Published on *The Embryo Project Encyclopedia* (https://embryo.asu.edu)

Ethics and Induced Pluripotent Stem Cells [1]

By: Brind'Amour, Katherine Keywords: Stem cells [2] Pluripotency [3]

The recent development of induced pluripotent stem cells [5] (iPSCs) and related technologies has caught the attention of scientists, activists, politicians, and ethicists alike. IPSCs gained immediate international attention for their apparent similarity to embryonic stem cells [6] after their successful creation in 2006 by Shinya Yamanaka [7] and in 2007 by James Thompson and others. Although iPSCs may appear to solve the controversy over the destruction of embryos in embryonic stem cell (ESC) research by involving only the genetic reprogramming [8] of somatic cells, further analysis of the new technique and its subsequent ethical issues could potentially lessen some ethical advantages iPSCs seemingly hold over ESCs.

ESC research is laden with ethical concerns, particularly regarding the ideas of personhood [9], human dignity, and justice toward humankind that arise from dealing with human life in one of its earliest forms, the embryo. It is a controversial international issue, and many governing bodies have either banned the research altogether or placed restrictions on what may be done with embryos and ESCs. Additional ethical concerns surrounding such research include informed consent [10], improper inducement, and health and safety risks for women donating eggs necessary for the creation of embryos via *in-vitro* fertilization [11]. Though these issues do not exhaust the list of ethical considerations of ESC research, they represent the chief topics occupying those interested in its ethical aspects. iPSCs have been touted as ethically uncomplicated alternatives to ESCs, so the ethics surrounding iPSCs are largely evaluated in comparison to those involving ESCs.

If iPSCs turn out to be a useful alternative to ESC research, they will avoid the most significant concerns in feminist ethics [12] surrounding the issue. Because no eggs are needed for iPSCs, there is no unequal burden on women for supplying the necessary cells for the technology. The egg donation [13] process is often the most worrisome aspect of ESC research due to concerns for the women?s health during and after the invasive surgery; controversy over appropriate compensation for a sometimes painful and considerable health risk; and ethical disagreement over what essentially becomes the purchase of parts of the human body, or commodification [14]. The use of iPSCs as an alternative to ESCs may eliminate both the health risks to the donor and the issues of appropriate compensation, as individuals would typically donate cells through a non-invasive procedure for research leading to the donor?s own therapeutic use.

Research to date indicates iPSCs may be very similar to ESCs, except for their origin and inability to generate the cell layers necessary for producing and directing development of a complete embryo. If iPSCs can be programmed to express the same potential as ESCs (including the development of the outer embryonic layers) as some scientists believe may be possible after further research, they could lose nearly all of their potential ethical high ground over natural ESCs. Although iPSCs would still eliminate considerable health risks to women, such a development would complicate the ethical battle over the definition and protection of human life and the acceptable reasons for its creation or destruction. Scientists and ethicists

would have to decide whether creating a human embryo from iPSCs would change its degree of humanity or worthiness of legal protection. This confusion over the personhood [9] of an iPSC-originated embryo could possibly be deterred by advanced regulation [15] against attempting to reprogram an iPSC back to full embryonic potential. Without organizations to monitor and regulate such research in some nations, however, any embryonic potential iPSCs may possess could be discovered in the not-too-distant future.

If researchers do uncover full embryonic potential in iPSCs, the cloning [16] controversy will also enter the mix, as the resulting cells would be exact genetic matches of their human donors. However, if iPSCs do not possess the ability to be completely reverted to embryonic potential, or if regulations against such reprogramming are effective, the fact of being genetically identical to the donor would be a factor in their favor. Patient-specific therapies have been the goal of many stem cell researchers, as such therapies would be less subject to the recipient?s immunorejection of foreign cells, implants, or treatments.

