endorsed by the House Judiciary Subcommittee on Crime on July 19, 2001 and agreed on by the full committee on July 24, 2001. The House approved H. R. 2505 on July 31, 2001. The bill was heard in the Senate. The action passed the Senate on August 8, 2001. The bill has been supported by the Administration. This bill bars the procedure of human cloning named somatic cell nuclear transfer for reproduction plus research and therapeutic proposes. It also limits stem cell research. Senator Brownback's bill, S. 1899, the Human Cloning Prohibition Act of 2001, which was the companion bill to H. R. 2505, was brought in on January 28, 2002 and is supported by the administration.⁶⁴ The Senate deliberated on Senator Lott's revision to H. R. 10, the Railroad Retirement and Survivors' Improvement Act of 2001, which would have forced a 6-month suspension on all human cloning research and consequently have impinged on stem cell research. It was,

⁶¹ Duffy.

⁶² Duffy.

⁶³ Duffy.

⁶⁴ Duffy.

however, not passed. On May 1, 2002, Senators Specter, Feinstein, Hatch, and Kennedy, along with other senators, brought in S. 2439, the Human Cloning Prohibition Act of 2002.⁶⁵ This bill banned human reproductive cloning, however it allowed cloning for medical research, which incorporated stem cell research. The bill was sent to the Senate Committee on the Judiciary.⁶⁶

Lawsuits

Numerous lawsuits have been filed concerning stem cell research. In March 2001, a lawsuit was filed in federal court to halt federal funds going to human embryonic stem cell research and to throw out the National Institute of Health guidelines regarding stem cells derived from human embryos.⁶⁷ In *Nightlight Christian Adoptions, et al. v. Thompson*, the plaintiffs sought 'declaratory and injunctive relief'. The plaintiffs, which were a non-profit adoption agency along with others, asserted that the National Institute of Health guidelines disobey the legislative ban located in the appropriations rider. The plaintiffs questioned National Institute of Health's statement that the prohibition on embryonic stem cell research does not cover embryos destroyed by private funds.⁶⁸ The complaint asserts the National Institute of Health guidelines are subjective and changeable when it comes to the Administrative Procedure Act, 5 U. S. C. § 706(2), and therefore is not the result of logical decision-making and conflicts with scientific data.⁶⁹ In May 2001, a motion to delay the case was issued until the President reviewed the National Institute of Health guidelines. The claim is now moot. In May 2001, a federal lawsuit was filed alleging the Bush administration unlawfully suspended federal funding for stem cell research. In *Thomson v. Thompson 18*, actor Christopher Reeve and seven researchers filed suit in the U. S. District Court for the District of Columbia stating that the administration

⁶⁵ Duffy.

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was carrying out permanent harm in impeding on the development of therapies that could save lives.⁷⁰ They contend that administrative measures were not adhered to when it comes to stopping the research that is allowable under federal law.⁷¹

Other lawsuits involve licensing, patent, and intellectual property rights connected with stem cell research. In 1999, Geron Corporation attained a license from the Wisconsin Alumni Research Foundation for human embryonic stem cell technology. It permitted Geron sole commercial rights to cultivate six kinds of human cells resultant from stem cells, i.e. nerve cells, heart cells, and liver cells.⁷² Geron then tried to use its commercial rights for 12 additional cell types but Wisconsin Alumni Research Foundation responded by saying this was no longer a choice. On August 13, 2001, Wisconsin Alumni Research Foundation requested that the U. S. District Court in Madison find Geron's employment of this option null and void. The complaint was later altered in order to request that the court proclaim that Geron's license does not insure rights to research products that could possibly be generated from the stem cells.⁷³ Geron has asked the court to rule on the dispute by determining the contractual intention without a trial. In September 2001, the National Institute of Health discussed with the Wisconsin Alumni Research Foundation access to human embryonic stem cells to federally financed scientists. Wisconsin Alumni Research Foundation possesses rights that involve 64 stem cell lines, not to mention exclusive rights to five of the stem cell lines. An agreement was arrived at between Wisconsin Alumni Research Foundation and federal researchers, according to Secretary Thompson.⁷⁴

Ethical Issues

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⁷¹ Duffy.

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Freedom to Research

Some state that federal policy should encourage freedom to be able to perform research. They consider these restraints on research as generally unwarrantable. The argument about the moral status of the human embryo is not as strong as the ideals of freedom of thought, freedom of conscience, and freedom of inquiry.⁷⁵ The most frequent declaration for the protection of research as an essential right comes from an interpretation of the First Amendment's protection of free speech to include free expression and possibly freedom of inquiry and thought. Some individuals contend that research is a type of expression, predominantly when it is politically or socially controversial, or when moral restraints are forced on the research. One ethicist states:

"One could make the case that research is expressive activity and that the search for knowledge is intrinsically within the First Amendment's protection for freedom of thought."⁷⁶

Others have stated that American researchers and science will suffer the most from this policy. They state it will hinder embryonic stem cell research work in the United States and possibly cause well-known scientists to do research overseas.⁷⁷

Opponents argue this research is as much action as expression, as much creation as discovery. One individual states:

"Scientists may have the right to pursue knowledge in any way they want cognitively, intellectually but when it comes to concrete action in the lab, that becomes conduct and the First Amendment protection for that is far, far weaker."⁷⁸

⁷⁵ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*, (2004, assessed 13 April 2004); available from <http://www.bioethics.gov/reports/stemcell/chapter3.html>; Internet.

