A Dialogue on Stem Cell Research

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What are stem cells?
As defined in Tabor's Cyclopedic Medical Dictionary, stem cells are "cells that give rise to a specific type of cell as in hematopoiesis." In a general sense, not all stem cells are "unspecialized."

What are embryonic stem cells? Where do they come from?
Assuming this question is specific to human embryonic stem cells (hESC), these cells come from embryos, which are considered to be in the blastocyst stage of growth. At this stage the embryo is 5-8 days old and consists of 50-200 cells, depending on the exact age. It is at this stage the blastocyst would naturally be implanted in the uterine wall and continue to develop into a healthy baby. To produce the human embryonic stem cell line, the developing embryo must be destroyed and the life of that child terminated, in order for the individual cells to be harvested and cultured.

To put this in a more distinctly ethical perspective, one needs to understand that currently children have been successfully adopted earlier than the blastocyst stage. There is no difference in the humanity of a child at the single cell stage and a fetus or newborn. There are only differences in size and maturity. To fully comprehend this, one should visit http://www.nightlight.org/snowflakes_description.asp to see the children that were adopted when they were just 2 or more cells big – much smaller in comparison than the embryos sought for harvesting into hESC lines.

What are adult stem cells? Where do they come from?
Adult stem cells are undifferentiated cells found in (differentiated) tissue. These cells can renew themselves and generate specialized cell types (e.g. cells found in bone marrow). The use of these stem cell lines does not require the termination of human life.

Are adult or embryonic stem cells better for research?
Adult stem cells have been successfully used with human patients in treating brain tumors, ovarian cancer, testicular cancer, lymphoma, leukemia, multiple myeloma, breast cancer, non-Hodgkin's lymphoma, Hodgkin's lymphoma, renal cell carcinoma (kidney cancer), multiple sclerosis, Chrohn's disease, rheumatoid arthritis, lupus, various autoimmune diseases, sickle cell anemia, aplastic anemia, corneal regeneration, bone repairs, surface wound healing, spinal cord injuries, stroke, Parkinson's disease and more… (www.stemcellresearch.org)

Even though adult stem cells are not as convenient without pluripotency, their effectiveness is unquestionable. More recent research demonstrates that the versatility of some types of adult stem cells is also more substantial than once perceived.

Consistent in many different reviews of the use of human embryonic stem cells is the belief that these cells may have the potential to effectively treat or cure diseases in the future. Their effectiveness is primarily speculative at this point in time.

Does the federal government ban cloning?
There is no federal law prohibiting cloning. There have been eight bills introduced in the 109th Congress, in both the U.S. House and U.S. Senate. Six would prohibit human cloning, one would prohibit federal funding of human cloning, and one would encourage research leading to human cloning. None of these measures have passed their respective chamber.

Does the federal government fund cloning?
In March 1997, President Clinton issued a directive prohibiting federal funding of cloning (see http://grants.nih.gov/grants/policy/cloning_directive.htm), which is still in effect today.

What is reproductive cloning? What is therapeutic cloning?
Both reproductive cloning and therapeutic cloning use the same process, "somatic cell nuclear transfer" (SCNT) to create a product that would mirror the human embryo (definition of terms will be critical). SNCT involves the removal of the nucleus from an adult's somatic cell—or any cell in the human body other than sperm cells in men and egg cells in women. The nucleus taken from the somatic cell then is transferred to a woman's egg cell, from which the nucleus has been removed. Through proper stimulation, the egg cell develops into an embryo-like clone.

Reproductive cloning has a distinct purpose of initiating a pregnancy by implanting the cloned embryo-like product into a woman's uterus. If the procedure leads to a live birth, the resulting clone inherits one person's genetic material, that of the individual from which the somatic cell was taken. Therapeutic cloning carries the intention of creating the clone for the specific purpose of destroying it for research in disease prevention or treatment. Both types of cloning carry substantial implications for the formation of policy.

