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October 14, 2008

Five Basic Things To Know About Stem Cell Research

ScienceDaily (Oct. 14, 2008) — In just a few weeks, Michigan voters will have an important decision to make when casting their ballots. Not just who they want to be president, or to represent them in Congress, but what they want the state to do about stem cells. And the way they vote on a ballot measure called Proposal 2 will determine the fate of a Michigan law that currently restricts research using embryonic stem cells.

Meanwhile, in other states, stem cells are emerging as a key issue in many races.

To cast an educated vote on stem cells, voters in Michigan and beyond must understand a complex, fast-emerging new field of medicine – no easy task. Stem cell research is generating great interest and investment worldwide because it could lead to possible treatments for spinal cord injuries, Parkinson's disease, juvenile diabetes and other diseases. But some aspects of embryonic stem cell research may pose an ethical or moral dilemma for some people.

The main thing is to understand the goals of stem cell research and to sort out fact from fiction. There are several key facts that citizens can keep in mind as they navigate through a flood of often conflicting information about stem cell research, say University of Michigan stem cell scientists Sean Morrison, Ph.D., and Sue O'Shea, Ph.D. Morrison directs the Center for Stem Cell Biology at U-M's Life Sciences Institute and is a faculty member at the U-M Medical School. O'Shea directs the Michigan Center for Human Embryonic Stem Cell Research at the Medical School.

Here are the five key things they feel every voter should know about stem cells:

1. Scientists generally agree it's crucial to push forward rapidly in all three key areas of stem cell research: embryonic stem cells, tissue/adult stem cells and induced pluripotent (or "reprogrammed") stem cells.

Around the world, these three kinds of stem cells are under intense study for possible treatments for conditions from spinal cord injuries to juvenile diabetes. It would be shortsighted to pursue only one kind, O'Shea says, because each may hold particular promise for understanding and treating specific diseases. "Results in one area of research will continue to shed light on work in the others," she notes.

Some intriguing new studies suggest that understanding how embryonic stem cells behave will bring new insights into cancer. And learning how embryonic stem cells can go awry may make it possible to intervene and avoid birth defects.

Morrison observes that much of the attention has focused on embryonic stem cells.

"Embryonic stem cells are one type of stem cell that people are very excited about because these are cells that come from the very earliest stages of embryonic development, from microscopically small clumps of

cells. And these cells have the capacity to make every cell type in the body in unlimited quantities," he says. "So, when you're trying to cure a public health problem, the capacity of embryonic stem cells to make any cell type in unlimited quantities is a powerful advantage."

2. Embryonic stem cells that scientists study come from early-stage embryos.

These embryos are created in fertility clinics for the purpose of fertility treatment. But for a variety of reasons, not all embryos can be used for fertility treatment, and many embryos are discarded. In Michigan, it currently is legal to discard embryos that cannot be used for fertility treatment. It is not, however, legal to use them in medical research that might help patients. Proposal 2 would give patients the option of donating for medical research embryos that cannot be used for fertility treatment and would otherwise be discarded. Many of these surplus embryos, which number about 400,000 nationwide, are otherwise discarded.

"The embryos that are used for research are microscopically small clumps of cells, smaller than the period at the end of a sentence on a piece of paper," says Morrison. "They have no specialized tissues of any type; there's no nervous system, there's no heart, there are no limbs. These are clumps of cells that oftentimes in a fertility clinic don't develop in a healthy manner and that doctors would not be willing to implant in patients."

Scientists in most states, but not Michigan, are allowed to use embryos from these clinics to create stem cell lines and develop disease therapies in their laboratories.

Things are moving fast in the embryonic stem cell field. Clinical trials — research studies involving human patients — are expected to begin in the next few years for embryonic stem cell-based treatments for juvenile diabetes, macular degeneration and spinal paralysis.

The cells scientists use come from embryos just five days after fertilization. Embryos at this stage, called blastocysts, are spheres containing about 100 cells that have not yet differentiated into more specialized cells. If some of these cells are placed in a lab dish in the right conditions, they can become stem cell lines that can be maintained indefinitely in an undifferentiated state, or guided to become specific types of cells.

