

CASE STUDIES

Case Study 1: Stem Cell

Standing in the voting booth, Raina hesitated. It was November 2, 2004, and she had to make her final decision on how to vote for California Proposition 71, the California Stem Cell Research and Cures Initiative. Proposition 71, a \$3 billion bond measure, would fund embryonic stem (ES) cell research at facilities across the state for the next ten years. Raina knew that Proposition 71 had widespread support, including that of Governor Arnold Schwarzenegger and several Nobel Prize-winning scientists, but she was also well aware of the controversy surrounding ES cell research.

Well before Election Day, Raina had taken the time to inform herself about the ongoing ES cell debate. She learned that ES cell lines are obtained by removing a group of cells, called the inner cell mass, from an embryo that is about five days old (also known as a blastocyst), and growing the cells in a Petri dish. The cells are prized by researchers because they are pluripotent, meaning that they have the potential to differentiate into a wide range of different types of cells if properly stimulated. Proponents of ES cell research say that such cells could be used to cure conditions such as Parkinson's disease, diabetes, heart disease, Alzheimer's disease, cystic fibrosis, and spinal cord injuries. In addition, ES cells could be studied to help scientists understand the basic processes of human development, and used to test new drugs.

ES cell research opponents say that it should be restricted because it requires the destruction of human life. Raina found this issue to be one of great concern. She learned that the ES cell lines currently used for research are obtained from embryos left over from in vitro fertilization (IVF). These embryos are voluntarily donated, and otherwise would be discarded. Raina wondered if embryos, even those so early in development, should be considered human beings. If so, then producing an excess of them for IVF and then discarding them would be wrong. Might it also be wrong to benefit from their sacrifice?

Raina had read about stem cells from other sources besides embryos. Some, known as embryonic germ cells, may be obtained from aborted or miscarried fetuses, but this source is subject to the same sort of controversy as ES cells. Some very promising results have come from research using stem cells taken from the umbilical cord and placenta, and adult tissues such as bone marrow and parts of the brain. In fact, some of these non-embryonic cells have already been used to treat medical conditions, including blood disorders, spinal cord injury and heart attack damage. Such stem cells are obtained without harming embryos or fetuses, and for this reason their use meets with few ethical objections. However, they appear to be more limited in their ability to differentiate than ES cells.

Finally, after weighing the arguments one last time, Raina cast her ballot. The next day, she learned that Proposition 71 had passed with 59% of the vote. Now it is possible that similar initiatives may appear on the ballots of other states.

Questions

1. How do you think Raina voted on Proposition 71? How would you have voted? Why?
2. Do you think that a five-day-old embryo should be accorded the status of a human person? If not, why not? If so, do the potential benefits of ES cell research outweigh the ethical objections? Explain.
3. In August 2001, President George W. Bush approved the use of federal funding for ES cell research, but only on cell lines already in existence, in order to avoid the destruction of additional human embryos. (ES cell research funding from other sources was unaffected.) Critics say that existing ES cell lines have only a limited lifespan before their usefulness for research is lost, and that the number of available lines is insufficient. Do you agree or disagree with President Bush's decision? Explain.
4. Should ES cell research prove fruitful, it raises the issue of a particular type of cloning known as therapeutic cloning. Therapeutic cloning would not result in the production of a new human being, but it would mean creating an embryo from which ES cells could be removed that would match the cells of a person's own body. This would prevent the rejection of transplanted cells by the immune system of the recipient. Would you support the use of therapeutic cloning in order to produce ES cells for treatment of disease or injury? Why or why not?

An alternative way of avoiding the transplant rejection problem mentioned in question 4 would be to reprogram adult body cells and make them into stem cells. Research in this area is already underway. Do you think that research efforts currently focused on ES cells should be shifted to this venue, or that a variety of approaches should be pursued? Explain your answer.

Case Study 2. Cloning

In December 2004, a tabby kitten named Little Nicky made headlines for being the first cloned-to-order pet in the United States. The original Nicky was a cat that died at the age of 17 years. His owner, Julie, chose to have some of Nicky's tissue "banked" so that he could be cloned. The company that produced Little Nicky, California-based Genetic Savings & Clone, Inc., also funded the creation of the very first cloned cat, CC, in 2002, and made the first cloned pet cats, Tabouli and Baba Ganoush, in the United Kingdom earlier in 2004. Cloning pets should be a very profitable business indeed: Little Nicky cost Julie \$50,000.