⁷⁶ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁷⁷ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁷⁸ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

They also assert that even if the research is protected from government restriction; it is not clear that federal funding would not be restricted. The government sometimes does not finance activities it considers constitutionally protected rights. Supreme Court decisions from 1977 to 1991 involving abortion and government funding recognized that government did not necessarily have to fund those activities that the Constitution defends.⁷⁹ Opponents also argue human subject protections are usually placed on scientific research performed with private funds and especially federal finances. But the question comes down to are embryos human beings.⁸⁰

The Importance of Relieving Suffering

Many contend that biomedical science's fundamental principle is the responsibility to search for the relieving of pain and suffering of others. Some feel that the administration has decided to emphasize the protection of human embryonic life over relieving pain and suffering of others. Many critics wonder how anyone could refuse aid for research that could provides therapies for spinal cord injury, diabetes, and Parkinson's.⁸¹ These diseases have many human faces that are filled with the agony of a debilitating illness. They state that the pain and suffering of these patients overshadow concerns for human embryos that are frozen in a laboratory.⁸² Therefore, the greater the research potential, the more assistance it should get. The main argument is a utilitarian one, meaning what is the greatest good for the greatest amount of people.⁸³

Advocates of the administration's policy contend that all though it

⁷⁹ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁸⁰ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁸¹ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁸² The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁸³ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

seeks the protection of human embryonic life, simultaneously seeks the advancement of medical research to relieve the suffering of others. They state that there are rules that prevent particular procedures, no matter how valuable these procedures maybe to comprehending and remedying an illness. These procedures cannot jeopardize or infringe on the dignity of human subjects involved in the research.⁸⁴ Proponents argue that those who desire medical research and treatment to overrule the protection of human embryos would not suggest that human subject protections should be overridden in research on children or adults. The key principle is that the federal government should not encourage the destruction of human embryos, despite the potentiality of research. Medical research can be advanced as long as it is within the boundaries of this principle. Once again, the issue comes down to the status of nascent human life.⁸⁵

The Moral Status of the Human Embryo

The fundamental questions are how should human embryos be considered and are all human embryos the same or are some, because of their conditions, foundations, or prospects, different than others, and therefore should be treated as such. The moral status and subsequent treatment of human embryos remains a controversial and divisive issue, in part because of its inescapable entanglement with the abortion discussion in America. The subject of the moral status of the human embryo involves other basic moral and existential questions concerning human beginnings, human dignity, and the moral implications of biology.⁸⁶

Once again the question is "when does life begin?" That question implicitly states that human beings, i.e. newborns to adults, should be

⁸⁴ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁸⁵ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁸⁶ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

granted protection and are, effectively, sacred. Hence, should human embryos be merited protection, and as a result, be considered sacred.⁸⁷

Many who argue on either side of this issue take either the biological continuity or discontinuity side of embryonic and human life. One side states that the fundamental organismal continuity from fertilization to natural death signifies that no lines can be drawn between embryos and adults. On the other side, discontinuity is illustrated in different stages of development, which should direct the subsequent treatment of human embryos.⁸⁸

Those who strive to protect the human embryo and have it considered as inviolable, establish their argument on biological continuity. They assert that the human embryo is an entire, living organism from the first stage of natural development, and that within the appropriate environment, it will form into a human fetus and then a human child.⁸⁹ Therefore, they state that the adult human beings that currently exist were once human embryos. The achievement of syngamy, which is the uniting of paternally- and maternally-donated haploid pro-nuclei that results in a unique diploid nucleus of a developing zygote, is an indicator of a new protection-worthy human life. There is now a new genome and a single-celled embryo that is starting its cleavage and hence a continuous developmental path toward birth.⁹⁰

Some proponents of this view argue that it deals only with genetic identity and is not concerned enough with the current state or the importance of development. Human beings are more than a human genome.⁹¹ The human embryo is a cluster of cells, devoid of sentience or sensation and lacking human form. As a result, there is no clear boundary between nascent human life and

⁸⁷ The President's Council on Bioethics, *Monitoring Stem Cell Research*: Chapter 3.

⁸⁸ Holland, 165.

⁸⁹ Holland, 167.

⁹⁰ The President's Council on Bioethics, *Monitoring Stem Cell Research*: Chapter 3.

