Over a long period of time, a species improves and evolves through natural selection [a3]. One of the methods to perform this unnaturally, or what the media calls ‘unnatural selection’ is embryo screening [a1]. Embryo screening, or pre-implantation genetic diagnosis (PGD), is a procedure used before the implantation of an embryo to identify genetic defects [.1]. It was introduced in the 1990s and has been used for detecting aneuploidies, which are irregular numbers of chromosomes [.4] and for gender identification to prevent passing down sex-linked diseases. Today, it is used to diagnose around 170 conditions, including cystic fibrosis and hemoglobin disorders [.2]. This helps parents choose which embryo to implant [.3].  More recently, the idea of altering the genes of an embryo has been debated. Is this technology allowing us to “play God”? Should parents have the right to choose a healthy baby [a2]? Before these questions can be answered, embryo screening and genetic modification in humans should be analyzed in scientific, societal, and legal perspectives.

There are two methods for performing embryo screening: polar body analysis and embryo analysis, both of which require biopsies. Polar body analysis studies the genes or chromosomes inherited from the female using polar bodies before fertilization to identify problems from the female [.5]. In embryo analysis, an embryo is allowed to grow to specific stages, where one or a few cells are removed [.6], thus allowing for the identification of diseases beyond sex-linked diseases [.2]. To perform the analysis, the testing methods include total chromosome analysis and polymerase chain reaction. Both methods amplify DNA sequences, generating thousands or millions of copies, which are screened for irregularities [.8]. Overall, preimplantation diagnosis aids in decreasing the chances of passing disorders to the child and increasing the success rate of pregnancies from in vitro fertilization [.5].

The interest in genetic alterations to human embryos arose in 2015 when Chinese scientists genetically modified a human embryo using CRISPR, or clustered regularly interspaced short palindromic repeats. It has recently shown to possess the ability to edit genomes quickly and cheaply. It uses the Cas9 enzyme and an RNA fragment that guides it to the target DNA, where it can then cut and replace the DNA as desired [.9].

The major benefit to PGD is that it provides parents with a chance to have healthy children and eliminate any genetic disorders from their bloodline. [[1]](http://www.nature.com/scitable/topicpage/embryo-screening-and-the-ethics-of-human-60561) Techniques such as amniocentesis and CVS are already commonly used to test fetuses at risk for genetic disorders such as Down Syndrome. Based on these diagnoses, parents may choose to undergo an abortion. [[2]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1794693/) For example, the abortion rate in fetuses diagnosed with Down Syndrome in the U.S. is on average 67%. [[3]](https://www.ncbi.nlm.nih.gov/pubmed/22418958) Thus, another advantage to PGD is that it detects genetic disorders before implantation, eliminating the need to make a tough decision to terminate a pregnancy. [[4]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4449675/) The ability to choose a genetically normal embryo for implantation increases the chance of carrying a healthy child to term, since many genetic disorders cause natural miscarriages. However, this is not guaranteed, and miscarriage is still possible. [[5]](https://www.canada.ca/en/public-health/services/fertility/genetic-testing-screening.html) Another concern is that many embryos must be created and screened and only the best one is selected, resulting in the rest being discarded. PGD gives parents greater choice of the traits their baby will have, and with the rise of genetic engineering, this could result in creating designer babies and misuse of the technology: there is the possibility of the use for enhancement of the gene pool rather than disease treatment, which may reinforce discrimination among groups with differing beliefs. [[1]](https://www.genome.gov/10004764/germline-gene-transfer/) Therefore, although PGD is only a diagnostic test and not a genetic manipulation, regulations must still be put in place to define the situations in which PGD should be allowed, to avoid misuse of the technology.

In Canada, PGD with in vitro fertilization is widely implemented. It is legal for parents to select an embryo based on the ‘health’ interpreted from the DNA sequence because it does not involve any direct alteration of its genetic material. It is illegal though, to “alter the genome… such that the alteration is capable of being transmitted to descendants [a].” This prohibition is one of ten outlined in Canada’s Assisted Human Reproduction (AHR) Act. It restricts parents from selecting any preferable traits such as sex, height or intelligence. Currently, Health Canada is in charge of regulating the act whereby those who do not comply, including accomplices (doctors, advisors, etc) can be fined up to $500,000, serve a jail time of up to 10 years, or both [c][d]. According to a 2009 paper by the Canadian Medical Association, PGD is entirely illegal in countries including Germany and Italy. Moreover, in many major countries including the UK, Canada, and Australia, genetically modifying an embryo and maintaining it in a laboratory for longer than 14 days is illegal [e] therefore in no country is it allowed to plant, carry to term and birth a genetically modified embryo. Most major countries around the world share Canada’s stance [f] in that embryo screening, much like a prenatal diagnosis, is an acceptable method to allow parents to prepare for the health conditions of their expected child but for the safety and wellbeing of the future society, genetic modifications of embryos should be kept illegal.

As technology continues to develop, embryo screening and genetic modification of humans becomes easier, cheaper, and more accessible to the public. Embryo screening is an acceptable method in allowing parents to have a healthy child, as it results in fewer terminated pregnancies and a greater chance of carrying a healthy child to term. However, when it comes to genetic modification of humans, doctors and scientists must consider the potential detrimental health and societal consequences of modifying an embryo's genetic material, and whether this technology is only bringing up the chance for emergence of designer babies. Thus, despite rapid development in genetic engineering, it should continue to be illegal around the world.

References

[a] <http://laws-lois.justice.gc.ca/eng/acts/a-13.4/page-1.html#h-2>

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[d] <https://www.canada.ca/en/health-canada/services/drugs-health-products/biologics-radiopharmaceuticals-genetic-therapies/legislation-guidelines/assisted-human-reproduction/prohibitions-scientific-research-clinical-applications.html>

[e] <http://theconversation.com/destroying-research-embryos-within-14-days-limits-chance-of-medical-breakthroughs-71986>

[f] <http://www.cmaj.ca/content/suppl/2009/09/21/cmaj.080658.DC1/gen-bouffard-4-at.pdf>

[a1] <https://www.theglobeandmail.com/life/parenting/unnatural-selection-is-evolving-reproductive-technology-ushering-in-a-new-age-of-eugenics/article1357885/?page=all>

[a2] <https://www.nature.com/scitable/knowledge/library/natural-selection-genetic-drift-and-gene-flow-15186648>

[a3] <https://www.nature.com/scitable/topicpage/genetic-inequality-human-genetic-engineering-768>