How do you make a clone like Little Nicky? The first mammal to be cloned from a somatic (body) cell of an adult was Dolly the sheep. She was made in 1996 at the Roslin Institute in Scotland, using a technique called somatic cell nuclear transfer. In this technique, the nucleus of a cell from a donor's body is combined with an enucleated egg (one with its nucleus removed) from a female of the same species, and the resulting cell is stimulated to start dividing and grow into an embryo. The embryo is then placed in the uterus of a surrogate mother to continue its development. Although additional sheep, as well as pigs, cattle, goats, horses, rabbits, and mice, have been cloned using somatic cell nuclear transfer, one problem with this method is the low survival rate. Most embryos do not survive long enough to be implanted in a surrogate mother. And of those that do, almost one-quarter of the clones born have health problems so severe that they do not reach adulthood. These problems are thought to stem from the fact that the donor cell has already differentiated, and as a result its nuclear material is structurally different from that in a fertilized egg with respect to associated proteins. Some of the proteins associated with the nuclear chromatin may get carried over to the enucleated egg, where they interfere with development. CC was made using somatic cell nuclear transfer, but most consumers probably would not opt for this technique for cloning their pets because of its low success rate.

In 2003, a new cloning technology known as chromatin transfer became available. In chromatin transfer, the chromatin is made to condense, much as it would prior to cell division. The condensed chromatin is treated to remove any extraneous materials prior to being injected into the enucleated egg. This method has resulted in a greater rate of cloning success, and was used to create Tabouli, Baba Ganoush, and Little Nicky. It is likely that there will be many more cloned pets. In fact, Genetic Savings & Clone looks to clone up to 50 cats over the next year, and plans to include dogs in the near future.

Questions

1. What are some of the reasons an individual might give for having a pet cloned? Cost aside, would you choose to have a pet of yours cloned? Why or why not?
2. The first cloned cat, CC, looks different from her genetic donor, Rainbow, due to a well-understood complication involved in cloning a calico cat. The two also reportedly have different personality traits. On the other hand, Little Nicky, Tabouli, and Baba Ganoush look like their donors, and their owners claim that their personalities are identical. What do you think cloning may teach us about the roles of nature and nurture in development?
3. Critics of Genetic Savings & Clone and its customers say there is no justification for having a pet cloned when so many dogs and cats are being euthanized because no one will adopt them. Do you agree or disagree with this point of view? Explain.
4. Cloning may help save endangered species that have too few members to be rescued by a typical breeding program. Some scientists who are even more optimistic hope to revive extinct species via cloning. What would you predict about the ability of such species to survive without further cloning? Does it make sense to start banking tissue samples from endangered species for future cloning before their numbers reach critical lows? Why or why not?
5. The cloning of primates, including humans, is proving to be more difficult than the cloning of some other mammals. However, it is likely just a matter of time until technological advances make this possible. What reasons can you think of for some people to want to have themselves cloned? What issues would likely arise, for both the clone and the donor?

Case Study 3. Heart Transplant

The hospital ethics committee was discussing an important and urgent case. A donor heart had become available, but an extremely rare thing had happened. Two heart-transplant candidates in the hospital were both matches for the donor heart. One patient was known to the committee as Mr. X, the other as Ms. Y.

For someone with heart failure, Mr. X had been on the transplant waiting list a long time. He had been waiting one year and was near death. Ms. Y had just been placed on the list and could be sustained with medication for quite some time, possibly until another heart became available. The answer seemed obvious-give the heart to Mr. X.

A number of the members of the committee did not agree with this answer. They argued that time on the transplant list should be only one factor considered. They saw a problem in Mr. X's medical record.

Mr. X was 64 years old and had suffered from a heart condition for years. He had had two angioplasties and two bypass operations to correct a blockage of the heart's blood vessels. The problem seen by some committee members was that Mr. X still smoked, ate fatty foods, and was very overweight. After each procedure, doctors had warned Mr. X that he must change his life-style, and that if he didn't, his condition would worsen. He never stopped smoking, however, and never changed his diet. He said it was too hard.

Research has proven that smoking and high cholesterol are risk factors for heart problems. Blockage of the coronary arteries is directly attributed to these two factors. Treatments such as angioplasty (opening the blood vessels by passing a tube into the arteries) and bypass surgery (connecting new blood vessels that go around the clogged ones) can correct the problem, but they are not a total cure. To avoid further problems, patients must control their diet, stop smoking, and alleviate stress. This, of course, is not easy. Mr. X appeared not even to try.