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What are stem cells?
Every human being began life as a single, pluripotential stem cell, having received one half of their full compliment of DNA (22 autosomes and one sex chromosome) from the mother's egg and the other half (22 autosomes and one sex chromosome) from the father's sperm. That initial cell then began to divide and every one of the cellular divisions would receive 46 chromosomes, thus retaining the information (within the DNA located in the nucleus) necessary to become any organ or perform any function in any portion of the body. The "lines" of stem cells that we hear so much about are those cells that appear at about one week following the initial fertilization and division process. At that point there are approximately 150 cells. They form four layers; the outer layer forming a cystic structure (the blastocyst) is destined to become the placenta which will attach to the lining of the womb and supply nutrients and oxygen to the developing human. Inside the cyst is a tuft of tissue, three layers deep. Those cells make up the ectodermal stem cells, the mesodermal stem cells and the endodermal stem cells. The ectodermal stem cells will further differentiate and become the skin and its appendages and the central and peripheral nervous system. The mesoderm is destined to become blood vessels, bone, bone marrow, ligaments, tendons and muscles (skeletal, smooth and cardiac). The endodermal stem cells are destined to become the digestive tract, liver, pancreas and kidneys.

What are embryonic stem cells? Where do they come from?
These are the cells which are for the most part taken from a human being at its earliest stage of development, at or prior to the blastocystic stage. They may come from an aborted baby, a baby formed via invitro fertilization for that specific purpose, or one that is left over (and there are typically many of these) from invitro fertilization which has been for the purpose of providing a child for a barren marriage. That embryo may be one of those 450,000 now frozen in one of our nation's invitro fertilization labs. In the process of using these embryos, the life of the human is sacrificed for the sake of scientific progress. At every stage of development from the first stem cell to the full term child the full compliment of human DNA (46 chromosomes in each and every cell- the blueprint for life) is present.

What are adult stem cells? Where do they come from?
These are derived from one or more somatic cell types in fully developed humans. The most plentiful supply is found in the umbilical cord blood. For years we have harvested these adult stem cells from the peripheral blood after stimulating the bone marrow to produce them. They are then used to replace the bone marrow in that same person, whose marrow will be destroyed during chemo or radiation therapy. These adult stem cells can also be obtained from the spinal cord, skin or mesenchyme (the tissue that connects various internal organs). In the process of obtaining these no human life is sacrificed.

Are adult or embryonic stem cells better for research?
If an embryonic stem cell is used to produce an organ for replacement, its genetic blueprint will differ from that of the organ recipient. As a result rejection will occur. To thwart that rejection the person receiving the organ developed from the embryonic stem cell will be destined to a life time of taking anti-rejection drugs. They have terrible side effects. If a person's own stem cell is used to produce the new organ or tissue the rejection phenomena will not come into play. At this point, researchers say that they can get their end results quicker with embryonic stem cell research; that may be so but is debatable. However, for the sake of expediency human lives are sacrificed and the end result still faces the same issues we now face in organ transplantation; that of rejection. Necessity being the mother of invention, if these consummately brilliant scientists are forced to use their ingenuity to develop research with only adult stem cells, they will get the job done. The easier path is not the wiser path.

Does the federal government ban cloning?
At this point in time there are no federal laws that ban cloning of humans.

What is reproductive cloning?
The science exists to accomplish this. One simply takes a somatic cell from a person and removes its nucleus containing the full compliment of genetic information necessary to reproduce that person's body. That information is then placed in a female egg, the nucleus (yolk) of which has been removed. The nucleus had contained all of the genetic information belonging to the female. The egg's cytoplasm (i.e. the white of a hen's egg) retains all of the necessary parts and functions to provide cellular division and propagation of the individual body being cloned. The "fertilized" egg (with a new "yolk") is then placed in a womb and allowed to develop over nine months. The end result of this process is a fully developed human being's physi-

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What is human life?
To understand everything below, we must first detail what happens biologically in the first few weeks of life. Both sperm and ovum have a haploid number of chromosomes i.e. 23. When the sperm head penetrates the ovum its chromosomes then migrate to the center of the ovum cell and join with the 23 in the ovum to then constitute a 46-chromosome cell. All other cells, from then on in the human body, have 46 human chromosomes. This cell, however, is different from any other cell in the body as, at this point, it is a complete human body, however yet being only one cell. In the second day of life, cell division begins and is progressive from then on. For the first week of this tiny new being's life, it floats freely down the mother's tube. When seven days old, it implants within the nutrient lining of the uterus and sends a chemical hormonal message through her blood to her pituitary gland in the brain. This notifies her body of the new passenger and stops her from having her oncoming menstrual period. When yet a single cell this being is human (46 human chromosomes), is alive (not dead, is on going in a self-controlled pattern of growth and maturity), is already sexed (x and y chromosomes distinguish male and female from the first cell stage), and is complete, for nothing will be added to this single cell, whom each of us once was, nothing but food and oxygen, for the rest of the life of this new living human. Biologically speaking, human life begins at the first cell stage. It is impossible to draw a line in time from that first cell until the old man dies and say that before this, this was not human life and after this, this is. Biologically speaking, this is human life from the very beginning.