⁹¹ Holland, 169.

adult individuals.⁹²

Protection should be given to human embryos once they have the capability to feel pain, display neural activity, and basic self-awareness, some aspects of human form, or the ability to function autonomously. Until that time, the embryo does not merit protection equivalent to human beings.

⁹³Genetic identity and organismic continuity are not enough; existing appearance and function are more significant. Three discontinuity views have been offered in order to divide the stages when the human embryo can be used for research and from when it merits protection.⁹⁴

The most accepted discontinuity view is determinate on the emergence of the primitive streak, which indicates where the vertebral column will develop. The primitive streak usually develops approximately on the 14th day following the first cell separation. One of the reasons why primitive streak is held so notably has to do with the biology of twinning.⁹⁵ Preceding the primitive streak, the embryo can still divide to form identical twins. As a result, some deduce that individuality is not yet established. Therefore the embryo does not have definitive individuality, which is necessary for human personhood and moral status, and therefore cannot have moral status before the appearance of the primitive streak.⁹⁶ Advocates of embryo research recommend the 14th day of development as a stopping point for allowable research. Critics state that twinning is a typical event in development, and the moral worth of the embryo before twinning is not diminished.⁹⁷

A second discontinuity view centers on the emerging nervous system. The nervous system is an essential indicator of humanity because the human brain

⁹² Holland, 170.

⁹³ Holland, 171.

⁹⁴ Holland, 171.

⁹⁵ The President's Council on Bioethics, *Monitoring Stem Cell Research*: Chapter 3.

⁹⁶ The President's Council on Bioethics, *Monitoring Stem Cell Research*: Chapter 3.

⁹⁷ The President's Council on Bioethics, *Monitoring Stem Cell Research*: Chapter 3.

is part of what makes human beings human, and the nervous system is the base of sensation, in particular the feeling of pain. Supporters state that before an embryo has acquired sentience, no moral boundary has been crossed when it comes to subjecting it to research.⁹⁸

The third discontinuity view contends that basic elements of human form must be obvious before the human embryo should be worthy of protection. The human form indicates the presence of a human life. A cluster of cells is not clearly human, and consequently should not be regarded as human.⁹⁹

Some arguments for funding embryo research depend on questions of embryo-viability and potential. The most frequent circumstance deals with cryogenically frozen embryos that were left over from in vitro fertilization. One study implies hundreds of thousands of these embryos are in the United States.¹⁰⁰ The egg and sperm donors will never request most of these frozen embryos, which means many are fated to stay frozen and die without further development. There have been efforts to encourage adoption of embryos and to use them in assisted reproduction, but this is unlikely change the future of most of these embryos.¹⁰¹

Many proponents feel that since many of these embryos will die they might as well be used for some beneficial purpose. Critics feel this argument disregard the moral implications of creating and freezing them in the first place.¹⁰² Even though, the decision to the produce and store these embryos was erroneous; it does not change the fact that the embryos now exist. Critics further contend that there may be possible condoning of creating spare

⁹⁸ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

⁹⁹ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

¹⁰⁰ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

¹⁰¹ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

¹⁰² The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

embryos in the future. It would be impossible to determine the embryos formed only for reproduction, and those created for research.¹⁰³ Advocates utter that there is no likely way such embryos will develop, and therefore utilizing them in research does not imply loss of possible life. Critics argue that the moral status of the embryo is then dependent upon those in charge of it, which means moral status is determined by its potential development. Potential development means the embryo has to be in a uterus, which means the moral status of an embryo rests on human choices.¹⁰⁴

Some argue that embryo destruction for research would not cause greater loss than the natural process, and at least the research would bring about benefits for humanity. Natural embryo loss following conception in regular human reproduction is high and well known, and this is not seen as tragic and great strides have not been made to prevent or reduce it.¹⁰⁵ Therefore, human embryonic stem cell research would increase human survival and results in no greater loss of life than natural processes do. Opponents argue that the natural deaths of embryos and intentional deaths for research are not comparable.¹⁰⁶

Federal Funding

The federal funding of human embryonic stem cell research remains a controversial issue. The pro side of the argument was discussed in an article named "*Ethical Issues in Human Stem Cell Research*," from September 1999. The article stated that federal funding should be allocated to human embryo

¹⁰³ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

¹⁰⁴ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

¹⁰⁵ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

¹⁰⁶ The President's Council on Bioethics, *Monitoring Stem Cell Research: Chapter 3*.

research that uses embryos that are leftover after in vitro fertilization.¹⁰⁷ The prohibition on human embryonic stem cell research is due to a rider in the appropriations bill for the Department of Health and Human Services, of which the National Institutes of Health belongs. The rider forbids funds to be used to support research "in which a human embryo [is] destroyed, discarded or knowingly subjected to risk of injury greater than that allowed for research on fetuses in utero."¹⁰⁸ The ban on federally funded research suggests a moral point of view, wherein embryos have personhood or in the fact that enough public disagreement exist against using government funds to finance this type of research. The ban further clashes with the objectives of medicine, which are healing, prevention of harm, and research.¹⁰⁹