The heart was about to be airlifted to the hospital. The committee had to make their decision very soon.

Questions

1. What should the committee do?
2. How would you vote if you were on the committee?
3. In some cases, transplant operations are not successful, and a second operation is needed. Should someone be allowed two transplant procedures? Three? Why or why not?
4. In some hospitals, alcoholics are not allowed to receive liver transplants. In other hospitals, they are. Those who see alcoholism as a genetically determined condition argue that these people cannot help their addiction. Others feel that these people are responsible and should just stop. Should hospitals deny transplant livers to alcoholics?
5. What other factors should go into choosing who should get an organ when two people are eligible? List three.

Case Study 4: Hormones and Multiple Births

Dr. Marshall Marino talks to couples every day at the fertility clinic where he works. All of his patients are there because they have infertility problems, which are usually due to one of three things: not enough sperm, not enough eggs, or problems holding the embryo in the uterus. Both partners are tested for infertility problems.

Today, Dr. Marino is speaking to the Hernandezes. They have been trying to get pregnant for four years, but are still young, in their thirties. The doctor explains that Maria's ovaries are not producing eggs on a regular schedule. He suggests they begin hormone treatments as soon as possible. The hormones will stimulate the ovaries to make eggs.

Mark and Maria Hernandez have done their homework, though. They read about the McCaughey septuplets born in Iowa and wonder if that might happen to them. Dr. Marino wants to be honest with all of his patients, so he explains the side effects of taking the hormone treatments. Often the ovary responds to the hormone by giving off a number of eggs at one time. If these eggs are all fertilized, the result is a multiple birth. Years ago, doctors thought they could control the dosage of the hormone and, therefore, keep the ovulation under control. This has proven not to be true. There is a chance of what are called "supertwins," that is, triplets and more.

Maria thinks a multiple birth would be good. With their problems, who knows if she will ever get pregnant again? But Mark has read that the more embryos in the uterus, the more danger there is of premature birth, brain damage, and possibly death. This frightens him.

Questions

1. What should the Hernandezes do?
2. Should Dr. Marino have told them about the problems? Why or why not?
3. If the treatment is successful and multiple births result, who is responsible for the problems?
4. What options does an infertile couple have if they find out they are carrying five or six babies? Research this.
5. In some cases, like the McCaughey's septuplets, all of the babies are born healthy. What other problems might the McCaugheys have in the future?

Case Study 5: AIDS VACCINE

AIDS (acquired immunodeficiency syndrome) afflicts 38 million people worldwide. Almost 3 million people died from AIDS in 2003 alone, and over 20 million have died since the epidemic began. A vaccine that could prevent or slow down the spread of this deadly disease would be a boon to the world. However, since 1981 when the first cases of AIDS were diagnosed, researchers have been unsuccessful in their attempts to develop such a vaccine. The efforts of a company called VaxGen illustrate the complexity of this task.

VaxGen, which is located in Brisbane, California, developed a vaccine called AIDSVAX. The vaccine contained synthetic proteins of recombinant gp120, a protein normally found on the surface of HIV, the virus that causes AIDS. The vaccine was designed to induce the immune system to respond to this noninfectious protein and to produce antibodies that could protect the recipient from an actual HIV infection. In phase I clinical trials, the vaccine was tested for safety. Phase II clinical trials included a larger-scale test for safety as well as a test for the production of antibodies against gp120. As a result of these trials, AIDSVAX was shown to be safe, and patients receiving the vaccine did develop antibodies against gp120.

Phase III clinical trials involved large-scale, placebo-controlled, double-blind tests of the vaccine's effectiveness. The first trial began in June of 1998 and involved 5,100 gay men and 300 women, all volunteers, from the United States, Puerto Rico, Canada, and the Netherlands. The second trial began in March of 1999 and involved 2,500 IV drug abusers from Bangkok, Thailand. Both trials were completed in 2003. Unfortunately, these trials revealed no difference in the overall rate of HIV infection between the vaccinated and the unvaccinated participants. The data indicate that recipients of the vaccine did produce antibodies against gp120, but that those antibodies were not adequate to protect against HIV infection. (It did appear that certain subgroups—ethnic minorities other than Hispanic—exhibited a small but statistically significant lowering of the infection rate, but these results are still being examined.)