What are stem cells?
Stem cells are unspecialized cells that have two important characteristics that distinguish them from other cells in the body. First, they can replenish their numbers for long periods through cell culture and division. Second, after receiving certain chemical signals, they can differentiate, or transform into specialized cells with specific functions, such as a heart cell or a nerve cell.

What are embryonic stem cells? Where do they come from?
Embryonic stem cells are very primitive, undifferentiated stem cells. They are capable of becoming any of the cell types and organs of the human body. In order to obtain them, the researcher must cut open the body of a five-day-old living human embryo (at this stage called a blastocyst) and extract from the inside of this living embryo these embryonic stem cells. This process of extracting these cells directly kills this five-day-old human embryo.

What are adult stem cells? Where do they come from?
Adult stem cells are undifferentiated cells found in all organs of the body. Conventional wisdom, yet only one or two years ago, held that there were very few of these, that they were hard to obtain and that they would probably not be as versatile as embryonic stem cells. Amazingly rapid progress has been made in the last one or two years which has largely dispelled this original thinking. Now adult stem cells are routinely obtained from the cord blood of a newborn child, from the placenta but also from skin, the pulp of baby teeth and, increasingly, from almost every organ in the body. It was felt that they would not grow well in culture and therefore could not be produced in the same quantities as embryonic stem cells. This is no longer true as there are now techniques that can duplicate adult cells in very large numbers.

Are adult or embryonic stem cells better for research?
Here, again, convention wisdom of only a year or two ago has been largely been replaced by modern research findings.

What are embryonic stem cells?
Theoretically these should be better for research, but in practice not only have they been shown to not be superior to adult stem cells, but that adult cells have proven to be far more versatile. Scientific conjecture maintains that these should be more useful but this is yet to be proven. To date, experiments have been limited to animals. To date, there have been no successful clinical trials using embryonic stem cells in humans. For example, the National Institute of Health, one year ago, detailed that it was funding 300 human clinical trials with adult stem cells that were treating 74 different disease processes. At that time it was not funding a single human clinical trial with embryonic stem cells. Reasons for this are that embryonic cells are foreign tissue to the human who is being treated and therefore subject to rejection. These can also carry infection from the donor human to the patient being treated. But most importantly, science has yet to learn how to control their growth for they are very "plastic." Embryonic stem cells have a propensity to grow wild in the human recipient, forming tumors of many different cell types. Because of this, they have not yet been used in treating human problems.

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What is human life?
This question intimates the seriousness of this debate. Prior to neo-natal science, a human life was a baby, acknowledged in the womb or visibly born. In the era of modern science our ability to see the earliest stages of life have led some to seek a distinction between that which looks like a baby, or is viable outside the womb and that which is developing into a fully independent infant. The quest for a universal policy legalizing abortion forced political entities, including the Courts, to "divide the baby" and attempt to create an unnatural division of human life.

From a perspective of honest logic the result of conception is fully human in its construct and capacity and left unhindered by experimentation or illness will develop into a child birthed at term. To divide the child into a non-child at any step in the developmental process requires a tool that is unnatural, inconsistent with medical knowledge, and outside the legal tradition of protecting life as an "unalienable" right "endowed by the Creator".

Are adult or embryonic stem cells better for research?
There is an abundance of evidence that adult stem cells are and will remain far superior to embryonic stem cells for the purpose of providing real treatments and cures. The state should not be concerned with funding or facilitating "research" that leads toward dead ends. By banning embryonic stem cell research, the state will only take away a current convenience to a handful of researchers and firms. The private sector is not investing in these firms because the results are not profitable now or for the foreseeable future. By legalizing only adult stem cell research the state is creating an incentive toward the research that is most productive at every level and requires no loss of life or controversy over such a debate.

