NATIONAL BIOETHICS COMMISSION

R E P O R T

HUMAN ENHANCEMENT
PHYSICAL ENHANCEMENT

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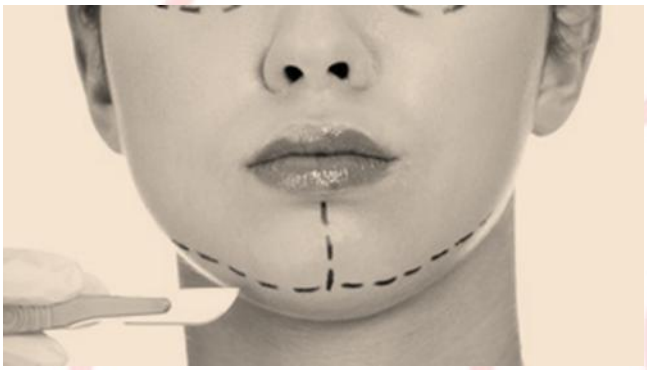

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A. ENHANCEMENT OF HUMAN CHARACTERISTICS

1. Introduction

Human enhancement has emerged as a major issue in bioethics. The continuous technological and scientific advances enable interventions in basic, "normal" human capabilities, a fact that raises serious social and ethical issues. Some forms of enhancement already have practical applications, whereas other forms belong to the realm of science fiction.

The term refers to the improvement or enhancement of human performance, appearance, behavior or emotions, through the use of medical technology (including genetics and biotechnology). Biomedical applications are used in order to develop capabilities beyond of what is considered as normal or healthy. Perhaps instead of "enhancement", "expansion" is a different term that can be used, and does not necessarily imply that such interventions are beneficial to the person.

2. The facts

a) Distinctions

Certain distinctions between certain concepts are important for the discussion on human enhancement.

a) *Internal (in the human body) and external enhancement*

Human enhancement can be achieved by means acting *within* the human body or by external tools acting *on* the human body. For example, the use of drugs affects normal biological functions of the human body, whereas an external computer could control human functions externally, after connecting with an implant.

b) *Temporary and permanent enhancement*

Human enhancement may cause temporary changes in humans, such drug use, where the effect ceases by not providing these substances, or permanent changes, such as the genetic modification of gametes.

c) *Treatment and human enhancement*

The distinction between human enhancement and treatment is also important in this discussion, although it is not easy. Treatment aims to correct pathological characteristics, human diseases or injuries and restores – to the extent possible- the normal function of the human body. In contrast, human enhancement aims to improve the human characteristics or capabilities beyond the normal. One might consider that therapy provides the means to *get well*, whereas human enhancement provides the means to *become better*.

Of course this assumes that there is a clear definition of "normal", "healthy" and "disease". However, it is difficult to define "healthy" since the World Health Organization (WHO) describes in its constitution that "*health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*". This definition expands the boundaries of health, including non-medical problems such as those resulting from specific social characteristics. The definition of normal is even more difficult if one considers that there are "natural" differences, not only between individuals but also within the same individual at different developmental stages.

On the other hand, the modern medical practice already applies practises that aim not only at the correction of pathological conditions and diseases:

- First and foremost, *preventive medicine*, which aims to prevent and ultimately avoid disease. Preventive medicine includes preventive vaccination.
- *Palliative care*, which is offered in order to relieve from pain and prevent the suffering of patients.
- *Infertility treatments*, aiming, ultimately, to reproduction.
- *Plastic surgery*, which is offered to healthy people who want to enhance or change their physical characteristics.

b) Techniques of human enhancement

Human enhancement can be achieved by various methods and techniques, including:

- *Pharmaceutical substances* causing for example exaltation and happiness, that enhance memory, physical strength and stamina and cognitive abilities.

- *Techniques of genetic intervention* that facilitate for example the selection and creation of healthy or smarter children and increase life expectancy.
- *Regenerative medicine*, which aim to regenerate tissues and organs.
- *Technological interventions* that improve human capabilities.
- *Cosmetic interventions* (surgical or non-surgical) that aim to improve the external appearance and physical characteristics.