Questions

1. How does HIV differ from other viruses for which there are effective vaccines. Then hypothesize why it has been so difficult to develop a vaccine against AIDS
2. Why do you think a person would volunteer to test an AIDS vaccine?
3. In the AIDSVAX trials, some people were given a placebo instead of the vaccine. All the recipients had been told of this possibility ahead of time, but they did not know which substance they were receiving. Is it ethical to give some of the trial participants only a placebo?
4. If a vaccine being tested works for some ethnic minorities but not others, do you think it should be given to just those races or to everyone?
5. Since the antibodies produced in AIDSVAX recipients were insufficient to protect them against infection, what might scientists try next?
6. If a private company develops an AIDS vaccine, it will spend a large amount of money on development and testing. Should it offer the vaccine free of charge to people who cannot afford it, especially those in very poor countries? How can private companies afford to develop vaccines if they do not charge for them?

Case Study 6: Ban of Smoking

Next Tuesday is the election, and Marcia Oster doesn't know how she will vote. Marcia's state is asking its constituents to vote on a ban on smoking in all public places, including restaurants, businesses, and bars.

The proposed ban would require businesses to set aside an area a few feet outside the business where people may smoke. California, for example, has such a measure in place. It prohibits all smoking of tobacco products in 100% of enclosed places of employment. The objective, as cited in the law, is "to reduce employee exposure to environmental tobacco smoke." Smokers may have an enclosed smoking room, if it has proper ventilation. Employers must also post nonsmoking signs at the entrance to their establishment. This includes all restaurants and bars. The California ban was implemented gradually over a five-year period; in 1998, the third phase, which affects bars and clubs, went into effect.

Many business people, especially restaurant and bar owners, oppose smoking bans such as the one in California. These owners argue that they should be able to operate their businesses as they please and that government-imposed smoking bans take away that right. They are also afraid revenues will decrease if smokers no longer patronize their establishments. However, some studies show that smoking bans have no significant effect on overall profits.

Although Marcia doesn't smoke, both her parents do, and they have told her many times that they feel discriminated against by groups pushing for nonsmoking areas and by laws that restrict where smokers can go. It doesn't bother them that they cannot smoke while shopping, but they are angry about the proposed ban in restaurants and bars. Most restaurants in their state already have nonsmoking sections, and Marcia's parents feel this is enough.

On the other side of the issue, Marcia's friend Cathy is very allergic to cigarette smoke. Her physicians have told her to stay away from smoke whenever possible because it triggers her asthma. While smokers claim that smoking bans infringe on their personal freedom, Cathy argues that people should only be allowed to do what they want as long as their actions do not harm others. She points out that if you are around smokers, you have no choice but to breathe in the smoke they exhale, and that the harmful effects of breathing secondhand smoke have been documented. The Centers for Disease Control report that an estimated 3,000 lung cancer deaths and 62,000 deaths from coronary heart disease are attributed to secondhand smoke annually. In children, secondhand smoke is also linked to sudden infant death syndrome, low birth weight, chronic middle ear infections, and respiratory illnesses. In fact, some scientists have determined that exhaled smoke actually contains more carbon monoxide than smoke inhaled directly from cigarettes.

Questions

1. How would you vote if you were Marcia?
2. Do you think a state should be able to regulate where a person smokes? Why or why not?
3. Businesses, too, may suffer from a smoking ban due to the loss of customers. Many bars in California have filed suit to stop the ban, but so far they have not succeeded. Should businesses have the right to decide who comes into and what is done on their premises? Why or why not?
4. Can you think of any compromises or alternatives to a total smoking ban?
5. The California law demands that an owner ask nonemployees to stop smoking and take reasonable steps to stop them. What would be some "reasonable steps"?
6. Many opponents of the California law say that it "deprives people from using a legal product in a private establishment." Should the government of California or any state make cigarettes illegal? Why or why not?

Case Study 7 ADHD Screening

Heather and Steven have just left a meeting with their son Daniel's first-grade teacher, and they are worried. They have been told that Daniel fidgets constantly in class and has a hard time staying in his seat. He usually has trouble following instructions, and doesn't complete his work. Daniel also talks excessively and at inappropriate times, often interrupting others. Heather and Steven have always thought of Daniel as energetic and rambunctious, but they've brushed it off—after all, “boys will be boys.” Steven even reminds Heather that his parents claim Daniel acts exactly like he did at that age. However, at the meeting Heather and Steven just attended, the teacher recommended that Daniel be evaluated for ADHD (Attention Deficit Hyperactivity Disorder).