Does therapeutic cloning create or destroy "embryos?"
The answer to both questions is wholly dependent upon the definition of terms. The equally important question is whether or not the product of asexual cloning, is in fact human in the classical definition of the term. The fact that the asexual cloned cells are not the result of the conception of two unique human parts, male and female, makes it a totally new and unique medical phenomena. The clone is an extension of existing cells, but it is not the same entity as an embryo created by the union of sperm and egg. Therefore, it is not technically correct to overlay identical definitions upon an embryo as classically understood and cloned cells.

Should stem cell research be subsidized with public funds?
The passage of Issue One creates a legal mechanism to use $500 million in long-term taxpayer funded debt for investment though at least 1.1 million Ohio voters disagree with this use of funding. The Ohio Constitution bans state investment in private corporations or ownership in the like so the nature of any subsidies other than the Issue One money cannot be legally directed to private firms. Given the limited platform for legal investment the Legislature should be extremely careful to not invest in any research that destroys human life or creates unneeded controversy over cloning. Other states have wisely banned cloning and ESC research placing their interest in the technology that is most productive and least controversial.

Where do right-to-life groups stand on these issues?
Citizens are working hard to gain full understanding of the data surrounding this highly technical debate. The position that most protects the sanctity of life and avoids high-risk scientific exploitation of life is to prohibit embryonic stem cell research and human cloning.

Isn't this only a religious question?
It might be, only if you ignore the words of the Declaration of Independence and centuries of American law and jurisprudence regarding the sanctity of human life. To intimate that only the "religious" person is concerned with the definition and protection of life is an insult to all non-religious citizens who recognize that fundamental rights are essential in a civil society. You don't have to be religious to see the medical downsides of embryonic stem cell research and human cloning. The problem is, many people have little understandable data on the real issues surrounding this debate. It is always dangerous to enact public policy prior to a consensus of understanding in the general population.

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Does therapeutic cloning create or destroy embryos?
The term "embryo" has different meanings to different fields. However, it is accurate to say that therapeutic cloning creates a "product"–albeit through asexual reproduction–with a full genetic complement that is capable of implantation. That "product" is destroyed after cells have been extracted from it.

What is cell therapy?
Cell therapy can be defined as a group of new techniques, or technologies, that rely on replacing diseased or dysfunctional cells with healthy, functioning ones. These new techniques are being applied to a wide range of human diseases, including many types of cancer, neurological diseases such as Parkinson's and Lou Gehrig's disease, spinal cord injuries, and diabetes. Replacing dead cells in the retina with new ones may someday cure even presently incurable eye diseases such as glaucoma and macular degeneration.

Does Ohio fund embryonic stem cell research?
Ohio allows for the funding of embryonic stem cell research if the stem cells are used from the current registry monitored by the NIH.

Does Ohio fund adult stem cell research?
Yes. In the last biennium, Ohio awarded $19.5 million to Center for Stem Cells and Regenerative Medicine at Case Western Reserve University.

What does the substitute version of H.B. 355 do?
HB 355 would prohibit state funding of research that involves the products of induced abortions, stem cells derived from destroying human embryos, and human cloning (both reproductive and therapeutic). It creates exceptions for research on embryonic stem cell lines authorized in the President's Executive Order of August 9, 2001 and cloning techniques to produce plants, animals, and human tissues OTHER than human embryos. It enacts an outright ban on both types of cloning and establishes criminal penalties for violations of the ban.

What does the Senate-passed version of S.B. 210 do?
SB 210 would ONLY prohibit state funding of research that involves stem cells derived from destroying human embryos. It creates exceptions for research on embryonic stem cell lines authorized in the President's Executive Order of August 9, 2001 and cloning techniques to produce plants, animals, and human tissues OTHER than human embryos.

It would not prohibit any type of human cloning or human embryonic stem cell research funded from other sources.

What do other states do?
Fourteen states have laws pertaining to human cloning. Six states–Arkansas, Indiana, Iowa, Michigan, North Dakota and South Dakota–ban both reproductive and therapeutic cloning. Six states–California, Connecticut, Massachusetts, New Jersey, Rhode Island, and Virginia (hard to determine due to vagueness of law)–prohibit reproductive cloning but permit therapeutic cloning. Arizona bans state funding for both types of cloning. Missouri bans state funding for reproductive cloning only.

