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## REVIEW ARTICLE

### Social and Ethical Impact of Advanced Artificial and Biological Enhancements

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#### Abstract:

##### Background:

While modern humans seek ways to extend life expectancy, the necessity of advanced bioengineering tools for the production of effective human enhancement applications appears as compelling as ever.

##### Objective:

The technological future of Homo sapiens has been scheduled within a quantum environment and advanced physical interventions are imperative to occur in the anatomy of modern humans, including genetic improvement and human cloning. New terminologies and latest projects such as genome editing, mind uploading and tissue engineering applications for the growth of new organs are issues of discussion in this paper.

##### Methods:

Several advanced biotechnological methods are presented in this paper, including the 14-days rule, the 2045 Initiative project and the CRISPR technique and their social and ethical implications are discussed.

##### Results:

The exponential aging of the population results in rapidly increasing demands for next-generation drugs and innovative pharmaceutical products that target individualized genetic treatment, resulting in the emergence of controversial ethical and social implications in the forthcoming post-Homo sapiens Era.

##### Conclusion:

The next-generation ethics must be clarified, an interdisciplinary debate should be initiated, and all the different perspectives must be recorded and evaluated to adopt the most efficient practices for controversial topics like the potential digital immortality.

**Keywords:** 14-days rule, 2045 Initiative project, CRISPR, Designer babies, Enhancements, Evolution, Eugenics, Genetic variety, Homo sapiens, Homo Universalis, Human cloning, Immortality, Mind uploading, Next-generation ethics, Tissue engineering.

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## 1. INTRODUCTION

Since the first mathematical models and cosmological observations of the ancient mathematician, astronomer and

geographer Claudius Ptolemy, medicine embedded with cosmological principles has been practiced in all ages of the world concerning different parts of the human body and their direct association with diseases and possible drug treatments. With a reasonable degree of accuracy, ancient philosophers and scientists expressed the connection between the signs of the zodiac to certain parts of the human body, mainly influencing the traditional and alternative types of medicine until now [1, 2]. In-depth philosophical issues concerning natural laws and

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their impact on human existence seemed to start being clarified in a more rule-based set of principles through Aristotle's teleological explanations. Teleological explanations were the central feature of Aristotle's investigation of nature and reflected the importance he attributed to final causality in the coming to be and the presence of regular natural phenomena [3]. Since then and after centuries of methodical scientific documentation and experimentation, the evolutionary inquiry is now successfully based on interdisciplinary fields such as genetic engineering, nanotechnology, quantum mechanics, neuroinformatics and futurism biogerontology, and offers a chance of further evolution opportunities and technological achievements to human species.

Nanodevices [4 - 6] and techniques like the CRISPR/Cas9 targeted genome editing [7], which can repair cells and treat genetic diseases, promise significant improvements in longevity and quality of life, involving radical modifications of the human genome, thus leading to the old but diachronic hypothetical issue of human immortality [8]. The intervention on genetic information, the creation of artificial organisms, the production of transgenic animals for human organ transplantation and the convergence of humans and machines, lead to entirely hybrid entities for our descendants, already defined as the hypothetical future transhuman era. This current perspective study is focused on the establishment of the initial framework of the post *Homo sapiens* species, where humans will have the ability to live in unknown cosmological environments and adjust their biological entities using bioengineering applications for increasing of their average lifespan [9]. By taking into consideration all the latest technological achievements in space and life sciences, this future species has been determined by the authors with the term 'Homo Universalis', referring to all the anatomically enhanced modern *Homo sapiens*, who seek for life even beyond the frontiers of the earth [10].

It is obvious that next-generation ethics and social mechanisms [11] must be addressed concerning the technological products and pharmaceutical materials of the next decades that are based on the scientific achievements of today. While synthetic biology is characterized as the *nth* industrial revolution [12], the generalized biomedical breakthrough has been advertised as the fourth industrial revolution, demanding the combination of several scientific fields [13]. For several scientists and philosophers, the biotechnological revolution as it is expressed with applications like the mind uploading seems to be utopic visions of an incredible future [12]. Therefore, it is crucial to clarify what is really scientifically potential and what is just imagination or technological fiction, even though the announcement of futuristic promising projects is commonly the 'bait' for securing research funding [14]. Probably the main query of this debate is to define the differences between the 'potential-necessary' future and the 'possible-acceptable' future [15].

