

**MEDIMUN XIII Annual Session**

**2018**



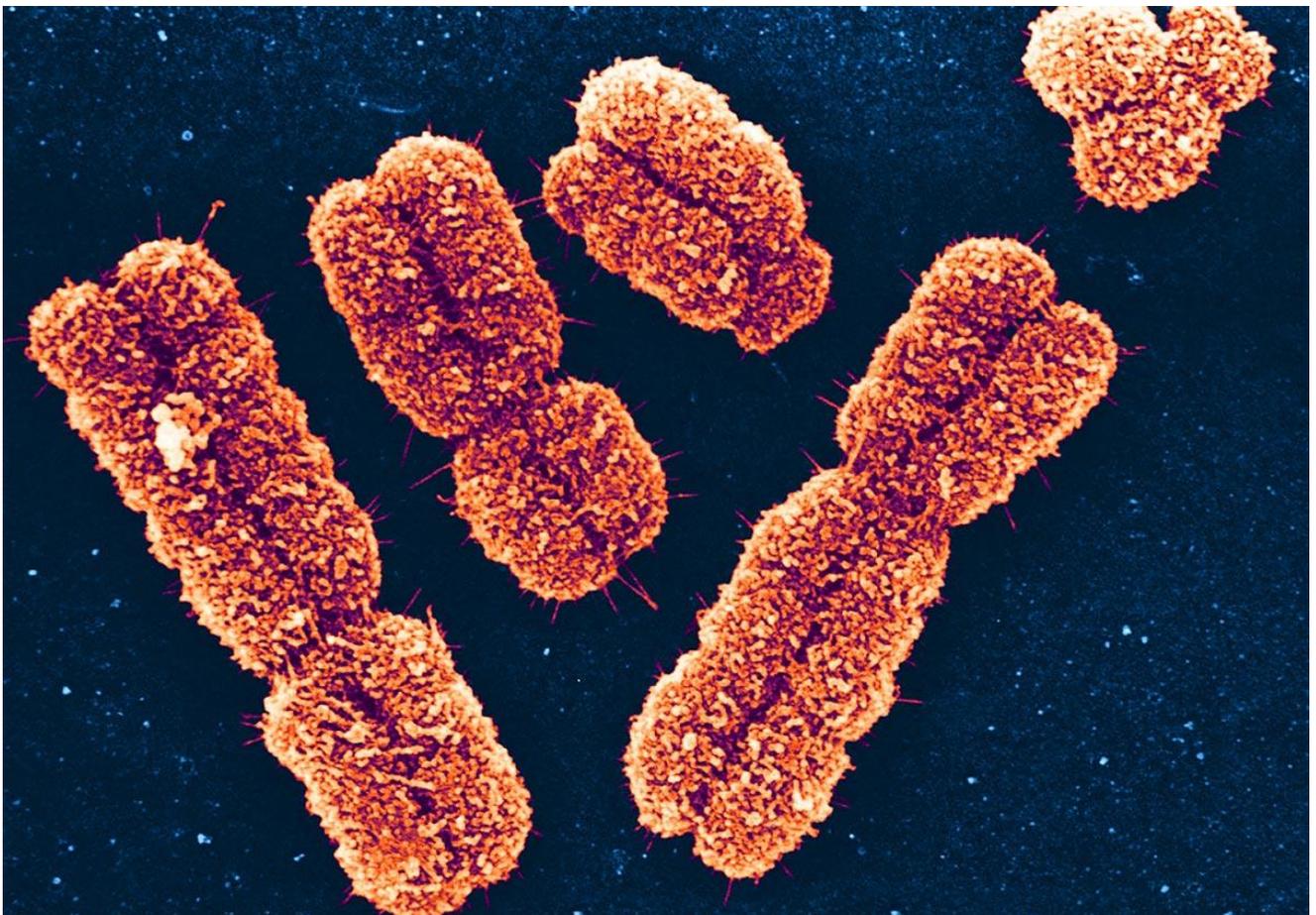
**RESEARCH REPORT – Committee of  
Bioethics**

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## Topic 1: The question of the future of organ provision for transplants

### Introduction

Since the first successful transplant in 1954, with a successful kidney transplant to a twin brother, the post surgeries have evolved and increased as the biomedical miracle has continually saved lives. Organ transplants have been scrutinized over the years as the question of utility and fairness has been questioned. Ethical donation is by consent, explicit or presumed, spontaneously offered or secured by request. Commercial dealing is now a live issue in organ procurement, whether cadaveric or by live donation, related or unrelated. Attention is given to children in transplantation, and to new developments with foetal organs, neural tissue, bone marrow and xenografts. Given all that medical science and skill can now offer, patients are still free to decline.

Optimal use of viable organs demanded precise definition of brain death in heart-beating cadavers with artificially maintained ventilation and circulation. Viable organs must remain well perfused to be suitable for procurement and transplantation into carefully selected recipients on an equal-opportunity basis. This has led to extreme lengths in attaining viable organs.