Heather and Steven have heard a lot about ADHD. News stories about the abuse of ADHD medications and the increasing incidence of ADHD diagnosis are common. Many of their friends and family claim that ADHD is just a fad—or that it could easily be prevented by stricter parenting, a better diet, less television, and so on. However, Daniel's teacher told them that there is increasing scientific support for the reality of ADHD.

The teacher said that ADHD appears to have a biological basis. Scientists have found physical differences in the brains of children with ADHD that are detectable through noninvasive procedures such as MRI (magnetic resonance imaging). More work is necessary before brain scans can be used as a reliable basis for diagnosis, but the areas of the brain most affected in ADHD appear to be those where the neurotransmitter dopamine is particularly important. Some of the genes involved in these dopamine-using pathways may be at least partly responsible for ADHD. This is no surprise, since family studies have shown ADHD to be highly heritable. Someday, a genetic test may be used to assist in the diagnosis of ADHD.

Since brain scans and genetic tests are not yet available for ADHD, diagnosis is based on an assessment of the child's symptoms. Daniel's teacher recommended that Heather and Steven first take Daniel to his pediatrician for a full physical examination. This will allow them to rule out other conditions that lead to ADHD-like behavior. The pediatrician may then focus on evaluating Daniel's behavior, or perhaps refer him to a mental health professional with expertise in treating ADHD. At this time, diagnosis of ADHD is based on whether or not a child regularly exhibits specific behaviors from a standard list as described in the *Diagnostic and Statistical Manual of Mental Disorders (DSM)*. If it is concluded that Daniel does have ADHD, he may be treated with medication, behavioral therapy, or a combination of both approaches.

Questions

1. Do you think Heather and Steven might have come away from their meeting with somewhat different feelings if the teacher had suggested that Daniel needed to have his vision or hearing tested, rather than be evaluated for ADHD? Why or why not?
2. Some people feel that the evaluation of ADHD symptoms is too subjective, making accurate diagnosis difficult. Does the need to help children who may have ADHD outweigh the possibility of an incorrect diagnosis? Explain your response.
3. Objective means of evaluating children for ADHD, such as brain scans and genetic tests, may become available in the near future. Such developments would be expected to increase the accuracy of ADHD diagnosis. Some people are likely to call for routine screening of school children to see if they have or are at risk for ADHD. Do you think such ADHD screening should be mandatory? If so, should it be required only for children exhibiting symptoms of ADHD, or for everyone? Explain your answer.
4. What advice would you give Heather and Steven about having Daniel evaluated for ADHD?

Case Study 8. Artificial Blood

Artificial blood is a potentially important product for people who need blood transfusions because it carries less risk of contamination than donated blood. Artificial blood might also serve as a supplement to donated human blood, and it could be used in the event of emergencies or shortages of specific blood types. However, like new drugs that are developed, blood substitutes must pass stringent clinical trials.

Various companies have attempted to develop artificial blood. Some blood substitutes are produced through recombinant DNA techniques, in which the gene for the oxygen-carrying compound in the blood, called hemoglobin, is inserted into bacteria, and those bacteria then produce hemoglobin. In another case, a type of artificial blood called HemAssist was engineered to be produced from outdated human blood.

HemAssist was developed by Baxter International and was the first type of artificial blood to go into phase III trials—that is, to be tested in humans. The phase III trials were conducted in Europe on 117 emergency room patients who had traumatic injuries caused by stabbings, gunshots, or accidents. The trial results showed that more patients in the HemAssist group died than in the group receiving donated blood. This was a blow to Baxter International, which decided to shut down the clinical trials. (An additional setback had occurred during previous trials when a slight elevation in blood pressure appeared to be a side effect of HemAssist.) The company closed its \$110 million plant in Switzerland and is faced with the loss of its \$500 million investment in the research and development of HemAssist.

Most recently, Baxter has approached Alliance Pharmaceutical Corporation of San Diego for an exclusive license to sell and distribute Alliance's new blood substitute, Oxygent, in the United States, Canada, and Europe. Oxygent is a synthetic, milky-white, fluorocarbon-based chemical that is much more efficient at oxygen transfer than hemoglobin. Phase III clinical trials with surgical patients are ongoing, but so far the results are promising, with fewer patients requiring blood transfusions. However, coronary artery bypass grafting studies were temporarily stopped when some patients had strokes.