## 2. MEDICAL ACHIEVEMENTS IN HUMAN EVOLUTION

*Ardipithecus kadabba*, still referred until now as the earliest human species that lived between 5.2 and 5.8 million

years ago, were bipedal with a similar body and with a brain size similar to a modern chimpanzee [16]. Newly discovered hominin footprints from the late Miocene period of Crete have been presented recently, placing the first human species probably, earlier, and in a different place [17]. Almost 200,000 years after the first period of our existence, the modern *Homo sapiens* started to show its existence through dramatic climate changes. During the last 3000 years, these modern humans succeeded to establish a very well structured civilization. But, if we focus on the last two centuries, amazing achievements can be presented concerning technology and science as well. Based on the pioneering work of physicists like Pauli and Feynman, and the establishment of the Weak Quantum Theory, human intelligence, and brain function could be more efficiently modeled *via* the quantum randomness, uniqueness, and entanglement rather than the standard binary information, in a universe of multiple dimensions [18, 19].

However, can we outline the future human? According to Futurists the human species that will upgrade *Homo sapiens* culture will probably occur by natural selection in a limited population rather than evolve into new species [20]. Future humans will probably adopt technological inventions to adjust to the future hostile earth environment genetically. The term *Homo Universalis*, declares the release of human species from its very terrestrial and planetary existence to a more cosmic and universal being, *via* the combination of bioengineering and pharmaceutical revolution as well as space discoveries. While the early *Homo Universalis* is already seeking for earth-like exoplanets, they need all the advanced technical knowledge to adjust the earth's way of living into less friendly and sustainable environments or into Earth-like planets [21]. For many people the waiting time of achieving holistic treatments to their diseases has already passed, therefore they have chosen to be cryopreserved in order to gain a second 'potential' chance in the achievement of immortality [22]. Others have preferred a more natural and low-risk strategy and started applying rejuvenation techniques in order to reverse aging at the cellular level [23]. Nowadays, few additional innovative but extreme studies are establishing a promising future for the humankind. The mind uploading and the so-called Whole Brain Emulation methods claim to create artificial human clones by scanning the structures and the functionalities of the brain and the CNS [24]. While the side effects of these methods and the up to now destructive manner of the deep scanning of human brain are major problems, philosophers have to answer with certainty if the human artificial clones and the other artificial intelligence (AI) applications have consciousness, emotions and are mentally identical to their natural 'human copy' [25, 26]. Another extreme development that aims to treat the organ transplant problem is based on the creation of human organs without using donors. The research team from the Texas Heart Institute is scheduling to create at the beginning human hearts, using decellularized hearts injected with stem cells and properly transformed to function again inside bioreactors and suitable artificial environments [27].

The enhancement of physical capabilities, through projects like the 2045 *Initiative*, will probably assist the dream of cosmologists for cosmic journeys, claiming funds for establishing an advanced technological future. For this

transition to occur, modern humans have to apply advanced genomics interventions into their biological information. Stem cells, artificial organs printed in 3D printing medical devices, nanotechnological drug delivery systems, and next-generation drugs with decreased side effects, will undoubtedly offer new perspectives to the researchers. On the contrary, this new framework may influence the pharmaceutical industry in terms of the intellectual property rights, the long-term efforts, the excessively high costs, the high risk of failure and the sharing of ongoing clinical trial results [28]. As far as the cost of personalized treatment is concerned, the cost of health care for elderly patients in an increasingly aging population is higher than the care in the younger ages even with severe disabilities. Targeting treatment on early ages can undoubtedly decrease the economic cost of side effects and assist the social integration of the patients.