The question of stem cells has been explored in order to provide genetically identical organs to people, evidently diminishing the problems of lack of organs, the rich as a priority and the black market, however, arguments like 'playing God' and creating an embryo only to destroy it have been put forward.

The black market has flourished, targeting war stricken areas or areas that have suffered from natural disasters as a hub of disposable human lives for viable organs. Other people might be coerced into giving a loved one an organ and constantly be pressured in order to provide them with such. Parents even go to the extent of considering donor babies, in which parents provide a sibling in which its sole purpose is to be used as an organ donor if their sick child is ever in need of an organ.

The question of organ transplant as a whole has been questioned as to what extent should humans be allowed to fight for their lives. The question of human vs mother nature has continued in today's community as people did not find it fair to 'cheat death' by attaining organs from another healthy person.

Many religions do not allow post mortis extraction. This raises the question if all people should be forced to donate their viable organs after death and save a life or should people respect religion and not allow a life to be saved

The selection of who will get the organs is also under fire as the rich have been put as a priority due to their influence in society. This causes this price of organs to rise, making it harder for people of different socioeconomic backgrounds. The fact that children are a priority also creates controversy as ageism and the question of morality has been put in place here.



## Defining Key Terms

What is organ donation and transplantation: Organ donation is the process of surgically removing an organ or tissue from one person (the organ donor) and placing it into another person (the recipient). Transplantation is necessary because the recipient's organ has failed or has been damaged by disease or injury.

Organs and tissues that can be transplanted include: Liver, Kidney, Pancreas, Heart, Lung, Intestine, Cornea, Middle ear, Skin, Bone, Bone marrow, Heart valves, Connective tissue, Vascularized composite allografts (transplant of several structures that may include skin, bone, muscles, blood vessels, nerves, and connective tissue)

Organ Donor: Organ donation is giving an organ to help someone who needs a transplant. Transplants can save or greatly enhance the lives of other people. But this relies on donors

and their families agreeing to donate their organ. Organs can be donated Post-mortem or pre-mortem

National Organ Transplant Act: October 19, 1984, and amended in 1988 and 1990, outlawed the sale of human organs and provided for the establishment of the Task Force on Organ Transplantation; authorized the Department of Health and Human Services to make grants for the planning, establishment, and initial operation of qualified Organ Procurement Organizations (OPOs); and established the formation of the Organ Procurement and Transplantation Network and Scientific Registry of Transplant Recipients.

Organ Procurement Organizations (OPOs): represent a unique component of health care. By federal law, they are the only organizations that can perform the life-saving mission of recovering organs from deceased donors for transplantation.

Organ harvesting: The removal, preservation and use of human organs and tissue from the bodies of the recently deceased to be used in surgical transplants on the living.

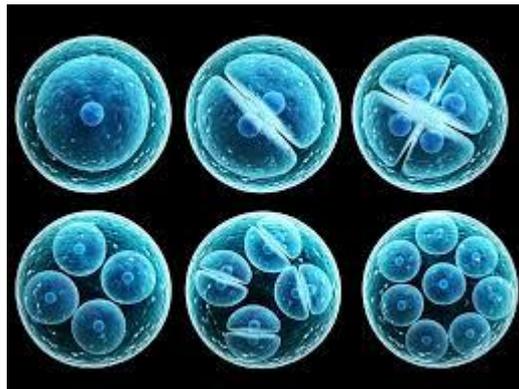
Black market: Illegal free market which flourishes in economies where consumer goods are scarce or are heavily taxed. In the first kind, black market prices are higher than the 'official' or controlled prices. In the second kind, prices are lower than the 'legitimate' or taxed prices, due to tax evasion.

Anonymity: The condition of being anonymous.

Transplant tourism: In which people from developed countries travel to mainly developing countries to pay for organ transplants.

The Transplantation Society in 2008: Adopted the Declaration of Istanbul, which calls for each country to save its own patients. In 2010, the World Health Organization issued new guidelines including similar policies to the declaration.

Saviour siblings: Children who are born for the sole purpose of being used for cell or organ transplants to save an older sibling. Conceived in vitro in order to screen the child to make sure that they themselves are viable donors.



## General Overview

Because of the fact that there are more people in need of organs than organ donors, people go to great lengths to attain a viable organ. And because of the lack of supervising, the black market has flourished. To understand the question of it is useful to refer to these 4 main subjects

1. The propriety of the young over the old & the rich and the poor
2. The degree of sickness in which a patient should be or not be allowed to attain an organ
3. The question of using stem cells to grow genetically identical organs
4. The question of gaining organs through the black market, war stricken countries and human harvesting
5. The continuing of human life past a certain point of illness.
6. The question of donor babies and coercing loved ones in becoming living donors
7. The question of attaining organs from cadavers and the question of religious rights

Up to 7,000 kidneys are obtained illegally every year, according to a report by Global Financial Integrity. Due to the desperation of people, every day 21 people are added onto the donor list in America, people exploit this and sell their organs on various websites one of which is specifically created to match donors and those who need organs. Advertising their organs and selling it off to the highest bidders, further making it difficult for people in lower socio-economic classes to attain a viable organ.