Questions

1. At what point do you think a pharmaceutical company should stop testing a drug because of its adverse effects?
2. If companies spend a great deal of money on research and development and then cannot market their product, how do you think they make up that loss?
3. A law called the Orphan Drug Act makes money available for drug companies to develop drugs for rare diseases. Without such an act, companies would not even try to develop such drugs. Could it be argued that this act covers a product such as Oxygent? Give three reasons why or why not.
4. What incentive is there for Baxter to continue to develop a blood substitute when the company has already tried and failed with HemAssist at great financial loss?

Case Study 9. Embryo Development

It wasn't a simple divorce case. The Davises, Junior and Mary Sue, were asking the court to make a judgment in a kind of case no other court had looked at before. Earlier in their marriage, because of infertility problems, the couple had visited a clinic and undergone a procedure called in vitro fertilization. In this procedure, her eggs and his sperm were fertilized in the laboratory and nine embryos were produced. Two were placed in Mary Sue's uterus, and seven were frozen. The two embryos placed in her body did not grow to a pregnancy. Although the Davises had planned to return and use the other seven, they found the situation of the marriage unbearable-perhaps partly because of the procedure itself, which is expensive and stressful. They decided to divorce, and now each was asking for the embryos.

Junior wanted the embryos to destroy them, whereas Mary Sue wanted to implant the embryos. Mary Sue's attorney argued for Mary Sue's right to proceed with the implantation on the basis that the embryos were potential human life, not typical property. She argued further that even if the embryos were ruled to be property, Mary Sue should have a say in their disposition, under the divorce laws of Tennessee. She also entered a counterclaim that Junior be ordered to pay child support in the event that Mary Sue bore a child.

For his part, Junior's attorney argued that an "embryo" is not a person and, therefore, should not be considered a child. He also said that it was Junior's right under the Constitution to not be "forced" to become a parent.

The court needed to decide if the embryos were property or children, or neither. If ruled to be property, the embryos would be divided between the Davises. If ruled to be children, custody would have to be awarded.

The trial court, the first court, decided the embryos were "children in embryo," awarding custody of them to Mary Sue and directing that she be allowed to implant them. Junior appealed the ruling to the Tennessee Court of Appeals. The court of appeals reversed the trial court and gave the embryos to Junior. Again, it was appealed, now to the state supreme court.

Questions

1. To whom should the court award the embryos? Why?
2. If neither Junior nor Mary Sue is awarded the embryos, what should happen to them? Explain.
3. Which attorney's argument do you agree with? Give three reasons.
4. In the United Kingdom, the first country where in vitro fertilization was performed, there are a large number of "abandoned" embryos. When some laboratories decided to destroy the extra embryos, there was a public outcry. Give two reasons why the public might have been upset. Give two arguments against those reasons.
5. In Australia, two frozen embryos were left when the couple from which they were produced died in a plane crash. The couple had millions of dollars. Many women wanted to be implanted with these embryos, believing that the embryos, as children, would inherit the money. The Australian court decided that no one would get the embryos. Do you agree with this decision? Why or why not?

Case Study 10. Artificial Womb

Over the years, the development of human babies in artificial wombs has been a significant element in much science fiction, going back at least as far as Aldous Huxley's *Brave New World*, published in 1932, and explored more recently in the *Vorkosigan Saga* authored by Lois McMaster Bujold. When Miles Vorkosigan, the main protagonist of the series, makes his first appearance, he is a tiny newborn being removed from an artificial womb and presented to his anxious parents. Miles spent the last four months of his development in the artificial womb in order to receive experimental treatment for exposure to a teratogen (a substance that disrupts fetal growth). As readers of the series know, Miles did not escape all the detrimental effects of the teratogen, but artificial womb technology saved his life.

Although Bujold's *Vorkosigan Saga* takes place in a futuristic setting with advanced reproductive technology, the artificial womb appears to be emerging from the realm of fiction into reality. It is likely that it will first be used to treat premature infants. The earlier such a baby is born, the slimmer are his or her odds of survival. Many premature infants who do survive require an extended period of life support, including an incubator to maintain body temperature, a ventilator to assist breathing, intravenous feeding, and so on. Some of these life-sustaining treatments damage the infants' fragile bodies and can result in lifelong medical problems. An artificial womb would provide such infants with a more favorable environment in which to complete their development.