Richard M. Doerflinger, the associate director for policy development and secretariat for Pro-Life Activities of the National Conference of Catholic Bishops stated against federal funding for human embryonic stem cell research in *Testimony before the Senate Appropriations Subcommittee on Labor, Health and human services and Education* on December 2, 1998.¹¹⁰ He stated that Congress should fund medical research that values human life while at the same time improving it. A civilized society should not move forward with scientific research at the expense of human dignity. The Tuskegee syphilis study and the Cold War radiation experiments occurred because there was only a need to enhance scientific research, no concern about the individual.¹¹¹ Legislators, in deciding whether or not to fund research, are making a moral decision on what research is beneficial and ethical on behalf of all tax-paying citizens.¹¹² Government can use this opportunity to take a moral stance and by example direct both public and private research to avenues that

¹⁰⁷ Bettelheim, 1090.

¹⁰⁸ Bettelheim, 1090.

¹⁰⁹ Bettelheim, 1090.

¹¹⁰ Bettelheim, 1091.

¹¹¹ Bettelheim, 1091.

¹¹² Bettelheim, 1091.

respect human life and dignity. The government should fund research that does not involve the exploitation of human beings, such as in the use of placental blood to treat leukemia and other diseases.¹¹³

Abortion and Cloning

Cloning has a long history. In 1880, August Weissmann asserted that a cell's genetic information reduced with every cell separation. Walter Sutton confirmed that chromosomes contain genetic information in 1902.¹¹⁴ Hans Spemann, in the same year, split a Salamander embryo in two and thereby illustrated early embryo cells hold on to all genetic information required to form a new organism. In 1928, the first nuclear transfer experiment was done by Hans Spemann.¹¹⁵ In 1938, he proposed the transporting of one cell's nucleus into an egg that does not have a nucleus. Oswald Avery determined that cells' nucleic acids transport genetic data in 1944.¹¹⁶

Many major developments that shaped the future of cloning occurred in the 1950s and 1960s. Briggs and King cloned tadpoles in 1952. In 1953, Watson and Crick discovered DNA makeup. In 1958, F.C. Steward produced whole carrot plants from carrot root cells.¹¹⁷ In 1962, John Gurdon of Oxford University pronounced that he used adult intestinal cells' nuclei to clone South African frogs. J.B.S. Haldane created the term 'clone' in a speech called "Biological Possibilities for the Human Species of the Next Ten-Thousand Years" in 1963.¹¹⁸ In 1966, Marshall Nirenberg, Heinrich Mathaei, and Severo Ochoa deciphered the genetic code which led to genetic engineering studies and achievements in the 1970's. In 1967, the enzyme DNA ligase, which joins strands of DNA, was isolated. In 1969, James Shapiro of Harvard University, working with

¹¹³ Bettelheim, 1091.

¹¹⁴ G. Waite, *Cloning, Immortality, History* (Assessed 13 April 2004); available from <http://www.reproductivecloning.net/hosting/waite/>; Internet.

¹¹⁵ Waite.

¹¹⁶ Waite.

¹¹⁷ *History of Cloning* (Assessed 13 April 2004); available from <http://home.hawaii.rr.com/johns/history.htm>; Internet.

¹¹⁸ *History of Cloning*.

Jonathan Beckwith stated the isolation of the first gene, which directed sugar digestion in a specific kind of bacteria.¹¹⁹

Cloning started to get more recognition in the 1970s. In 1970, Howard Temin and David Baltimore independently isolated the first restriction enzyme labeled Reverse Transcriptase, which cut DNA molecules at certain locations.¹²⁰ In 1972, Paul Berg of Stanford University produced the original recombinant DNA molecules by combining two different organisms' DNA. Stanley Cohen and Herbert Boyer formed the first recombinant DNA organism in 1973.¹²¹ In 1977, Karl Illmensee, working with Peter Hoppe at Jackson Laboratory in Maine, produced mice with only one parent. In 1978, David Rorvik's book, *In His Image: The Cloning of a Man*, generates a worldwide debate on the ethics of cloning. Karl Illmensee asserted that he had cloned three mice in 1979.¹²²

Cloning and DNA experimentation continued through the 1980s. In 1980, the U.S. Supreme Court decided that live, human-made organisms can be patented.¹²³ Kary B. Mullis created the polymerase chain reaction, which permitted the rapid synthesis of selected DNA fragments, in 1983.¹²⁴ In the same year, Davor Solter, working with David McGrath, tried to clone mice using his version of the nuclear transfer method. In 1984, Steen Willadsen cloned a sheep from embryo cells. He was the first to clone a mammal using nuclear transfer.¹²⁵ He eventually utilized his cloning method to replicate prize cattle embryos. In 1986, Neal First, Randal Prather, and Willard Eyestone, working at the University of Wisconsin, cloned a cow from early embryo cells.¹²⁶

Cloning research attained huge magnitudes in the 1990s. In October of

¹¹⁹ *History of Cloning.*

¹²⁰ *History of Cloning.*

¹²¹ *History of Cloning.*

¹²² *History of Cloning.*

¹²³ Waite.