Donor babies or Saviour siblings are children who are born for the specific task of providing their sick siblings with an organ or cell transplants. The siblings are conceived through in vitro fertilisation and the zygotes are tested for genetic compatibility by Using PGD to make sure that they too don't have the disease the diagnosed child has. The HEFA (Human Fertilisation and Embryology Authority) in the UK ruled that it is legal to grow such a child for this type for purpose. The argument that if the parents where not already going to have another child or where not planning to have another child in the future then the ethics are heavily questioned as the child will be used to save their older sibling, they are a means to an end.

Explicit consent post mortem has been carried out in countries all around the world. Many believe that people should be able to donate their organs without consent once they die if they have viable organs. Countries like Singapore have put legislations in place, that by law, puts everyone as an organ donor once they have died and if they have viable organs to use. This has been scrutinized by many as some religions do not allow for the body to be used for organ transplantations. The religion will not allow the individual to donate their organs as they do not want the body to be tampered with post or pre-mortem, believing that the body will descend to their respective paradise once they are dead and will continue living with their physical somatic state.

Many have also argued that we should not be tampering with mother nature. Natural selection has been used as a credible argument as it is a way to control the population of our earth. People have said that we should allow for death to come without tampering with the patient in order to avoid death. Since death is inevitable, the patient should not be finding 'loop holes' to 'cheat' death and should just accept their fate.

Many people have argued that the rich and young children have been made a priority. Since there is no clear indication of how organs are allocated to patients, it has left people on waiting lists for many years. The fact that the higher socioeconomically people get priority really creates a sense of unethical as people who are in lower socioeconomic classes have a minimal chance of getting a viable organ. Also, the priority placed on children has caused controversy as ageism has been used to define the rights of the elderly and the fact that adults may have a more sever case and are in more need of an organ.

The lack of organs has caused many people to explore the ideas of the black market and organ tourism where they travel to a specific country in order to get a transplant. Typically, in these countries there is high corruption and may have suffered from war or natural disaster, leaving people vulnerable to organ trafficking rings.

The question of prolonging stem-cell research in order to be able to grow a genetically identical organ. This solution has been heavily argued as, on the one hand, there will be no need for an organ waiting list as the patients will be using their pluripotent cell in which they will be able to grow an organ that is specifically tailored to them, avoiding the risk of rejection and eliminating problems like the black market, shortage of organs and priority of the rich over the poor. However, many argue that by using stem cells we are tempering with religion as totipotent cells are attained from embryos as they are created only to be destroyed and other issues like 'playing God'.

Also, arguments from the financial aspect play a role as it has been argued that money used for stem-cell research can be used in other fields

### Major Parties Involved

You may want to consider the following party when researching this topic:

#### The WHO

- The WHO has taken several steps in order to define and make clear the donations are consensual while not overstepping in the countries own jurisdiction
- Recognizing the different difficulties of living donors i.e. pressure from loved ones
- Recognizing the difficulties of cadaver donors i.e. 'explicit consent' and 'opting out'/'opting in'
- Creating a well detailed guide in which detailed principle of human organ transplantations has been recognized and steps in which countries can take in order to address this issue and choose which principles is best suited to their countries position in organ transplants
- [http://www.who.int/ethics/topics/transplantation\\_guiding\\_principles/en/index2.html](http://www.who.int/ethics/topics/transplantation_guiding_principles/en/index2.html)



## Previous attempts to solve this issue

[http://www.who.int/ethics/topics/transplantation\\_guiding\\_principles/en/index2.html](http://www.who.int/ethics/topics/transplantation_guiding_principles/en/index2.html)

## Possible Solutions

- Creating prerequisite contracts in which people must provide information in which they consent or not to give their organs
- Enforcing greater care of war stricken children to aid their vulnerability to human harvesters
- Creating a stronger anonymity in which people will not feel pressured into given organs and creating a barrier between donor and those who need organs in which financial coercion will be avoided
- Enforcing laws to attain organs from all people post mortem.
- Using nanotechnology to create more viable organs
- Allowing for more research on stem cells in order to genetically make unique and tailored organs for those in need

## Sources

<https://my.clevelandclinic.org/health/articles/organ-donation-and-transplantation>

<http://www.bioethics.com/donation-transplantation>

<http://www.nejm.org/doi/full/10.1056/NEJMp058155#t=article>

<https://medlineplus.gov/organdonation.html>

<https://www.decodedscience.org/organ-harvesting-human-trafficking-black-market/56966>

[http://www.who.int/ethics/topics/transplantation\\_guiding\\_principles/en/index2.html](http://www.who.int/ethics/topics/transplantation_guiding_principles/en/index2.html)

<https://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm>

<https://www.ncbi.nlm.nih.gov/books/NBK24616/>

[https://en.wikipedia.org/wiki/Savior\\_sibling](https://en.wikipedia.org/wiki/Savior_sibling)

<http://www.dailymail.co.uk/health/article-1389499/I-know-I-born-save-Charlie-instead-born-just-Brotherly-love-saviour-sibling.html>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1083849/>

## Topic 2: Bio-engineering the human genome

### Introduction

Bioengineering the genome was first introduced after World War Two, after the introduction of Chemical and Agricultural engineering. It was a revelation in the scientific community as it introduced the idea of genetically changing the DNA to create the optimum product. We could bioengineer bacteria in order to prevent a certain disease from spreading, we could potentially bioengineer milk to help diabetics and create new inventions in which it would better our communities. However, arguments like 'playing God' and manipulating our genetics in order to create the 'perfect race' were introduced as well as the fact that modifying the genome is a clear violation of nature causing the idea of bioengineering the genome to become a widely debated topic.

