Fact Sheet: Three-Parent Embryos

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What is a three-parent embryo?

A three-parent embryo contains genetic material from three individuals — the mother, the father, and a second mother who contributes an egg with healthy mitochondrial DNA. The scientific term "mitochondrial replacement techniques" (or MRT) describes the process of mixing mitochondrial DNA from a donor egg with the egg or embryo of a woman seeking to become pregnant.

Is this process legal?

Congress has forced the FDA to halt the use of MRT in the United States. The process has also been banned in Great Britain, but in February 2015 the British Parliament approved research on mitochondrial transfer and is debating what regulations should govern it. In the US, a committee of the Institute of Medicine (IOM) was asked by the FDA to advise the agency on MRT, and the IOM committee issued a report on February 3, 2016, stating its opinion that research on MRT is ethical as long as certain guidelines are followed.

Access the report here: (http://www.nationalacademies.org/hmd/Reports/2016/Mitochondrial-Replacement-Techniques.aspx)

While these techniques are not yet allowed in the United States, there are people who are working to make them legal.

How does MRT work?

The MRT techniques replace the nucleus of an egg with healthy mitochondrial DNA (mtDNA), with the nucleus of an egg with faulty mtDNA from a woman who wants to become pregnant. The egg is then fertilized in vitro with the father's sperm and placed in the mother's uterus with the hope of achieving a successful pregnancy. Another version of this technique destroys an embryo with faulty mtDNA, and transfers its nucleus into a second embryo with healthy mtDNA.

Why do scientists want to do this?

If successful, this technique would make it possible for women who carry mitochondrial disease to bear their own biological children. The disease in the mother's mitochondria would not be passed on to her child. This is a type of gene therapy or genetic modification: the technique would permanently change the mitochondrial DNA of the child. Mitochondrial disease is a serious disease which often causes severe physical or cognitive disabilities. It can appear at birth or develop later. The disease is progressive and incurable. Mitochondrial disease is carried in mitochondrial DNA, which is different from nuclear DNA. It is passed down only from the mother, because only eggs, not sperm, contain mitochondrial DNA.

Mitochondrial DNA exists in nearly every cell in the body; mitochondria are the structures within cells that convert energy from food into a form that the body can use. Nuclear DNA contains most of our heritable features, such as hair and eye color — so the child conceived by this technique would still receive his nuclear DNA from his mother and father, but would receive mitochondrial DNA from the third parent, that is, the second mother whose egg had healthy mitochondria.

Why oppose MRT research?

Research on MRT techniques is controversial for several reasons:

1) The research on these procedures would destroy many human embryos. Even if the procedure became successfully developed, the use of the procedure will result in the destruction of some embryos who are the children of the very parents who would be seeking to use the technique — they may or may not succeed in a successful pregnancy but have several of their embryos die in the attempt.
2) The child to be born would have the genetic material of three people, and we do not know what the long-term generational consequences would be.
3) Use of gene therapy to prevent disabilities could devalue the lives of the disabled.
4) If gene therapy is allowed for mitochondrial disease carriers, it opens the door to allowing it for other reasons. This takes society a step closer to allowing the creation of "designer babies."