¹²⁴ Waite.

¹²⁵ Waite.

¹²⁶ Waite.

1990, the National Institutes of Health started the Human Genome Project, a massive international collaborative effort to locate the 50,000 to 100,000 genes and sequence the estimated 3 billion nucleotides making up the entire human genome.¹²⁷ Medical researchers began linking human traits with certain genes begun to determine the source of genetic disorders and diseases. In 1994, Neal First produced genetic copies of calves from embryos, which matured to 120 cells.¹²⁸ Ian Wilmut and Keith Campbell of the Roslin Institute in Scotland successfully cloned two sheep, named Megan and Morag, from differentiated embryo cells in July 1995.¹²⁹ On July 5, 1996, Ian Wilmut and Keith Campbell, researchers at the Roslin Institute in Scotland created Dolly. Dolly became the first organism to be cloned from adult cells. One week after the creation of Dolly, scientists twinned rhesus monkeys from embryos. In July 1997, Ian Wilmut and Keith Campbell created a Poll Dorset lamb called Polly that was cloned using laboratory developed and genetically modified skin cells to include a human gene.¹³⁰ In July 1998, Ryuzo Yanagimachi, Toni Perry, and Teruhiko Wakayama of the University of Hawaii stated that they had cloned fifty mice from adult cells beginning in October 1997. Japanese scientists asserted that they had cloned eight duplicates of a cow in December 1998.¹³¹

Research has been leaning more toward therapeutic cloning. In March 2000, the group that created Dolly produced the first cloned pigs. Researchers believe that pigs could be genetically engineered to aid in human organ transplants. A rare Asian ox named a gaur that was cloned died two days after birth in January 2001.¹³² On February 13, 2004, Korean and U.S. researchers stated that they had cloned a number of human embryos and removed

¹²⁷ *History of Cloning.*

¹²⁸ *History of Cloning.*

¹²⁹ *History of Cloning.*

¹³⁰ *History of Cloning.*

¹³¹ *History of Cloning.*

¹³² *History of Cloning.*

from one clone embryonic stem cells. Their method was an illustration of therapeutic cloning, which researchers anticipate can be employed to produce replacement tissue as in brain cells, skin, and so on. The clones were created by using eggs and cumulus cells, which are located in the ovaries and enclose a developing egg.¹³³ Korean women picked by the researchers contributed these cells. The nuclei from the egg cells were substituted with the nuclei from the cumulus cells, therefore matching the woman's egg cell with her cumulus cell.¹³⁴ Then a chemical trigger was used to initiate the development of the eggs as if sperm had fertilized them. They only acquired 30 blastocysts out of more than 200 attempts.¹³⁵ The researchers failed when they attempted to clone men using a piece of skin from the ear and when they tried to clone a woman by means of another woman's hollowed-out egg.¹³⁶ Scientists were pleased with the advancement but emphasized it would be years before any patient was helped by this method. On the other hand, the researchers urged an urgent global ban on reproductive cloning.¹³⁷

The argument of abortion and embryonic stem cell research boils down to whether one believes personhood begins at conception or not. Anti-abortion groups came together to protest the use of aborted fetuses for embryo research. Opponents of abortion continue to fear the slippery slope of justification. A society that allows the destruction of human embryos will then allow the destruction of human fetuses and then human babies.

Most people believe that if research on human embryonic stem cells is allowed, it would be just a matter of time before cloning is permitted as well. Many of the misconceptions about cloning come from science fiction novels and films. These same people have the misconceptions that the world

¹³³ Associated Press, *Scientists' cloned human embryos* (CNN.com, 2004, assessed 13 April 2004); available from <http://www.cnn.com/2004/HEALTH/02/12/science.clone/>; Internet.

¹³⁴ Associated Press.

¹³⁵ Associated Press.

¹³⁶ Associated Press.

¹³⁷ Associated Press.

will be amassed with clones that are drones. These drones will be exploited and be treated as slaves without the same rights as humans. They also feel that women will become incubators for these clones. They also feel that cloning might lead to a state eugenics program.¹³⁸

Most researchers do not see human cloning this way. Most think the research could be used in beneficial ways to help infertile couples and to study and prevent genetic disease.¹³⁹ Plus research has shown that a cloned person would not be an exact copy of the human being because there would be differences at the molecular level even though the gene structure would be similar. It has also shown that cloned cells with identical sets of genes differ somewhat in shape and color. In addition, the brain cannot be cloned or duplicated from a DNA blueprint.¹⁴⁰