It has caused many arguments to arise like creating 'designer babies' and even leading to 'neo eugenics'. Parents will be in full control of which genes their child will have i.e. they will control how the child looks like, which genetic diseases the child will avoid and even the idea of picking DNA that has correlation with certain fields i.e. the 'CEO genome'. The children will be created and will cause a chain of events like the creation of the 'perfect child' which will lead to the creation of the 'perfect race'.

Bioengineering could potentially lead to cloning as it will give the exact copy of the ideal human being. The question of religion also plays a role in the sense that, by using bioengineering we are not allowing the child to grow with the features, DNA that it was supposed to have, thus portraying the whole act of Bioengineering as 'playing God'. Many religious groups are against this as they believe that we should tamper with the way the child is to be born and that by doing so we are disturbing the natural balance that exists.

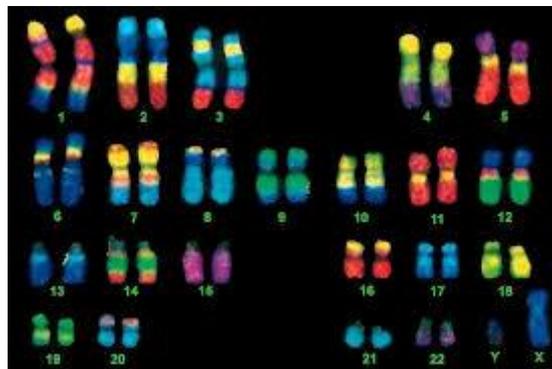
Manipulating the genome could also cause extinct animals to be brought back to life and making it so that the animal will be resistant towards a certain disease further creating controversy as we are 'cheating death' and quite literally bring the dead back to life.

Stem cell research will have to be continued as the results will be revealing how the 'designer babies' will be resistant to some diseases or creating genetically identical organs that will ensure that if the child is ever sick, they will be saved by their own organ that will be genetically modified to ensure optimum function. Diseases like Alzheimer's will be a thing of the past as stem cell research will be used in order to better understand these diseases as well as pinpoint exactly where the disease is found on the DNA and by using the CRISPR-Cas9 or other genetically modifying techniques be able to 'edit' the DNA to prevent the child from getting the disease.

By manipulating the human genome, we could be potentially creating a human race that is resistant to many diseases. This causes the issue of interfering with mother nature as natural selection will no longer be a defining factor in our lives. There will be no natural way in which people will be dying leading to further problems like overpopulation. People will be able to remain in power for a longer time and people no longer be affected by disease. Also, the cost of the genome manipulation will hinder people from less economically developed backgrounds to use it and only the rich and influential will be using the technique.

There are also cogent biological reasons for opposing the manipulation of the human genome as it could result in reproductive cloning. Using cell nuclear transfers will cause problems like the fact that we are not sure yet whether somatic cells used for generating embryos carry mutations that have the potential to harm later generations. The edited DNA using the CRISP- Cas 9 technique has not been tested long enough to show any long-term effects so we may not be aware of the mutations that it may cause.

By using clones in the society to make sure that the 'perfect human' is created, we will be lowering the genetic diversity of the human race and this will lead to mass destruction as if the clones are not resistant to a new disease, it could possibly lead to the destruction of the human race.



## Defining Key Terms

**Human genome:** The human genome is the complete set of nucleic acid sequence for humans (*Homo sapiens*), encoded as DNA within the 23 chromosome pairs in cell nuclei and in a small DNA molecule found within individual mitochondria. Human genomes include both protein-coding DNA genes and noncoding DNA.

**Bioengineering:** is a discipline that applies engineering principles of design and analysis to biological systems and biomedical technologies. Examples of bioengineering research

include bacteria engineered to produce chemicals, new medical imaging technology, portable disease diagnostic devices, and tissue engineered organs.

DNA: deoxyribonucleic acid, a self-replicating material which is present in nearly all living organisms as the main constituent of chromosomes. It is the carrier of genetic information.

CRISPR: a segment of DNA containing short repetitions of base sequences, involved in the defense mechanisms of prokaryotic organisms to viruses. A genetic engineering tool that uses a CRISPR sequence of DNA and its associated protein to edit the base pairs of a gene.