### 3. DATA AND METHODS

#### 3.1. Possible or Potential Future

##### 3.1.1. Human Cloning

One of the well-known emerging genetic technologies with controversial ethical implications is human cloning. Cloning for many researchers and philosophers, should not be described as *a priori* with deniability, but only in correlation to the corresponding human intentions. Therefore, the question of what is morally irrevocable should be addressed in each case separately, since the main issue of conflict is to what extent we intend to replace traditional value-driven ways of behavior and how imperative is our need to integrate technology. For many people, the treatment of infertility or other hereditary diseases through cloning would not only violate their status and dignity, but it could serve as redemption. Besides, we are now capable of classifying the differentiation between the human personal identity and the genome identity. While the origin of the genome identity can be precisely determined and analyzed in-depth even before the birth of the human (although the interference of any epigenetic factors is undefined and uncertain about the time of their integration within the genome identity), the formation of the personal identity is not associated with an individual biological event, nor at any particular time in human life.

While human cloning is strictly forbidden for reproductive purposes according to the UNESCO Universal Declaration on Human Genome Rights, the ability to produce human embryonic stem cells is a new alternative treatment practice. However, what is the moral hazard behind human stem cell management techniques? Although nowadays we can obtain stem cells from adults, it is considered acceptable to use the 'spare' embryos from the IVF procedures, highlighting the occasional embryo over-production into an ethical tool for the legal use of embryonic stem cells [29 - 31]. Without any doubt, there are diverse moral concerns on the human embryo research which are summarized under the 14-day limit debate of embryo research to the first two weeks of development, separating the pre-embryo from the unborn child [32, 33]. The report of the Warnock Committee of Inquiry into Human Fertilisation and Embryology and latest studies summarize the

arguments of extending or not this 14-days global policy to the clarification of the moral and the biological status of the embryo [34]. From the argument that the moral status of the human embryo equals to the moral status of a human being to the rather extreme nihilistic approach that the embryo is just a simple collection of cells, there are intermediate and scientifically-based approaches of recognizing the ability of the moral status of the embryo in relation to neural development and the ability to sentience [35 - 39]. While scientific evidence supports that there are no sensory systems to offer stimulation to the embryo until the first 28 days and there is an additional great medical interest between the 14th and the 28<sup>th</sup> day of the embryo development [33 - 34, 39 - 40] the query of revising or extending this 14-days soft limit can be reconsidered for the betterment of the human life [41].

##### 3.1.2. CRISPR Technology

A few years have already passed since the first announcement of the promising CRISPR technology for editing, regulating and targeting genomes [42]. In the next decades, genome editing technologies like the CRISPR-Cas9 will not only target genetic disease treatment and repair cells but will potentially offer the creation of customizing the human genome and may be linked to longevity with relevance to modifications of the human genome.

The CRISPR/Cas9 system has already signaled a revolution in genome and epigenome editing, for treating common complex diseases like cancer and Alzheimer's disease (AD). Even though the gene editing is still at the beginning [43], the news are encouraging for neurodegenerative diseases like the AD, especially if we take into consideration the disappointing failed clinical trials on the amyloid hypothesis [44] and the rapidly increasing proportion of patients in the general population and the enormous social and economic costs [45].

Of course, there a lot of aspects to be further analyzed and addressed, in order to further apply the CRISPR/Cas9 technology. The use of the CRISPR/Cas9 technology may not be exclusively linked to the activation of anti-aging genes due to severe side effects leading to mitochondrial apoptosis and cell death [46 - 47]. Therefore, the CRISPR/Cas9 technology could be applied as a remedial method of greater nanotechnological solution that targets healthy aging, minimizing in this way the ethical barriers of an exclusively genetic treatment.

While human genetic-wearable-cognitive-artificial enhancements extend the cognitive and physical limits of the human body [48, 49], the extreme capabilities that some want to inherit their children with, it will surely establish a future society of strong inequalities [50, 51].

Eugenic techniques like the 'Designer babies' [52] creates several ethical dilemmas such as the desirable traits that are selected to be inherited, the uncertainty of the result is related to the lack of environmental interaction between DNA and other epigenetic factors [53] and the difficulty of verifying the outcome with expensive clinical trials. Even though several significant technological inventions offer new and practical solutions on a daily basis, there is still much skepticism and

doubts about the reliability of artificial and biological enhancements [54, 55].