In recent years, much progress has been made in developing artificial wombs. In 1997, Yoshinori Kuwabara of Juntendo University in Japan and his research team made headlines with their artificial womb, which was able to sustain fetal goats for several days. Kuwabara's womb was a clear plastic tank filled with synthetic amniotic fluid, with a component that acted as a placenta for the delivery of oxygen and nutrients and the removal of wastes. At the time, Kuwabara expressed hope that it would soon be possible to support a human fetus in such a device. Kuwabara has since passed away, but other researchers are continuing his work.

More recently, Hung-Ching Liu of Cornell University has been successful with a different approach. She and her team grew cells from human endometrium (the inner lining of the uterus) on a biodegradable scaffold. When growth was complete, the scaffold broke down, leaving an artificially grown uterus. Liu took human embryos remaining from in vitro fertilization (IVF) and got them to attach to the inside of the artificial womb, where they survived for several days. Liu was not able to determine how much longer the embryos would have survived because the experiment was stopped to comply with regulations that place time constraints on human embryo studies.

Media reports of research like Kuwabara's and Liu's have generated a great deal of controversy. Some hail artificial wombs as a great medical advance—one that could save the lives of many babies who would otherwise die or suffer lasting harm as a result of premature birth. Others point to issues that may arise should it become possible for babies to develop entirely in artificial wombs. On one hand, women would be free of the discomfort and danger associated with pregnancy and childbirth, without the legal and emotional entanglements of using surrogate mothers. However, some people are concerned that artificial wombs might be misused, and that women could even suffer diminished reproductive rights as a result of the new technology.

Questions

1. In order to develop artificial womb technology for use on humans, human embryos and fetuses would at some point have to be used as experimental subjects. Under what circumstances do you think this should be permissible, or should it? Explain your response.
2. What impact do you think artificial womb technology will have on the abortion issue? Why?
3. If artificial wombs for humans become a reality, they are likely to be quite expensive, at least at first. What concerns does this raise about who should pay?
4. Do you think people should be able to choose to grow their babies entirely in artificial wombs? If so, should this choice be available to everyone? Explain your response.
5. Would you consider using an artificial womb to have your own children? If so, under what circumstances? If not, why not?
6. What is your prediction regarding how advances in artificial womb technology will affect women in our society? Explain.

Case Study 11. Frozen Embryo

Acorn Fertility Clinic has a space problem. Its director, Franklin Pearce, just presented Acorn's Board of Directions with the problem, and now a vigorous discussion was going on. Pearce left the room to think.

The problem is partly a result of the clinic's success. Since its inception ten years earlier, the clinic has almost tripled its number of patients, and its success in achieving pregnancies in infertile couples is equal to the national average.

The clinic's greatest success has been in the use of in vitro fertilization. This procedure involves fertilizing the egg outside the body and then placing the zygote in the uterus of the patient. Usually up to 15 zygotes are produced, but only a few are placed back in the woman. The rest are frozen and held in liquid nitrogen.

Infertility specialists have been freezing embryos since 1984, with much success. The length of time an embryo can be held in a frozen state and "thawed out" successfully is not known. With better and better freezing techniques, the time is increasing. Recently a baby was born from an embryo that had been frozen for eight years.

Acorn Fertility has been freezing embryos since its inception. It has a large number of such embryos—thousands, in fact—some frozen for ten years. The parents of many of these embryos are present or past patients who have no need for them. With its patient base increasing, Acorn needs the space for new embryos.

The problem is not Acorn's alone. Ten thousand embryos are frozen each year in the United States, and the numbers are increasing. Many of these are sitting in liquid nitrogen in fertility clinics like Acorn.

Now sitting in his office, Dr. Pearce wondered what the Board of Directions would decide to do with the embryos that aren't being used.

Questions

1. What should the board decide? List five things that might be done.
2. Dr. Pearce is a medical doctor who has sworn to uphold life. What should his view be?
3. In a number of legal cases, frozen embryos have created questions. Who owns them? Are they property? Are they children? In general, courts have decided that they are neither, and that they should be left frozen because no person can be made a parent if he or she does not want to be. Is this the right decision? Why or why not?
4. In Australia, a couple died before the woman could be implanted with the frozen embryos that had been produced from the couple's eggs and sperm. The courts, upon being asked to decide if the couple's money belonged to the embryos, said no, and ruled that the embryos could not be implanted in another woman and should be destroyed. This was 15 years ago, and the embryos are still frozen. What should be done with them?
5. In the future, we will be able to successfully thaw and implant embryos that have been frozen for 25 to 30 years. What problems do you foresee with this? What benefits? List three of each.