CRISPR- Cas 9: A unique technology that enables geneticist and medical researchers to edit parts of the genome by removing, adding or altering sections of DNA by using an enzyme called Cas-9 that acts as a 'molecular scissor' that cuts the DNA at a specific location in which the DNA can be edited

Genetics: a branch of biology that deals with the heredity and variation of organisms, the genetic makeup and phenomena of an organism, type, group, or condition

Eugenics: the study of or belief in the possibility of improving the qualities of the human species or a human population, especially by such means as discouraging reproduction by persons having genetic defects or presumed to have inheritable undesirable traits (negative eugenics) or encouraging reproduction by persons presumed to have inheritable desirable traits (positive eugenics)

Genome: A genome is an organism's complete set of DNA, including all of its genes. Each genome contains all of the information needed to build and maintain that organism. In humans, a copy of the entire genome—more than 3 billion DNA base pairs—is contained in all cells that have a nucleus.

Genomics: Genomics is the study of an organism's genome aimed at the functional specification of the different parts of the sequence that comprise the blueprint of the living cell to unveil the mechanisms of the physiology of the cell and its basic, developmental, and tissue-specific processes.

Proteomics: the comprehensive study of the executive molecules of the cell coded by the genome, further raising the level of complexity, because of the large amplification in the number, going from genes to proteins, and to the sophisticated structural and functional characterization of protein products, which confer specific biochemical properties.



## General Overview:

For many years molecular biologists have been looking for using cellular repair processes to intervene and modify DNA of organisms by guided genome editing; thus is, to change the organism genome by introducing a new function or correcting a mutation. In the last years CRISPR/Cas9 has been chosen as preferred method for genome editing due to its high degree of fidelity, relatively simple construction and low cost. These characteristics make this technique attractive to be used by any molecular biology lab, but the problem is that can be used for any purpose unless be regulated.

### **BIOENGINEERING**

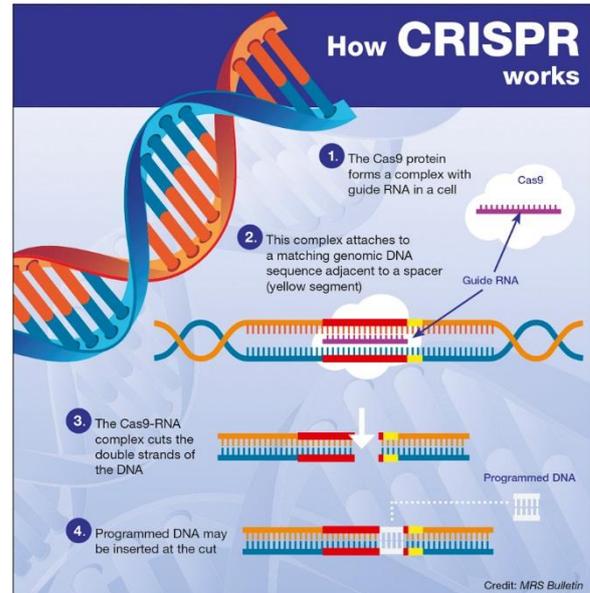
Refers to the application of the concepts and methods from the biological, physical, chemical, mathematical and computer sciences combined with the synthetic and analytic methodologies of engineering to open up the possibility of creating new human tissues, organs and blood.



An important ethical issue in research is that benefits must be greater than risks. Greater attention must be placed on risks, since they may damage living beings or the environment. The application of CRISPR/Cas9 technique involves risks since it may produce off target mutations, which can be deleterious. A high frequency of off target effects has been found in human cells, but low in mice. One problem is that large genomes may contain multiple DNA sequences identical or highly homologous to intended target DNA sequence. CRISPR/Cas9 may cleave also these unintended sequences causing mutations which may cause cell death or transformation. Efforts have been made to reduce off target mutations, but further improvement is needed, especially for precise modifications needed for therapeutic interventions. Another important problem is the efficient safe delivery of CRISPR-Cas9 into cell types or tissues that are hard to transfect and/or infect.

In experiments using RNA-guided gene drives based on CRISPR/ Cas9 technique, it is necessary to probe specificity considering off target effects. Since gene drive is still operating in created beings, the possibility of mutations off target continues and may increase each generation. If there is risk of transferring genes to other species, then there is risk of transferring modified sequences, passing the negative trait to related organisms even across political borders. The dispersion of gene drive trait may be difficult to control.

Furthermore, the disappearance of a whole population targeted by gene drive may carry drastic consequences in the ecosystem equilibrium. For example, other plagues may be developed. Some scientists have warned about the risks of accidental release in the environment of experimental organisms modified using gene drives. This demands careful assessment of each potential application and the need of regulatory norms. Safety measures are necessary to avoid disseminations of organisms that may cause ecological damage or affect human health.



Another ethical issue to discuss is the possibility of non-therapeutic interventions using genome editing. Its use in germ line is ban for safety reasons. But, the efficiency of CRISPR/Cas9 technique increases the possibility to intervene somatic cells to match genetics to our life interests. Many phenotypic characteristics have a genetic component, apart from environment, which could be intervened. For example, the technique could be used to enhance performance of athletes or to prevent violent behaviour or diminish addiction.

