AN ETHICAL DILEMMA IN STEM CELL RESEARCH

Elliana Dusman (edd30@pitt.edu)

ETHICAL CODES AFFECT EVERYONE

Every day engineers develop inventive, resourceful solutions to fix the newly discovered problems in society. Yet with every implemented decision comes benefits and repercussions. Engineers must understand both the national code of ethics and the code of ethics specific to their occupation in order to ensure that their proposed solution does not violate any rights protected within these ethical codes. Even as an undergraduate student working towards a bachelor’s in science, and relatively new in the field, I am still responsible to know and adhere to the set code of ethics.

SCENARIO

Aspiring to become a biomedical engineer, I searched for any opportunity that would get me out into the professional world and provide tangible experience in the field. Specifically interested in synthetic biology and the progress scientists were making within the new field of regenerative medicine, I immediately accepted a summer internship that placed me alongside other lab technicians researching stem cell growth through microfluidic bioreactor technology that simulate an environment similar to one found within a living organism. What made this opportunity even more significant was the possibly of being offered a permanent job at the internship’s conclusion. With this huge opportunity on the line, I wanted to do my best work to showcase my potential and value to the research facility.

Unfortunately, while examining the different ratios of ingredients in the cell media and their effect on stem cell growth, some of the microfluidic bioreactors were switched and consequently the wrong cell media was added mistakenly to each microfluidic bioreactor, effectively contaminating the induced pluripotent stem cells housed by each. Since the results of this experiment were due in two weeks and the process of inducing adult stem cell lines alone took significant time, it would be impossible to repeat the experiment and submit the results by their deadline. After debating with the rest of our research team, my supervisor decided that it would still possible to get results for the experiment if we saved time by skipping over the inducing process and instead used embryonic stem cells that were stored in the facility. Immediately I felt unsure about the situation.

Not only was the use of embryonic stem cell lines against my moral values, but their use instead of induced pluripotent stem cell lines changed a variable of the experiment which could unknowingly change the data results. Yet not submitting the results of this experiment could end in the dismissal of our entire research team, leaving me without an internship or job.

CELL DERIVATION DIFFERENCES

Embryonic stem cells come from isolating inner cell mass of an embryo during the early stages of development. But to get the embryonic stem cells, the embryo is destroyed in the process. [1]

The generation of induced pluripotent stem cells from a somatic, adult cell is not terminating its life but reprogramming its genetic code to return to an embryonic stage. Four specific genes -- Oct4, Sox2, Klf4, and c-Myc -- are transplanted into the adult cell using a variety of techniques featured in Figure 1. Viral transduction would infect the cell with a virus which would alter the cell’s DNA. Using recombinant proteins that penetrate cell membrane would change the cell’s orientation. DNA-based induction or mRNA transfection would directly affect the genetic code of the cell as well. After additional nuclear reprogramming with the newly introduced genes, the original adult stem cell returns to a state that mimics an embryo’s. [2] Like regular embryonic stem cells, these “reprogrammed” pluripotent cells can produce cells that are characteristic of all three germ layers and nearly identical to their parent donor. This allows scientists to generate better, more precise tissue samples while also lowering the risk of an immune system’s rejection to these potentially beneficial cells. [3]

Unfortunately the time frame to complete each process of inducing pluripotent stem cells takes between three to four weeks, definitely outside the two week deadline. [1] Since

---

University of Pittsburgh, Swanson School of Engineering  1
2014-10-28

Dr. Vidic 2:00
R04
redoing the experiment with induced pluripotent stem cells and finishing by the deadline was not a feasible option. I had to consider whether the use of embryonic stem cells was ethical.

EMBERYONIC STEM CELLS’ ETHICAL CONCERNS

As previously stated, the derivation of embryonic stem cells results in destruction of the donor’s embryo. But what makes this fact significant is the classification of that embryo as either purely “cell tissue” or “human life.” Many debates have been waged on the very topic in determining the correct classification and a definitive division still has yet to be established.

Advocates

The individuals who support the use of embryonic stem cells do not consider embryos as human. Instead they perceive them as cell tissue that will enable advancements in research to ultimately better the quality of life in society. One of the medical field’s great dreams is to be able to regenerate a synthetic organ composed entirely of stem cell lines that could one day be used in organ transplantation surgeries. [4] But in order to achieve this fantastic goal, substantial research, especially in the area of stem cells, must still be conducted.