It is also necessary to distinguish between the different types of human cloning. Cloning can refer to molecular cloning, cellular cloning, embryo twinning, and nuclear somatic transfer. When most researchers discuss human cloning, they are referring to nuclear somatic transfer. This is what occurred with Dolly the sheep. In molecular cloning, strings of DNA containing genes are duplicated in a host bacterium.¹⁴¹ In cellular cloning, copies of a cell are made, resulting in a cell line where identical copies of the original cell can be grown ad infinitum.¹⁴² In embryo twinning, an embryo that has already been formed sexually is split into two identical halves.¹⁴³ In nuclear somatic transfer, the nucleus of an adult cell is implanted in an egg cell where the nucleus has been removed. A variant of this process called fusion is to put the donor cells next to an enucleated egg and fuse the two with a tiny electric current. A blastocyst, a preembryo of about a hundred

¹³⁸ Gregory E. Pence, *Who's Afraid of Human Cloning?* (England: Rowman & Littlefield Publishers, Inc., 1998), 43-46.

¹³⁹ Pence, 11.

¹⁴⁰ Pence, 11.

¹⁴¹ Pence, 11.

¹⁴² Pence, 11.

¹⁴³ Pence, 11.

cells or less, starts to develop because the pulse that produces fusion also activates egg development.¹⁴⁴

Many arguments exist for the allowing of human cloning. One such argument is personal liberty and the right to self reproduce.¹⁴⁵ Another argument is the benefit that it would have for children in the sense that the child's genetic inheritance can be improved and that if a child is born with a certain genetic abnormality it could be corrected. Another argument is that it could aid infertile couples and also gay and lesbian couples. An additional argument is that a clone could be an ideal source of stem cells.¹⁴⁶

For the many arguments that exist in support of cloning, many others exist that oppose it. One such argument is that it is against the will of God. Another argument is that it will decrease the diversity of the gene pool.¹⁴⁷ Another argument is the risk to the child due to mistakes from genetic transfer and fetal development. An additional argument discusses the slippery slope that may occur and that may lead to additional discrimination of the disabled, lower economic classes, and women.¹⁴⁸

The United States has introduced restrictions and bans on human cloning. In June 1997, the National Bioethics Advisory Commission urged Congress to ban somatic cell nuclear transfer for the creation of in both the public and private sector. The Commission felt human cloning was unsafe and unethical. In spite of this, the Commission did not want any legislation passed barring cloning to interfere with other areas of scientific research. President Clinton signed a five year suspension on federal and privately financed research on human cloning in June 1997.¹⁴⁹ Even states, such as Wisconsin, California, Ohio, Illinois, and Connecticut, have restricted human

¹⁴⁴ Pence, 11.

¹⁴⁵ Pence, 87.

¹⁴⁶ Pence, 87.

¹⁴⁷ Pence, 90.

¹⁴⁸ Pence, 90.

¹⁴⁹ Waite.

cloning in their state laws. Democrats and Republicans have proposed bills in Congress dealing with the issue of human cloning. The Democratic bill, recommended by Senators Dianne Feinstein and Edward Kennedy, would ban implanting of cloned human embryos but permit limited cloning research. And also, the ban would end in ten years. The Human Cloning Prohibition Act, which is the Republican form, would want a permanent ban on human embryo cloning and cause it to be a crime carrying a punishment of up to ten years in prison and a \$250,000 fine.¹⁵⁰

European nations also took measures against human cloning. On January 12, 1998, the Council of Europe and six other nations signed a ban that banned human cloning, even though cloning cells for research would still be acceptable.¹⁵¹ Germany and Britain were not party to this. This would explain why Britain became the first country to allow a copyright on cloned initial human embryos in January 2000. Geron Corporation, which obtained the patent, states it was not going to produce cloned humans.¹⁵²

The United Nations' General Assembly in New York chose to delay a ban on human cloning until 2005. The other option was a Costa Rican-led comprehensive ban on both human reproductive and therapeutic cloning, which was supported by the United States and 43 other countries.¹⁵³ Reproductive cloning, making babies, is considered treacherous and unethical by all countries. But the opinion on therapeutic cloning is divided, which is using cloned embryos to yield stem cells for medical purposes. The stem cells would not be rejected after implantation into the donor. Proponents state that the embryo's death is wrong under any circumstance.¹⁵⁴ Plus, cloned animals have

¹⁵⁰ Duffy.

¹⁵¹ Waite.

¹⁵² Waite.

¹⁵³ Celeste Biever, *UN postpones global human cloning ban* (New Scientist.com, 2003, assessed 13 April 2004); available from <http://www.newscientist.com/hottopics/cloning/cloning.jsp?id=ns99994359>; Internet.

¹⁵⁴ Biever.

experienced health problems. This is one of the reasons why reproductive cloning is banned in over 30 countries. The United Kingdom, Japan, China, Germany, France, other countries, and most scientific institutions want a global ban on reproductive cloning while allowing each country to make its own choice on therapeutic cloning.¹⁵⁵

Scientific advancement is typically praised but not when it interferes with the realm of creating human life due to the uncertainty of the degree to which scientists should be involved in doing this. Therefore, at this time, human cloning at the national and international level is deemed unacceptable. The world is not prepared for full-scale human cloning.