Generally, gene therapy looks to improve the health of a patient for its own benefit, but it may happen in the future that the criminal justice system mandate genome editing of genes related to violence for repeat offenders or violent dangerous criminals. If the intervention is done during development, there are problems of informed consent with minors, since it is questionable that parents or guardians should be allowed to decide for them their future for non-health reasons. Socially, there will be a problem if some populations or individuals may be enhanced genetically having advantage over others, for example in intellectual capacity.

Many have urged a public dialogue over the social, ethical and legal implications of using genome-editing technique in human germline, but there are other relevant issues to be discussed in relation with this technique as well. The use of CRISPR/cas9 revives many other social and ethical issues, not only with humans, also with other organisms and the environment, such as taking into account the non-maleficence principle in risk assessment, safety issues to avoid ecological impairment or the possible use of the technique for genetic enhancement.

Stem cells have tremendous promise to help us understand and treat a range of diseases, injuries and other health-related conditions. Their potential is evident in the use of blood stem cells to treat diseases of the blood, a therapy that has saved the lives of thousands of children with leukemia; and can be seen in the use of stem cells for tissue grafts to treat diseases or injury to the bone, skin and surface of the eye. Important clinical trials involving

stem cells are underway for many other conditions and researchers continue to explore new avenues using stem cells in medicine.

The list of diseases for which stem cell treatments have been shown to be beneficial is still very short. The best-defined and most extensively used stem cell treatment is hematopoietic (or blood) stem cell transplantation, for example, bone marrow transplantation, to treat certain blood and immune system disorders or to rebuild the blood system after treatments for some kinds of cancer.

Some bone, skin and corneal (eye) injuries and diseases can be treated by grafting or implanting tissues, and the healing process relies on stem cells within this implanted tissue. These procedures are widely accepted as safe and effective by the medical community. All other applications of stem cells are yet to be proven in clinical trials and should be considered highly experimental.

### Major Parties Involved

You may want to consider the following party when researching this topic:

#### CRISPR Therapeutics

CRISPR Therapeutics is a leading gene-editing company focused on the development of transformative medicines using its proprietary CRISPR/Cas9 gene-editing platform. They are working to translate this technology into breakthrough human therapeutics in a number of serious diseases. Their lead programs in beta-thalassemia and sickle cell disease have advanced to IND/CTA-enabling studies with a CTA filing planned by the end of 2017, and they are advancing additional programs in ex vivo and in vivo disease areas. In addition to their fully-owned programs, their strategic collaborations with Bayer AG and Vertex Pharmaceuticals enable them with unique capabilities. Through their private financings, partnerships, and IPO they have raised >\$400M to fund and accelerate their research. Their company is headquartered in Zug, Switzerland.



### Concerns:

- Rise of demand for “designer babies” by parents.
- Testing on humans considered unethical and on fetuses could lead to teratogenesis and mutation.
- De-extinction: Bringing back to life animals that have been extinct like the woolly mammoth and the dodo.
- Escape of modified genes in the ecosystem, disrupting nature and contaminating the gene pool.

### Possible Solutions:

- Performing prolonged experiments on lab animals before proceeding to apply the technology to humans to see the long-term effects of genetic modification on organisms.
- Impose regulations that restrict scientists from performing experiments on humans until the technology is proven to be safe and controlled.
- Preventing parents from altering the child’s DNA to much and limiting the DNA changes to that of diseases and fatal mutations
- Making it difficult for parents to be approved to have the baby’s genome altered

### Sources:

<https://www.omicsonline.org/open-access/ethical-issues-in-genome-editing-using-crisprcas9-system-2155-9627-1000266.php?aid=70914>

<https://en.wikipedia.org/wiki/CRISPR>

<https://www.fastcompany.com/40426601/the-ethics-of-crispr>

[https://en.wikipedia.org/wiki/Genetic\\_engineering](https://en.wikipedia.org/wiki/Genetic_engineering)

<https://www.yourgenome.org/facts/what-is-crispr-cas9>

<http://bioeng.berkeley.edu/about-us/what-is-bioengineering>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1083849/>

<https://en.wikipedia.org/wiki/Genomics>

<https://ghr.nlm.nih.gov/primer/hgp/genome>

<https://www.ncbi.nlm.nih.gov/pubmed/22065387>

<https://www.asme.org/engineering-topics/articles/bioengineering/genomics-and-human-genetic-engineering>

## Topic 3: The question of human enhancement through non-genetic methods

### Introduction



Since the dawn of mankind, humans have always been striving towards technological advancements and improvement of quality of life. Progress in the sciences led to the discovery of the branch of medicine, which greatly increased the average human lifespan, and has led to the invention of life-saving medicine such as penicillin, and other drugs that we take for granted today. However, the scientific community does not want to stop there, and wants to take the human species to a completely new level, using human augmentation.