One major ethical catch in the production of patient-specific therapies and personalized medicine [17], however, is its cost. Concerns over the distribution of new and expensive, but ideally life-saving, patient-specific therapies revolve around the lack of equal access to the treatment based on socioeconomic status and quality of health care. Previously, most potential patient-specific therapies would have justified the common fear that only the rich could afford such care; however, because iPSCs are more easily obtained than ESCs owing to fewer research restrictions and greater ease of production, iPSCs may in time provide feasible and affordable options for mass production and regular clinical use of patient-specific therapies. If this becomes the case, iPSCs could potentially remove some of the ethical concerns over the unequal distribution of medical therapies based on wealth.

Although iPSCs may seem to directly lend themselves to the idea of patient-specific gene therapies, their usefulness in this field may not be so straightforward. Some scholars worry about the implications of using genetically altered cells in human therapies, not only due to the increased health risk posed by the potential oncogenic [18], or cancer-causing, nature of the added genes [19] in iPSCs, but also due to a general hesitancy to alter the human genome [20] in a way that may have larger or more permanent ramifications than desired. Others argue that failing to maintain the purity of the human genome [20] could begin a slippery slope eventually leading to human cloning [16], human-animal genetic admixtures, and other creations that might threaten our understanding and protection of human identity.

While the creation of human-animal chimeras [21] is banned in many countries capable of performing such research, the production of other chimeras [21] with the use of iPSCs may soon be commonplace. Chimeras are organisms containing cells from more than one source, and they can be made with multiple members of the same species or from animals of separate subspecies or species. IPSCs have already been used in mice chimeras [21], as somatic cells from one mouse [22] were injected into another mouse?s embryo, which then developed into an adult mouse [22]. These mice had a mixture of their original cells and the added iPSCs from a different mouse [22]. Several teams of scientists have identified this technique as a potential tool for saving endangered species. This act could be performed by injecting the genes [19] of the endangered species into the embryo of a similar subspecies and expecting that some of the resulting animals will produce gametes entirely of the endangered animals? DNA. Ian Wilmut [23], the University of Edinburgh [24] researcher who became famous for cloning [16] Dolly the sheep [25], is currently using iPSCs to work toward preserving the life of the nearly extinct northern white rhinoceros. While these efforts are seen by some as heroic

attempts to preserve biodiversity being lost due to human impact, others believe this to be uninformed interference overstepping the boundaries of scientific responsibility toward nature.

In the short existence of iPSC technology, it has become apparent that although this opportunity to perform stem cell research may seem like a quick fix to the ethical controversy over ESC research, it may in fact carry its own set of ethical quandaries that could be equally difficult to resolve. By exchanging feminist ethics [12] issues for reprogramming concerns, perhaps even retaining the problematic destruction of life and cloning [16] issues, iPSCs need to be thoroughly researched and analyzed before they replace ESC research or contribute to human clinical therapies. Overall, iPSC research is a promising new arena for the advancement of scientific knowledge with its own unique potential and corresponding ethical considerations.

Sources

1. Baylis, Françoise. (2008) ?ES Cells and iPS Cells: A Distinction with a Difference.? Bioethics Forum, Mar. 4. http://www.thehastingscenter.org/Bioethicsforum/Post.aspx?id=730&terms=iPS+Cells [26] (Accessed August 11, 2008).
2. Baylis, Françoise, and Timothy Krahn. ?The Trouble with Embryos.? Science Studies 22, no. 2 (2009): 31-54. (2008).
3. Connor, Steve. ?The Cloning Revolution (Part 2).? *The Independent*, Science Section online. April 18 2008. http://www.independent.co.uk/news/science/the-cloning-revolution-part-2-811224.html [27] (Accessed August 11, 2008).
4. Holm, Soren. ?Time to Reconsider Stem Cell Ethics?the Importance of Induced Pluripotent Cells.? *Journal of Medical Ethics* 34 (2008): 63?64. http://jme.bmj.com/cgi/content/full/34/2/63 [28] (Accessed August 11, 2008).
5. Kastenberg, Zachary, and Jon Oderico. ?Alternative Sources of Pluripotency: Science, Ethics, and Stem Cells.? *Transplantation Reviews* 22 (2008): 215?22.
6. Liu, Shi. ?iPS Cells: A More Critical Review.? *Stem Cells and Development* (2008): 391?98. http://www.liebertonline.com/doi/abs/10.1089/scd.2008.0062 [29] (Accessed August 11, 2008).
7. Solomon, Louis, and Sandra Brockman-Lee. ?Embryonic Stem Cells in Science and Medicine, Part II: Law, Ethics, and the Continuing Need for Dialogue.? *Gender Medicine* 5 (2008): 3?9.