While adult stem cells have significantly advanced some areas of medical research, such as the use of adult blood-forming somatic cells for bone marrow transplantation, their multipotent property limits the range of cells types in which they can produce. On the other hand, embryonic stem cells’ pluripotency gives them the ability to theoretically mature into any cell type whether tough cardio tissue or delicate brain neuron tissue. [5] Consequently, this inherent characteristic in embryonic stem cells, absent from adult somatic stem cells, make embryonic stem cells a more powerful and sought after resource. Stem cell research supporters assert that these embryonic stem cells’ potential, especially within the emerging field of regenerative medicine, outweighs the questionable ethics surrounding their origins.

In one extreme case, an anonymous individual stated that the constraint on killing human children and adults does not apply to early infants, and legitimately believed that “there may be circumstances where it is permissible to sacrifice infants for the greater good” [6]. Not only does this individual identify the embryo as human, but condones its murder for the betterment of research. But what about those who believe in the embryo’s right to live as a human?

Opposed

Some believe that human life starts at the moment of conception and it is a common belief that a human embryo is still a human being at an early stage in development. As part as my religion, I personally believed that at the moment conception, human life has begun by the hand of God. I also agreed with Patrick Lee, the director at Franciscan’s Institute of Bioethics and Princeton’s prestigious political professor Robert George’s joint claim that embryos possess the “potential” and “intrinsic power” to develop into a mature human being. [6] Working with induced pluripotent stem cells did not infringe upon my moral values because the parent cells of the induced pluripotent stem cells had already reached their “adult” form and would never mature into a human being. However, embryonic stem cells could still become human and therefore should be extended the same rights as any human being and not be “exploited as a medical resource” to further research. [5]

This precedent was set by the Nuremberg military tribunal, through which the medical experiments of twenty-three German doctors on unwilling human subjects gave way to the establishment of the Nuremberg Code that states, “The voluntary consent of the human participant is absolutely essential.” [7] Just as these experiments on unwilling humans sickened the world and catalyzed the implementation of ethical codes, especially those pertaining to human rights, should not the medical experiments that employ human embryos be viewed with the same critical eye?

In 2008 the Ethics and Public Policy Center administered a poll which initially questioned who supported and who opposed stem cell research. The results showed that 69 percent of the responders did support stem cell research. Then, the poll question was amended to specifically ask if human embryonic stem cell research was ethical, taking care to mention the subsequent destruction of the embryos. Made aware of this undeniable fact, only 59 percent of the responders still believed this research was ethical. However when asked whether to agree or disagree with the statement, “An embryo is a developing human life, therefore it should not be destroyed for scientific research purposes,” a small majority of 62 percent agreed with the statement. [5]

With public opinion clearly split on the topic of stem cell research ethics, my decision was not swayed by popular vote, but by the arguments of both sides. I remember returning to the local park near my childhood home to evaluate the facts. In that peaceful environment while observing adults out for a stroll and kids playing on the equipment, I found myself thinking that in order to have been in the park that day, everyone had to have been an embryo at the very beginning of their life.

ETHICAL CODES FOR ENGINEERING

National Society of Professional Engineers and Biomedical Engineering Society

As an engineering student working her way towards her professional biomedical engineering degree, I had additional sets of ethics to abide to aside from my own personal values. The first collection of principles and canons to consult was
the National Society of Professional Engineers (NSPE), a code of ethics that applies to all student, professional, or retired engineers in every possible field of engineering. Its preamble statement, “Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct,” establishes the lofty level of ethical expectations to which engineers must abide within society. [8] To put it simply, it is ethically unacceptable as an engineer to read the code of ethics and blatantly decide not to follow its outlined standards.

As a biomedical engineering major, not only did the NSPE’s code of ethics apply to me but I was also responsible to know recommendations and expectations within the Biomedical Engineering Society (BMES) Code of Ethics.

Application to Personal Scenario

Asserting its significance to engineers, both the NSPE and BMES’s opening canon underscores the importance of the public’s “safety, health, and welfare” [8] [9]. If I consider embryonic stem cells authentic human life and therefore part of the “public,” then to use them in the experiment would certainly violate its “health and safety.” The rules of practice that accompany this cannon further state that if I am “overruled under circumstances that endanger life [then I] shall notify [my] employer.” However, the fulfillment of this cannon would require directly confronting my supervisor or going behind her back to report her decision to the research facility’s director. According to the seventh professional obligation of the NSPE, if I “believe [she is] guilty of unethical or illegal practice [then I] shall present such information to the proper authority.” Informing the director would not be an “attempt to injure her professional reputation” but adherence to the NSPE code of ethics. Additionally, if embryonic stem cells were used, my supervisor would also be in violation of the first training obligation set by the BMES: “Honor the responsibility not only to train biomedical engineering students in proper professional conduct in performing research and publishing results, but also to model such conduct before them.” [9] By condoning the experimentation of embryonic stem cell without official approval from the director, she is “modeling” to summer intern students such as myself that unauthorized experimentation is acceptable.