Human augmentation, or human enhancement is improving and overcoming the limitations of the human body by using natural or artificial means. This type of technology has boomed greatly with the invention and successful implantation of the first cardiac pacemaker, which controlled the beat of a heart using short electrical impulses. Now scientists are looking to push and exceed the limits of the human body by creating exoskeletons, bionic body parts, and neural implants that improve cognitive function.

People that have lost limbs, have heart problems and some that are simply looking to push the boundaries of the species have turned to human augmentation to solve their health issues. Prosthetic limbs have existed for centuries, but now during the peak of technological advancement, robotic arms that are controlled with micro-movements are being developed that are fully functioning and can replace missing limbs. As prosthetics become more functional and more accurate and responsive, it raises the question if this technology becomes so advanced that it is better than our own limbs, when will we start replacing our own with prosthetics?

### Defining Key Terms

**Human augmentation:** Any attempt to temporarily or permanently overcome the current limitations of the human body through natural or artificial means. It is the use of technological means to select or alter human characteristics and capacities, whether or not the alteration results in characteristics and capacities that lie beyond the existing human range.

**Cyborg:** (short for "cybernetic organism") is a being with both organic and biomechatronic body parts.

**Implant:** A medical device manufactured to repair, replace, support and even enhance damaged biological structures, such as bones and organs. In comparison to transplants, an implant is an artificial device, an example being pacemakers.

Non-genetic methods: Any process in which the human body is adapted and improved without altering the human genome in any way.

Prosthesis: It is the addition of an external artificial body part to a human that replaces a missing part that had been lost due to trauma, illness or congenital conditions.

## General Overview

The idea of a mechanical body appeared in fiction back in 1868 in the novel “The Steam Man of the Prairies” published by Edward Sylvester Ellis, in which a humanoid-shaped steam engine was invented and operated with mechanical muscles. By 1961, two years before the fictional “Iron Man” comics were first released, the pentagon had already suggested the idea of an exoskeleton, a wearable robot in a way. It was described as “a human tank equipped with power steering and power breaks” that would be able to run faster, be stronger and lift objects many times the weight of the wearer. By the mid-60s engineers have been able to create wearable exoskeletons that weighed 15.8 kilograms that was dubbed the “superman suit”, which could potentially lift 453 kilograms in the near future.

Like many other technologies, the ideas about human enhancement and creating a stronger, more improved version of a human using machinery began from the army. Even though they had these technologies under its radar for a long time, they were also used to improve on medicine and to treat illnesses and disabilities that posed dangerous health risks. By 2030, Kevin Warwick who is an engineer in Coventry University known for his research on direct interfaces between computers and the human nervous system, stated that the possibilities of human enhancement are endless, and that the body can be extended by outsourcing memory, in other words being able to transfer data from the brain to electronic devices, and vice versa.

Given the technical scope of current and future implantable sensory/telemetric devices, these devices will be greatly proliferated, and will have connections to commercial, medical, and governmental networks. For example, in the medical sector, patients will be able to login to their home computer, and thus visit virtual doctor’s offices, medical databases, and receive medical prognoses from the comfort of their own home from the data collected through their implanted telemetric devices. However, this online network presents huge security concerns because it has been proven by several U.S. universities that hackers could get onto these networks and shut down peoples’ electronic prosthetics.

These sorts of technologies are already present in the U.S. workforce as a firm in River Falls, Wisconsin called Three Square Market partnered with a Swedish firm called Biohacks Technology to implant RFID microchips in the hands of its employees (which are about the size of a grain of rice) that allow employees to access offices, computers, and even vending machines. More than 50 of the firm’s 85 employees were chipped. It was confirmed that the U.S. Food and Drug Administration approved of these implantations. If these devices are to be proliferated within society, then the question that begs to be answered is what regulatory

agency will oversee the operations, monitoring, and security of these devices? According to this case study of Three Square Market, it seems that the FDA is assuming the role in regulating and monitoring these devices.

Current methods of enhancement:

- Doping and performance-enhancing drugs
- Implants
- Prosthetics and powered exoskeletons
- Nootropics and neurostimulators
- Computers improving cognitive function

## Examples

Neil Harbisson, also known as “The Eyeborg”

Implanted an antenna into his skull, officially recognized as a cyborg by the government. The antenna sends vibrations to his head that allow him to “hear” colours but also send other information to his brain. The operation for the antenna implant took place in 2004, and was rejected by bioethical committees, which was the reason why the surgery went underway by anonymous doctors. In 2011, the antenna was damaged by police during a demonstration, as it was believed that Neil was recording the police, and he filed a complaint for physical aggression as he believes that his antenna is a body part. This raises the question of what implants can be considered body parts, and which others are not.