Ohio also has a statute that was passed in 1974 which prohibits experimentation on any product of human conception for commercial purposes, if the product of human conception is the result of an abortion. (ORC 2919.14). The only difference between an aborted embryo and the embryos sought for hESC research is that one was implanted in a uterus and one was not.

Where do right-to-life groups stand on these issues?
Right-to-life groups are not divided on their perspective that state policy should protect life–even as small as a human embryo. The only differences on this issue rest in the approach to promulgate statutes and secure legislative support.

Do we allow cloning of animals?
Ohio law has no prohibition on the cloning of animals. The substitute draft of HB 355 would allow the cloning of plants and animals.

Has a human being ever been cloned?
In May 2005 scientists in South Korea at the Seoul National University announced that they had successfully cloned a "human embryo" and created embryonic stem cell lines from these cloned "embryos."

According to the Congressional Research Service's Report for Congress, "Human Cloning" (RL31358), Clonaid announced the birth of the first cloned human (7-lb. girl, named Eve) in 2002. To date the claim is unsubstantiated.

Additional policy considerations:
When formulating policy concerning stem cell research and cloning, it would be wise to consider the perspective of the "slippery slope." The National Academies of Science have published this year their recommendations for policy guidelines. The NAS acknowledges that research using hESC may lead to the creation of human/nonhuman chimeras and implanting interspecies chimeras into a human uterus, which they oppose "at this time." The NAS also specifies that human reproductive cloning should not be conducted "at this time." This is the "slope"–not now, maybe later.

It is very important to understand that certain ethical boundaries should not be crossed in the field of human experimentation. How easy it is to forget the lessons learned which led to the development of the Nuremberg Code.

Prolife policies will not stunt economic growth or research potential. State policy should support effective research and drive the market toward exponentially improving what has been accomplished using adult stem cells or umbilical cord stem cells. The market, with an ever increasing pressure to move past ethical constraints, should not drive policy.

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cal body. The question remains unanswered however, whether the end product is really human or merely a physical reproduction that is unable to deduce, emote, calculate or possess volition.

What is therapeutic cloning?
If the process of reproductive cloning is arrested at the blastocyst stage and the various stem cells in the ectoderm, mesoderm or endoderm are used for organ development, one has therapeutic cloning.

Does therapeutic cloning create or destroy embryos?
It will do to the embryo formed (created) exactly what happens to an embryo formed by in vitro fertilization; destroy it. However, the question remains unanswered as to whether or not that cloned blastocyst is really human. See above under the question regarding reproductive cloning. Until it is answered, if ever, one should not allow therapeutic cloning. One should instead devote all time, energy, intellect and public funds to the sole research of adult stem cells.

Does Ohio fund adult stem cell research?
Yes. In the last biennium, Ohio awarded $19.5 million to Center for Stem Cells and Regenerative Medicine at Case Western Reserve University.

What does the substitute version of H.B. 355 do?
HB 355 would prohibit state funding of research that involves the products of induced abortions, stem cells derived from destroying human embryos, and human cloning (both reproductive and therapeutic). It creates exceptions for research on embryonic stem cell lines authorized in the President's Executive Order of August 9, 2001 and cloning techniques to produce plants, animals, and human tissues OTHER than human embryos. It enacts an outright ban on both types of cloning and establishes criminal penalties for violations of the ban.

Where do right-to-life groups stand on these issues?
These groups are split in their approach. Some support a state ban consistent with the President's Executive Order of August 2001, and a ban on reproductive and therapeutic cloning. Other groups do not believe that the executive order goes far enough, and would like to see all embryonic stem cell research banned.

Do we allow cloning of animals?
Ohio law has no prohibition on the cloning of animals. The substitute draft of HB 355 would allow the cloning of plants and animals.

Has a human been ever been cloned?
To our knowledge, no human beings have been cloned. There are unsubstantiated claims that they have been in other countries. However, the same technology that has been used in other countries to clone sheep, goats, mice, dogs and cats may be applied to human beings.