The recent development of induced pluripotent stem cells (iPSCs) and related technologies has caught the attention of scientists, activists, politicians, and ethicists alike. IPSCs gained immediate international attention for their apparent similarity to embryonic stem cells after their successful creation in 2006 by Shinya Yamanaka and in 2007 by James Thompson and others. Although iPSCs may appear to solve the controversy over the destruction of embryos in embryonic stem cell (ESC) research by involving only the genetic reprogramming of somatic cells, further analysis of the new technique and its subsequent ethical issues could potentially lessen some ethical advantages iPSCs seemingly hold over ESCs.

Subject

Stem cells. [30] Stem Cells [31]

Topic

Technologies [32] Ethics [33]

Publisher

Arizona State University. School of Life Sciences. Center for Biology and Society. Embryo Project Encyclopedia.

Rights

Format

Articles [34]

Last Modified

Wednesday, July 4, 2018 - 04:40

DC Date Accessioned

Thursday, May 10, 2012 - 14:01

DC Date Available

Thursday, May 10, 2012 - 14:01

DC Date Created

2009-06-10

DC Date Created Standard

Wednesday, June 10, 2009 - 07:00

- Contact Us

- The Embryo Project at Arizona State University, 1711 South Rural Road, Tempe Arizona 85287, United States

---

Links:
[1] https://embryo.asu.edu/pages/ethics-and-induced-pluripotent-stem-cells
[2] https://embryo.asu.edu/keywords/stem-cells
[3] https://embryo.asu.edu/keywords/pluripotency
[4] https://embryo.asu.edu/search?text=Ethics%20and%20Induced%20Pluripotent%20Stem%20Cells
[5] https://embryo.asu.edu/search?text=induced%20pluripotent%20stem%20cells
[6] https://embryo.asu.edu/search?text=embryonic%20stem%20cells
[7] https://embryo.asu.edu/search?text=Shinya%20Yamanaka
[8] https://embryo.asu.edu/search?text=genetic%20reprogramming
[9] https://embryo.asu.edu/search?text=personhood
[10] https://embryo.asu.edu/search?text=informed%20consent
[11] https://embryo.asu.edu/search?text=fertilization
[12] https://embryo.asu.edu/search?text=feminist%20ethics
[13] https://embryo.asu.edu/search?text=egg%20donation
[14] https://embryo.asu.edu/search?text=commodification
[15] https://embryo.asu.edu/search?text=regulation
[16] https://embryo.asu.edu/search?text=cloning
[17] https://embryo.asu.edu/search?text=personalized%20medicine
[18] https://embryo.asu.edu/search?text=oncogenic
[19] https://embryo.asu.edu/search?text=genes
[20] https://embryo.asu.edu/search?text=genome
[21] https://embryo.asu.edu/search?text=chimeras
[22] https://embryo.asu.edu/search?text=mouse
[23] https://embryo.asu.edu/search?text=Ian%20Wilmut
[24] https://embryo.asu.edu/search?text=University%20of%20Edinburgh
[25] https://embryo.asu.edu/search?text=sheep
[26] http://www.thehastingscenter.org/Bioethicsforum/Post.aspx?id=730&terms=iPS+Cells
[27] http://www.independent.co.uk/news/science/the-cloning-revolution-part-2-811224.html
[28] http://jme.bmj.com/cgi/content/full/34/2/63
[29] http://www.liebertonline.com/doi/abs/10.1089/scd.2008.0062
[30] https://embryo.asu.edu/library-congress-subject-headings/stem-cells
[31] https://embryo.asu.edu/medical-subject-headings/stem-cells
[32] https://embryo.asu.edu/topics/technologies
[33] https://embryo.asu.edu/topics/ethics
[34] https://embryo.asu.edu/formats/articles