Case Study 12; DNA Dragnet

Mark Silano lived in a small town that rarely had serious problems. Recently, however, there had been a particularly brutal crime. A young girl had been found murdered in one of the town's parks. It had been almost three months and the police didn't seem to be getting anywhere.

As he was skimming his local newspaper, Mark came across an advertisement with a large black border. He read it carefully:

All males between the ages of 18 and 25 are asked to come in voluntarily to help in the investigation of the Anna P. murder case. One vial of blood will be drawn from each volunteer for the purpose of DNA testing.

At first Mark didn't understand the implications of the ad. Then he remembered a show he had seen on television, which told about DNA fingerprinting and how criminals could be identified from tissue samples found at a crime scene. Mark was 22 and so fell into the category asked for in the ad. He thought he should volunteer, but he was really frightened of needles. He didn't want to give blood.

The first investigation to use DNA forensics took place in the United Kingdom in 1983. All the men in a town where a murder had occurred were asked to give blood samples for DNA testing. Colin Pitchfork, who was the murderer, tried to pay a number of people to give blood for him. When one man did, but then realized what this meant, Pitchfork was arrested.

DNA dragnets, as they are often called, are now used all over the United Kingdom, and are increasingly used in the United States.

Questions

1. What should Mark do?
2. What might happen if Mark does not volunteer?
3. Can authorities force Mark to give blood if he does not volunteer?
4. Why, do you think, does this technique work better in the United Kingdom than in the United States?
5. In one case, a baby was found abandoned. Police officials asked for DNA samples from all girls in the community who were between the ages of 12 and 18 and absent from school on the day of the birth. Do you see any problems with this procedure?
6. If an action is "voluntary," can one refuse to perform it? Why or why not?

Case Study 12. Organ Transplant

After her gall bladder surgery, Ruth Sparrow had a serious problem. The problem was not her health. The surgery was successful, and she was recuperating well. The problem was money. Her bill was close to \$20,000, but she had no insurance and no savings to fall back on. Then she thought of a creative way of solving her problem. She offered one of her kidneys to the hospital. "I will give you a kidney, if you'll mark my bill paid in full," she told hospital administrators at Bayfront Medical Center in St. Petersburg, Florida.

The hospital turned her down. Ruth had another idea, though. She placed an ad in a local newspaper: "Kidney runs good. Taking offers. \$30,000 or best offer." While some of the responses were crank calls, several people took her ad seriously and called to ask her blood type. Before the ad had run its three-day span, however, it was pulled by the newspaper, who explained that only duly licensed agencies can run ads for organ donations. In addition, it is illegal to sell your organs, and in Florida it is a felony. Federal and state laws prohibit buying or selling of a human organ or tissue.

Recently a quiet campaign has arisen to convince the public to rethink the issue. With thousands of people on waiting lists for organ transplants, there are not enough donations to go around. Some advocates of financial reimbursement believe that more Americans would donate their organs if there were some incentive to do so. Lloyd Cohen, of George Mason University, has pointed out that a great deal of money is made on transplant operations. Hospitals, doctors, and drug companies all benefit-why not the donor?

How might this be done? Healthy people might contract to have their organs sold after death, with the money going to their family. Funeral or hospital expenses could be covered by donation of an organ after death.

Ruth Sparrow thought that if people could advertise the use of their eggs or sperm for a price, or even the use of their uteruses (surrogacy), she should be able to do the same with her kidney. "I have an organ here that could save a life," she said. "I've got two kidneys, one I could do without."

Questions

1. Was Ruth Sparrow wrong to try to sell her kidney? Why or why not?
2. Give three reasons that some people would be against payment for organ donation.
3. Recently, charges were brought against two Chinese citizens for trying to sell the organs of men sentenced to death in Chinese prisons. Human rights activists are not sure that the prisoners consented to have their organs removed after death. The Chinese claim they use only volunteers. Explain how you feel about this practice, and why.
4. In a recent newscast, a woman was asked if she would accept a kidney from a prisoner on death row. She said, "I wouldn't, because I'd be afraid I'd get his personality." Is she wrong or right?

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