International positions

United Kingdom

The United Kingdom has the most liberal policies concerning human embryonic stem cell research. A 1990s law permitted research on unused embryos up to 14 days old.¹⁵⁶ That same law allowed embryos to be created exclusively for certain research categories involving fertility. On December 20 2000, the British Parliament has voted to allow stem cell research on human embryos. The policy was passed 366 votes to 174 votes.¹⁵⁷ Scientists believe embryonic stem cell research could provide treatments and cures for many serious illnesses. "I'm very pleased that Parliament has agreed to this type of research, which has the potential to be of considerable health benefit," Martin Bobrow of the Cambridge Institute for Medical Research informed the *New Scientist*.¹⁵⁸ Mike Dexter, director of the Wellcome Trust, stated: "This is a vote for science, for health and for the future. The priority now must be to take forward the research and deliver real health

¹⁵⁵ Biever.

¹⁵⁶ Emma Young, *Stem cell go-ahead* (New Scientist.com, 2000, assessed 13 April 2004); available from <http://www.newscientist.com/hottopics/cloning/cloning.jsp?id=ns99994359>; Internet.

¹⁵⁷ Young.

¹⁵⁸ Young.

benefits."¹⁵⁹ Fiona MacTaggart, Labour MP for Slough, told parliament, "If you accept the 1990 Act, it is unforgivable not to vote for this extension."¹⁶⁰ Anti-abortion and some religious groups passionately protested against the regulations, in fear they would initiate the destruction of human embryos and allow restricted human cloning. Conservative MP Edward Leigh stated to parliament, "What we are doing today is very important indeed. For the first time we are saying that we shall create cloned human embryos. This is something entirely new."¹⁶¹ Peter Garrett of the campaign group Life stated, "The ethical implications are major. This is a momentous change."¹⁶² The health minister Yvette Cooper, who established the new policies, assured that the regulations would not lead to reproductive cloning, which continues to be illegal.¹⁶³

Germany

Embryonic stem cell research is a very delicate subject matter in Germany as a result of the medical abuses carried out by the Nazis and their subsequent endeavors to produce a master race. With this being said, the German lower house of parliament approved the allowance of the importation of embryonic stem cells, but voted against their creation in the country in January.¹⁶⁴ On April 26, 2002, the German parliament approved of a law that permitted embryonic stem cells to be imported for research. The vote was 360 to 190 with nine abstentions. The law went into effect on July 1.¹⁶⁵ Chancellor Gerhard Schröder supported the decision in order for Germany not to lag behind other countries in this area. Both biotech firms and scientists

¹⁵⁹ Young.

¹⁶⁰ Young.

¹⁶¹ Young.

¹⁶² Young.

¹⁶³ Young.

¹⁶⁴ EducationGuardian.co.uk, *Germany allows embryonic stem cell imports* (Guardian Newspapers Limited, 2003, assessed 13 April 2004); available from <http://education.guardian.co.uk/higher/research/story/0,9865,691047,00.html>; Internet.

¹⁶⁵ EducationGuardian.co.uk.

worried that if parliament did not vote in favor of this proposal that it would cost the country jobs and prominent scientists. The parliament decided on a three-year prohibition on the utilization of new embryos instead of the original permanent ban.¹⁶⁶ This new law results in Germany's stance being along the same lines as the United States'.

China

China is advancing in the field of embryonic stem cell research. Progress has been reported by the Ministry of Health in regards to the research done at the Stem Cell Research Center of the Second Hospital, which is connected to the University of Zhongshan. The Stem Cell Research Center has generated human embryonic stem cell systems.¹⁶⁷ Professor Huang Shaoliang, head of the Stem Cell Research Center and fellow researcher He Zhixu have created three human embryonic stem cell systems named CHE1, CHE2 and CHE3, which came from blastula material. By means of the phasing method, the center has been able to stimulate mice embryonic stem cells to develop into hemopoietic stem cells that are connected to the production of blood.¹⁶⁸

Netherlands

On October 9, the Dutch Parliament passed a law that permitted researchers to utilize leftover embryos from in-vitro fertilization for embryonic stem cell research.¹⁶⁹ The law, however, prohibited the creation of embryos exclusively for experimentation. It also excludes human cloning, manipulation of embryos for sex selection, and the blending of human and animal embryos. In order for research to be conducted, informed consent has to be received from the embryo donor. Moreover, a national committee must

¹⁶⁶ EducationGuardian.co.uk.

¹⁶⁷ Phillip Cho, *Human Embryonic Stem Cell Research in China* (U.S. Embassy Beijing, 2002, assessed 13 April 2004); available from <http://www.usembassy-china.org.cn/sandt/stemcell.htm>; Internet.