Scientists want to use these embryonic cells because they have the capacity to turn into any of the 200 cell types in the body. These "master cells" promise to provide large enough quantities of specialized nerve, pancreas or other cells to effectively help patients whose own cells are not functioning.

3. Adult stem cells are like supporting actors in the quest for stem cell treatments.

Adult stem cells are more specialized cells that arise from embryonic stem cells. Also known as tissue-specific stem cells, they are present in adults – but contrary to their name, they're also found in children, newborn infants and developing fetuses. They have the ability to make one or two kinds of cells, such as blood and immune system cells, brain or muscle cells. Adult stem cells have a more limited capacity to replace themselves than do embryonic stem cells.

Says Morrison, "There are many different types of adult stem cells present throughout our tissues. They differ from embryonic stem cells in that they're already partially specialized, so that blood-forming stem cells in the bone marrow can give rise to all types of blood cells, but not to cell types in other tissues. Adult stem cells are still useful, but they're more specialized than embryonic stem cells and they don't have the same capacity to give rise to unlimited numbers of specialized cells."

Decades of work with adult blood stem cells have led to successful bone marrow transplant treatments that are used today to treat people who have leukemia, lymphoma and some inherited blood disorders. Today, blood stem cells can often be isolated from the blood rather than bone marrow.

While adult stem cell research holds much promise, blood stem cells offer the only proven therapies that can be carried out using adult stem cells. The claim that adult stem cells have been used to cure more than 70 diseases has been widely discredited.

Although scientists continue to try to expand the use of adult stem cells, a key limitation remains. So far, it has been very difficult to get many types of adult stem cells to reproduce in sufficient amounts to lead to effective treatments.

4. Induced pluripotent stem cells, or iPS cells, are adult cells reprogrammed to behave like embryonic stem cells.

Recently, Japanese and American scientists have developed a third type of stem cell, which are skin cells that have been "reprogrammed" to be similar to embryonic stem cells.

About these cells, which are called "induced pluripotent cells", Morrison says, "This is exciting because it will really enhance our ability to study particularly inherited human diseases. But these cells aren't ready for prime time in terms of clinical use because the reprogramming process involves the use of viruses, which predispose those cells to cancer, and so none of the reprogrammed lines that we have so far at least would ever be usable in patients."

The discovery of iPS cells demonstrates the promise of embryonic stem cell research to lead to breakthroughs that would change the future of medicine; the ability to reprogram adult human cells was discovered as a result of research on human embryonic stem cells. While iPS cells are an exciting discovery, scientists agree it is too early to assess the technique's full potential and determine whether the reprogrammed cells truly can function the way embryonic stem cells do.

5. Michigan scientists want to explore all types of stem cells to look for treatments or cures. But they currently lack a key tool: the ability to develop their own embryonic stem cell lines.

Most Michigan scientists, along with many Michigan citizens affected by debilitating diseases, want current state law to be changed. If the Proposal 2 ballot initiative passes, the law would change to allow Michigan scientists to do what they currently cannot: develop new embryonic stem cell lines using early-stage embryos from fertilization clinics that would otherwise be discarded.

"Under current law, we in Michigan can study cell lines that are created outside of the state, but we can't derive our own new lines within the state," Morrison explains. "That's a crippling problem because most of the lines that we would like to be able to study, in order to study the diseases that affect the people of Michigan, don't exist yet."

O'Shea notes an important fact about Proposal 2: it requires that the allowed embryos are ones that couples designate for research. The proposal outlaws the sale or purchase of embryos for research and states the research needs to abide by federal law.

Here's the text that Michigan voters will see on their ballots:

A Proposal To Amend The State Constitution To Address Human Embryo And Human Embryonic Stem Cell Research In Michigan

The proposed constitutional amendment would:

Expand use of human embryos for any research permitted under federal law subject to the following limits: the embryos

- are created for fertility treatment purposes;
- are not suitable for implantation or are in excess of clinical needs;
- would be discarded unless used for research;
- were donated by the person seeking fertility treatment.

Provide that stem cells cannot be taken from human embryos more than 14 days after cell division begins.

Prohibits any person from selling or purchasing human embryos for stem cell research.
Prohibits state and local laws that prevent, restrict or discourage stem cell research, future therapies and cures.

Should this proposal be adopted?

Adapted from materials provided by University of Michigan Health System.