The latest announcement from the Chinese geneticist He Jiankui that the first gene-edited babies are already being created in his lab using the CRISPR/Cas-9 tool to disable the related to HIV CCR5 gene, seemed to shock the scientific community [51, 56]. This first claim of germline manipulation, could possibly directly affect our future evolution, leading to rapidly established inequalities within and between social groups and societies, but also to an exotic treatment of very lethal diseases. Obviously, the dilemma on such genetic interventions is great, therefore the role of the Ethical Committees must be very precise to justify the necessity of a genetic manipulation due to mainly therapeutic reasons in relation to potential side effects.

### 3.1.3. The 2045 Initiative Project and Artificial Intelligence Applications

On the opposite side, the supporters of human-machine convergence have already found, in the 2045 Initiative Project, a potential solution to escape physical death, through artificial immortals creatures, carrying out brain storage knowledge [57]. The 2045 foundation for achieving advanced non-biological carriers to extend life, already has a seven-year presence with its principal goal, as the 2045 Initiative founder Dmitry Itskov declared, the immortality for every human being *via* artificial bodies [58]. This technology has already produced anthropomorphic robotics, claiming that the next step will be the transferring of human personality to an immortal avatar, dealing decisively with the aging problem, but not yet addressing the ethical matters and the potential risks. We must specify that the 2045 Initiative Project declares that it will not produce artificial intelligence in a machine, but it will upload the human identity, personality and consciousness of a real person into a machine. Of course, this is a target product of the next two decades and for this reason, it must now be considered as technological speculation, while the so-called mind uploading technique requires at least a holistic brain structural and functional modeling, which is still a hot topic.

It is worth mentioning that the initial step for the social integration and recognition of the future robotics has already been made in October 2017, when the social humanoid robot called Sophia [59] received citizenship from Saudi Arabia and was the first non-human to be given any United Nations title until now. Of course, this robot is not the first humanoid with capabilities on face recognition, expressiveness, aesthetics, and interactivity with humans, but it is the first machine with an offered and recognizable human social reputation. Obviously, the unexpected citizenship of this robot aims to support the convergence of human-machine into a hybrid form and its potential social and moral acceptance by the general population in the next decades. This recognition is a first argument for the supporters of artificial enhancements, that a society can soon get used to of the appearance of a human-robot in the daily news, talking, interviewing, laughing, joking, interact with facts and express emotions.

Artists that produce scientific projects can bridge the gap between scientists and society, presenting innovative

applications like the exoskeleton and the third ear [60], or make the bioethical [61] and social impacts of human enhancement applications familiar to a broader audience.

## 4. AN ETHICAL OVERVIEW

Philosopher Derek Parfit in 'Persons and Reasons' claims characteristically that '*If certain things happen to me, the truth might not be that I become a very different person. The truth might be that I cease to exist and that the resulting person is someone else*' [61]. Even though very few studies until now discuss in-depth the controversial ethical queries of germline intervention, the excitement on potential therapeutic genetic modifications must be moderated considering the ration between risks and benefits [63 - 67].

Therefore, we propose the following topics as the baseline for establishing the new era of biologically and artificially enhanced humans and not another attempt of eugenics:

- The aspects of patentability on human genetic data, not only have to be declared as protected, but a more strict rule-based system must be applied in performing experiments or publishing clinical results.
- Millions of years of evolution have been based on randomness, in what we do not know and in what we cannot predict. The unconscionable use of genome editing tools without long-term clinical studies validation could also mean a missed opportunity to increase diversity.
- While genome editing techniques could probably produce unknown mutations or other side effects, we must secure any inherent alterations for future generations.
- Humans can evolve and adapt to the continually changing environment, developing unique characteristics and adopting dynamic epigenetic factors. Will humans lose that ability if they remain genetically stagnant?
- Will gendering diversity be visible in an artificial environment?

For centuries, humans believed that the environment is stable until Carl Linnaeus after decades of research has admitted that there are many different species (*species are all, crevit ab initio infitum ens*). Nowadays, given the influence of the human species on the other species evolution and the creation of new hybrid forms of life, humanity will probably face a series of potentially unpredictable future bio-evolutionary events. However, even if it sounds very wacky, humans are not forced to implement and embrace everything that science discovers or technology produces.