¹⁶⁸ Cho.

¹⁶⁹ Genet-News, *Spain closes door on embryonic stem cell research, Netherlands open it* (2001, assessed 13 April 2004); available from <http://www.gene.ch/genet/2001/Nov/msg00007.html>; Internet.

support all studies involving embryonic stem cells.¹⁷⁰

Spain

The Spanish parliament did not approve the Socialist party's proposition to permit the usage of leftover embryo's stem cells from in-vitro fertilization treatments on October 3. A government spokesman stated,

"the government must first create an Advisory Committee on Ethics of Scientific and Technological Research and because we are aware that 40,000 spare embryos have not been destroyed so future research projects are not at risk".¹⁷¹

The Socialist party wanted the Parliament to amend the 1988 law on assisted human reproduction. This law stated that embryonic stem cell research was a major crime.¹⁷²

Other European Union member states

The European Group on Ethics in Science and New Technologies, which is an advisory committee to the European Union, has allowed each individual country to make their own decision on whether or not to employ research on human embryos. Italy, Luxembourg, and Portugal have no particular legislation concerning human embryo research.¹⁷³ Belgium permits the production of human embryos for stem cell research. Austria, France, and Ireland ban the obtaining of stem cells from human embryos. Belgium, Denmark, Finland, Greece, and Sweden permit the acquiring of stem cells from supernumerary embryos.¹⁷⁴ Austria, Denmark, Germany, Spain, Finland, France, Greece, Ireland, Netherlands, and Portugal do not allow human embryos to be created for research due to the signed agreement of the countries at the Convention of the Council of Europe on Human Rights and Biomedicine in Oviedo on April 4,

¹⁷⁰ Genet-News.

¹⁷¹ Genet-News.

¹⁷² Genet-News.

¹⁷³ International Society for Stem Cell Research, *Stem Cell Research Regulations in the European Union* (2003, assessed 13 April 2004); available from <http://www.isscr.org/scientists/legislative.htm>; Internet.

¹⁷⁴ International Society for Stem Cell Research.

1997.¹⁷⁵

Conclusion

Just recently, embryonic stem cells have been stimulated to develop into bone marrow and blood cells in mice which could eradicate the necessity for a genetically matched human bone marrow donor for leukemia patients and others with such diseases. Evidence such as this has led many scientists to advocate human embryonic stem cell research. At the same time, these researchers have advocated the use of therapeutic cloning for medical purposes. However, proponents continue to discuss the inevitable slippery slope that will develop and in some sense has already happened- from abortion, to embryonic stem cell research, and predictably but hopefully not, in their opinion, cloning. They also assert that the life of a human embryo should not be destroyed to end the suffering of another, while advocates for this research feel that those suffering now should be held to a higher esteem than an embryo's future life.

Lawmakers and countries, both internationally and nationally, cannot agree on this research. Neither can the rest of the population. Countries, such as the United Kingdom and China have very liberal legislation when it comes to human embryonic stem cell research and therapeutic cloning. Other countries, such as Spain and Italy, which are predominantly Catholic, are against any form embryo research or any form of cloning. While other countries, such as the United States, France, and Germany are in between, trying to weigh the benefits and consequences of human embryonic stem cell research and therapeutic cloning. President Clinton favored federal funding for human embryonic stem cell research as long as the research followed certain guidelines because he believes that its potential benefit outweighed any cost. On the other hand, President Bush believed that the benefit of this research did not outweigh the future costs it might bring, so he allowed

¹⁷⁵ International Society for Stem Cell Research.

federal funding only for the 64 lines that already exist. Senators and congressmen and women have differed in their opinions on human embryonic stem cell research.

Human embryonic stem cell research has the potential to aid millions of suffering Americans. The research has the possibility to find treatments if not cures for Alzheimer's, Parkinson's, Multiple Sclerosis, and countless others. Birth defects and infertility could become a part of the past, as well as needed donor transplants. Scientists could also learn more about early human development from this research. Embryonic stem cell research could be used to test new medicines. For these reasons alone, embryonic stem cell research and therapeutic cloning should be federally funded. The federal government should be concerned with those suffering now, and not those that will exist in the future. People, such as Michael J. Fox and Christopher Reeves, are living proof that research and funding are needed. President Bush's policies have attempted to stifle medical advancement based on a religious stance of the embryo and misconceptions of issues, such as cloning.

The implications of embryonic stem cell research are broader than the issue itself. It concerns matters such as the right to research, the right to protest, the right to receive all possible treatments to relieve suffering, and the list goes on and on. The key matter, however, is advancement and progression of science and society. As medical advancement continues, these issues will continue to be brought to the forefront. Legislating against progress will never work. Researchers will always experiment in ways they believe will benefit society. Therefore, government and citizens should not contest progress but work with it, embrace it, and use it for good.

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