In “Case 14 – The Clinical Specialist” a scenario similar to mine is examined. Instead of a summer intern at research facility, I am a new member in Electrophysiology department who notices a clinical specialist clearly overstepping the professional boundaries of her job by actively participating in implantation surgeries of pacemakers and automatic implanted cardioverter-defibrillators (AICDs). Certain questions such as “What is the proper role of the clinical specialist in this situation?” and “Can you discuss this situation with your Chief of Service?” [10] helped put into perspective which aspects of my own ethical dilemma should be examined.

Reading onward for more helpful insights, I found that NSPE’s second canon, “Perform services only in areas of their competence” [8] did not exclusively apply to my situation since I was still operating in the biomedical field of engineering. But the following canons of NSPE’s code of ethic pertained to the honesty expected in engineering actions and definitely applied to my situation. The third cannon, “Issue public statements only in an objective and truthful manner” in addition to BMES’s second research obligation, “publish and/or present properly credited result of research accurately and clearly” [8] would be violated if we submitted data that was collected from embryonic stem cells instead of the official experiment’s induced pluripotent stem cells. While we would not receive any financial compensation from outside sources by using embryonic stem cells, we would be betraying the trust of the research facility at the cost of keeping our jobs. Instead of the “faithful agents” that NSPE canon four expects us to be, [8] we would become the opposite by potentially compromising the integrity of the entire company.

The fifth cannon which plainly states, “Engineers shall avoid deceptive acts” [8] reminded me of another case study where Raj, a possible candidate for a coveted job at an institute, decided to “tweak” his GPA from a 3.0 to a 3.5 and subtly increase his verbal and math SAT score by 100 points. [11] The case study questions the legalities of falsifying documents and wonders about the possible consequences that would result if these alterations were discovered. The BMES’s first research obligation also asks that biomedical engineers “Comply fully with legal, ethical, institutional, governmental and other applicable research guidelines.” [9]

In fact, if someone examined the results, it would be very possible to prove that embryonic stem cells were used during the experiments by examining the genetic expression of the resulting cell cultures. The “epigenetic memory” or genetic marks from the adult somatic cell origin that affect induced pluripotent stem cell’s genetic expression would be absent. [1] I soon realized it would be much easier to comply with the NSPE’s first professional obligation and “acknowledge [my] errors and not distort or alter the facts” then to risk the loss of my integrity if discovered.

CONCLUDING DECISION

Despite the promising medical advancements these stem cells facilitate, using embryonic stem cells to further research conflicts with my personal value that as a human life, they should not be part of the experimentation process without proper consent, especially since any experimentation results in their demise.

Along with the complicated ethics surrounding embryonic stem cells, the elementary ethic of honesty also had to be taken into consideration. Using embryonic stem cells instead of waiting to test pluripotent stem cells and intentionally not notifying authority definitely violates...
Ellie Dusman

multiple canons that address the honesty expected of an engineer.

After consulting both the NSPE and the BMES codes of ethics and examining my personal ideals and the morality pertaining to human embryonic stem cells, I was able to decide that it was unethical to use them in the experiment.

RECOMMENDATIONS FOR ENGINEERS

Whether student, professional, or retired, you will undoubtedly encounter a scenario that will place you in a difficult position to make a major decision. Naturally, you will be drawn to follow your instincts and abide by your personal values.

Yet, I encourage every engineer faced with an ethical dilemma to not only consult the multiple code of ethics applicable to their field but also understand the reasons behind each canon and research obligation. While the task may seem arduous and excessive, every cannon and principle is succinct and applicable to a wide range of ethical scenarios. In a society where new solutions are constantly being proposed to make our lives even better, there must be a limit set for society to examine when the consequences outweigh the benefits.

REFERENCES


ADDITIONAL SOURCES

“Kids’ Kingdom.” Hanover, Pennsylvania. (location)

ACKNOWLEDGMENTS

I would like express my gratitude to the librarians who instructed me about the useful resources on the library’s website and to my sister who helped to proofread my paper.