Ethics experts from Catholic Health East Inc., which is acquired by the Trinity Health Corporation, based on the practices of The American Society of Bioethics and Humanities have already proposed mechanisms for future ethics committees [68]. Their proposals are based mainly on the transparency of the procedures and the quality of their decisions through a measurably improved quality inpatient care and promotion of institutional values [69 - 72]. Next-

generation invasive or non-invasive treatments must be compatible with the patient's values and desires, respect patient autonomy and rights and promote equality and unlimited healthy aging [73]. Any ethical or social aspect concerning human evolution strategies [40], should be analyzed further by the Institutional Review Boards and be expanded to include cross-correlated fields such as neuroscience [74], nanotechnology [75] or synthetic biology [76] and update the ways of bioethics dissemination through alternative directions like applied arts. Additionally, more complex representations of reality and natural Laws such as the term Quantum Consciousness [77] and the possibility of applying Weak Quantum Theory in our everyday life activities [78], must be explained to all the social structures and in few cases to be demystified. We must adjust the traditional ways of educating our students, to accept shortly the possibilities of treating genetic diseases or successfully manage heredity problems. A bioethical debate on featured technologies like the mind uploading or the genome editing must take into consideration the same questions that were initially discussed decades before in the case of cloning, such as the right to the freedom of scientific research, the reproductive freedom, the right of any human to uniqueness, and the right to ignorance and to an 'open' and adjustable future.

A crucial element for bioethics is not only the ultimate scientific knowledge that will emerge but also the ways that this will become possible. At each stage of any process, the four basic principles of bioethics should be continuously respected: 1) the principle of autonomy, 2) the principle of benevolence, 3) the principle of avoidance of harm and pain, and 4) the principle of justice. Until now, the 'potential' biological immortality seems extremely different from the 'possible' digital immortality, while simultaneously current digital immortality methods may prove destructive to the human brain [24]. Until the real meaning of 'digital cloning' will be sufficiently clear regarding the similarity among human-clone personalities and characteristics, it is worth examining the social impact of the hypothetical resulted in human immortality as it is expressed through the religions [79]. The catalytic and inevitable state of biological death and its irrational character have gone through several stages of social acceptance and assimilation, from the fatal acceptance of the past to its direct controversy from modern medicine. However, if human immortality becomes real, any social and religious impact will be deeply influenced in relation to the degree of accessibility and the beneficiaries of this extreme knowledge. Either we refer to non-fundamentalist or fundamentalist religious societies or individual atheists, the modern world has the ideological, theological and philosophical background to adjust the accepted immortality into their historical presence looking ahead to their future existence.

## CONCLUSION

The ethical and social controversial attempts for immortality corresponds to the classification of the emerging technologies for a healthy human body into two broad categories: the biological enhancements *versus* the artificial transformations. The objectives are the same in any case: to push death further off, in combination with the overcoming of

our planet frontiers and gain a super-intelligent life.

The Convention ETS No.164 for the protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine of the Council of Europe, clearly states clearly and unlike most of the common global practices that '*It bans all forms of discrimination based on the grounds of a person's genetic make-up and allows the carrying out of predictive genetic tests only for medical purposes. The treaty allows genetic engineering only for preventive, diagnostic or therapeutic reasons and only where it does not aim to change the genetic make-up of a person's descendants. It prohibits the use of techniques of medically assisted procreation to help choose the sex of a child, except where it would avoid a serious hereditary condition*'. Undoubtedly, there is much skepticism on the latest technological achievements and the new reality of technical devices that improve human performance in the healthy population and disabled individuals as well. Probably we have not yet found convincing answers to what is natural and what is not and when an enhancement technology influences human identity. Scientists and ethicists must clearly identify the limitations of the human enhancements in order for a person to be the same, within a biological or an artificial carrier [80 - 82].

## LIST OF ABBREVIATIONS

AI	= Artificial Intelligence
CNS	= Central Neural System
CRISPR/Cas-9	= Clustered Regularly Interspaced Short Palindromic Repeats - Associated Protein 9
HIV CCR5	= Human Immunodeficiency Viruses C-C Chemokine Receptor Type 5

## CONSENT FOR PUBLICATION

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## CONFLICT OF INTEREST

The authors declare that they have no competing interests, financial or otherwise.

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