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What are adult stem cells?
As noted above, these are being widely used internationally to treat a broad spectrum of major illnesses. e. g. There are three cases now of using adult stem cells in quadriplegics where healing has occurred and function has returned to the paralyzed limbs. There are many places in the world where these cells are being used to rebuild damaged heart muscle walls. These are being used to reconstitute the insulin producing cells in a pancreas for a patient with diabetics. The list is long. In contrast to embryonic stem cells, there is no risk of rejection, for the adult stem cell is taken from the patient, cultured, multiplied and put back into the same patient. This, also, obviates any threat of possible transfer of infection. Finally, these cells have been controllable and do not form the tumors mentioned above.

Does the federal government ban cloning?
There is no federal law prohibiting cloning.

Does the federal government fund cloning?
In March 1997, President Clinton issued a directive prohibiting federal funding of cloning which is still in effect today.

What is cloning?
Human cloning, scientifically known as "somatic cell nuclear transfer" (SCNT), is the process by which one would create a new living human who would be the identical twin of the original subject, however of course, at the beginning of his or her life. This involves taking the ova (egg) of a woman. Its nucleus is removed and discarded. Then you take a skin cell from the human subject, remove its nucleus (discarding its shell) and insert that nucleus in the empty shell of the ovum. Then through low dose electric stimulations, this new fertilized egg, theoretically at least, can proceed as would a fertilized egg in the natural development process and, if implanted, would develop into an infant, the identical twin of the skin cell donor. Current terminology would use two different terms for what is then done. "Reproductive" and "therapeutic or research" cloning. They are both identically the same thing, the difference being what is done with them. "Reproductive" cloning is the term given when this new human embryo is implanted within a uterus, carried to term and delivered. "Therapeutic or research" cloning is the same identical process. However, this new human would then be used for research purposes in his or her first weeks of life and then killed. Accordingly, the term therapeutic is very misleading for therapy means healing, and this is certainly not what would be happening to this newly cloned human in this case. One advantage of research cloning to produce embryonic stem cells as compared to extracting them from other human's embryos is that it would probably eliminate the problem of rejection. This is not absolutely guaranteed, however, as in the cytoplasm, the substance in the shell of the ovum, there would still be some protein complexes called mitochondria carrying the donor woman's DNA. So it is possible that even a cloned embryonic stem cell might still create rejection problems.

Does therapeutic cloning create or destroy "embryos?"
What does the term embryo encompass? It is important to define terms. Traditionally, the term embryo has encompassed this new human from fertilization until he or she is approximately 6 – 8 weeks old in utero. A term pre-embryo has been invented in recent years to represent the first week or two of life, but this term has no scientific basis. A pre-embryo is best described as a swarm of sperm seeking one ovum. But when one penetrates in the process of fertilization this is no longer pre-embryo. Now this is an embryo. This first cell stage is usually called a fertilized egg or a zygote. After the first cell division, other names are applied to these first few days of life. The one most commonly heard is "blastocyst" which represents the fourth to seventh or eighth day of life. The term embryo, however, traditionally has encompassed all of these early days.

Does Ohio fund stem cell research? Yes.

Should stem cell research be subsidized with public funds?
Since adult stem cell research has been so startlingly successful in these last few years, there has been a large amount of venture capital, private funding, going into subsidizing this research. There has also been a significant amount of federal funding and some state funding going to adult stem cell research. Because there as been so little actual proven human clinical benefits to date using embryonic stem cells, there has been very little private money going into this research. However scientists, being scientists, eagerly want to pursue this unknown and therefore strongly support efforts to do embryonic research. Also, the powerful biotech firms have been lobbying aggressively for government funding for embryonic stem cell research. They have successfully obtained major funding in a number of states including California, New Jersey and others.

Where do right-to-life groups stand on these issues?
The right-to-life position would ban all human cloning. It would also ban the obtaining of embryonic stem cells by killing five-day old human embryos. It would encourage and subsidize the use of adult stem cells and stem cells from cord blood. Some right-to-life groups, recognizing that in some situation they cannot obtain the above ideal, have supported the President's Executive Order of August 2001.

Isn't this only a religious question?
You will note that none of the above mentions religious belief. The existence of fully human life at the first cell stage is a long proven scientific fact. Since this is a human life, then laws protecting human rights apply. The existence (or not) of a human soul is not a part of this discussion.