Jens Naumann, first person ever to receive an artificial vision system

Naumann lost his vision after a steel shard went into his eye during a work accident. After 3 years of adjusting to seeing the world with only one eye, he unfortunately had a second accident which cost him his other eye, which left him in complete darkness. Little did he know, that in April of 2002 he would undergo a surgery that would connect his brain to a series of electrodes which would eventually allow him to see. After a painful surgery, Naumann’s brain could now process the light entering the camera installed on a pair of sunglasses which allowed him to see a series of dots which could be interpreted as objects. However, the doctor that developed the whole project and completed the surgery was getting sick with each passing day, and he passed in 2004. He did not write any medical journals, so after the system began facing problems, Neumann found himself in darkness again. The question is, will this technology become so advanced that people will start replacing their eyes with bionic ones, in order to see more of the



electromagnetic spectrum, be able to see in the dark, etc? If so, should this type of technology be legal and why would the government want to prohibit such sort of operations?

## Concerns

The fact that humans can one day have bionic body parts that replace their limbs, eyes, etc. is a very concerning thought, and raises the following questions:

1. The use of implants and prosthetics in the army to create "super soldiers".
2. The fact that some ideas will be tested on humans and the extent at which these experiments will be ethical.
3. The extent at which we will be able to replace human body parts with bionic ones, and at which point is considered one considered more robot than human.
4. The fact that Bluetooth and Wi-Fi enabled devices and prosthetics can be hacked and could potentially harm the user.

Since the 1990s, several academics (such as some of the fellows of the Institute for Ethics and Emerging Technologies) have risen to become advocates of the case for human enhancement while other academics (such as the members of President Bush's Council on Bioethics) have become outspoken critics.

Advocacy of the case for human enhancement is increasingly becoming synonymous with "transhumanism", a controversial ideology and movement which has emerged to support the recognition and protection of the right of citizens to either maintain or modify their own minds and bodies; so as to guarantee them the freedom of choice and informed consent of using human enhancement technologies on themselves and their children.

Neuromarketing consultant Zack Lynch argues that neurotechnologies will have a more immediate effect on society than gene therapy and will face less resistance as a pathway of radical human enhancement. He also argues that the concept of "enablement" needs to be added to the debate over "therapy" versus "enhancement".

Although many proposals of human enhancement rely on fringe science, the very notion and prospect of human enhancement has sparked public controversy.

Dale Carrico wrote that "human enhancement" is a loaded term which has eugenic overtones because it may imply the improvement of human hereditary traits to attain a universally accepted norm of biological fitness (at the possible expense of human biodiversity and neurodiversity), and therefore can evoke negative reactions far beyond the specific meaning of the term. Furthermore, Carrico wrote that enhancements

which are self-evidently good, like "fewer diseases", are more the exception than the norm and even these may involve ethical tradeoffs, as the controversy about ADHD arguably demonstrates.

However, the most common criticism of human enhancement is that it is or will often be practiced with a reckless and selfish short-term perspective that is ignorant of the long-term consequences on individuals and the rest of society, such as the fear that some enhancements will create unfair physical or mental advantages to those who can and will use them, or unequal access to such enhancements can and will further the gulf between the "haves" and "have-nots". Futurist Ray Kurzweil has shown some concern that, within the century, humans may be required to merge with this technology in order to compete in the marketplace.[citation needed]

Other critics of human enhancement fear that such capabilities would change, for the worse, the dynamic relations within a family. Given the choices of superior qualities, parents make their child as opposed to merely birthing it, and the newborn becomes a product of their will rather than a gift of nature to be loved unconditionally. This is problematic because it could harm the unconditional love a parent ought give their child, and it could furthermore lead to serious disappointment if the child does not fulfill its engineered role.

Accordingly, some advocates, who want to use more neutral language, and advance the public interest in so-called "human enhancement technologies", prefer the term "enablement" over "enhancement"; defend and promote rigorous, independent safety testing of enabling technologies; as well as affordable, universal access to these technologies.

### **Possible Solutions**

- Limiting implants and prosthetics only to replace lost limbs and for essential body functions.
- Create safer technology that does not rely on wireless communication so that it is not easily hacked.
- Restricting army developments on human enhancement that could be used for creating more efficient soldiers.
- Encouraging development of more accurate and functioning prosthetics for people with disabilities.
- Encouraging human enhancement through "natural" and traditional methods, e.g. exercise, dietary supplements.

## **Sources**

[https://en.wikipedia.org/wiki/Human\\_enhancement](https://en.wikipedia.org/wiki/Human_enhancement)

[https://en.wikipedia.org/wiki/Neil\\_Harbisson](https://en.wikipedia.org/wiki/Neil_Harbisson)

<http://achhikhabre.com/jens-naumann-artificial-vision-experiment/>

<https://www.theguardian.com/artanddesign/2014/may/06/neil-harbisson-worlds-first-cyborg-artist>

<http://www.popularmechanics.com/military/research/a18574/enhanced-human-operations/>

<https://www.theatlantic.com/international/archive/2015/09/military-technology-pentagon-robots/406786/>

<https://www.technologyreview.com/s/602342/the-ethics-of-human-enhancement/>

<https://www.bbvaopenmind.com/en/article/ethics-issues-raised-by-human-enhancement/?fullscreen=true>

<http://www.bioethics.com/human-enhancement>

<http://www.bioethics.com/archives/40843>