Table I presents indicative examples of the above mentioned techniques, which can be applied to both treatment and human enhancement.

c) The "business" of enhancement

Human enhancement technologies are an opportunity for businesses to invest in, and may soon become a lucrative industry. Pharmaceutical companies, research institutes, universities and even governments spent and continue to spend huge amounts on drug research and human enhancement technologies. Similarly to the development of pharmaceutical drugs, for which companies invest in research with the ultimate aim to obtain approval and, consequently, to profit from drug sales, research in human enhancement comprises an area for business development. The growing demand for enhancing human characteristics is inseparable linked to the production and supply of such substances and technologies.

Typical examples are the drugs Prozac (antidepressant) and Ritalin (prescribed in cases of attention deficit hyperactivity disorder), for which the demand is growing with equivalent profits for the companies producing them, as well as the increasing demand for plastic surgery with corresponding economic benefits for those who provide such services (AAAS, 2006). It is certain that non-invasive methods of human enhancement, such as drug use, will attract more future investments considering that people are more receptive to them, access is easier through the internet, and they are not regulated as stringent in all countries.

Table I. Interventions applied to both treatment and human enhancement.

	Treatment	Human enhancement
Pharmaceutical substances		
Growth hormone	Developmental problems in children	Enhancing appearance Enhancing athletic performance
Insulin growth factor	Muscular dystrophy	Increasing muscle mass Enhancing athletic performance
Rimonabant and sibutramine	Obesity	Enhancing appearance
Erythropoietin	Increase strength in patients undergoing chemotherapy and present with anemia	Enhancing athletic performance
Modafinil	Sleep disorders e.g. narcolepsy	Enhancing attention, vigilance, memory
Ritalin	Attention Deficit Hyperactivity Disorder	Enhancing concentration
Prozac	Antidepressant	Enhancing emotions Reducing social characteristics e.g. shame
Sildenafil (Viagra)	Erectile dysfunction	Enhancing sexual ability, stamina
Techniques of genetic intervention		
Genetic testing (in various genes)	Disease diagnosis Disease prevention Effective treatment	Increasing life expectancy Selection of "better children" Enhancing athletic performance
In somatic cells	Stem cell treatment Stem cells to generate tissue and organs	Increasing life expectancy
In gametes	Correcting or avoiding abnormal genes Avoiding sex-linked diseases	Enhancing non-pathological genes Enhancing skills, stamina, intelligence, memory, metabolism, etc.
Regenerative medicine		
Tissue/organ regeneration	Restoration of organ function Restoration of sports injuries Scar repair after accidents or burns	Increasing life expectancy Enhancing athletic performance Enhancing appearance
Platelet rich plasma (gel)	Restoration of anterior cruciate Restoration of joints with osteoarthritis	Enhancing athletic performance

Table I (continued). Interventions applied to both treatment and human enhancement.

	Treatment	Human enhancement
Technological interventions		
Artificial implants	Early and accurate diagnosis Effective and targeted drug therapy Restoration of joints, organs	Enhancing athletic performance Increasing life expectancy
Implants - sensors	Diagnosis and treatment of diseases e.g. sensor of sugar levels and use of insulin	Enhancing athletic performance
Brain implants	Increasing memory in patients with neurodegenerative diseases Restoration of mobility in paralyzed patients	Enhancing senses, memory, intelligence Free access and opportunity to intervene in the physical world by thought
Nanotechnology	Targeted therapy e.g. targeting cancer cells	Increasing life expectancy Reducing the vulnerability of soldiers by controlling their metabolism
Aesthetic (surgical) interventions		
Skin graft	Patients with severe burns	Enhancing appearance and signs of aging
Reconstructive surgery	Scar repair after accidents or burns Restoration of anterior cruciate	Enhancing appearance and signs of aging
Liposuction	Reducing the risk of obesity	Enhancing appearance
Gender change	Agreement of physical and sexual identity	Enhancing gender characteristics
Breast implants	Breast reconstruction after total mastectomy	Enhancing appearance
Breast size reduction	Treatment of dermatitis Decrease neck pain	Enhancing appearance Enhancing athletic performance

3. The dimension of ethics

The possibility of changing properties of the human body by medical means, in order to seek some kind of "enhancement" (as the person interested understands it), poses, in principle, a general question: is "enhancement" a morally acceptable reason for medical interventions within the body or, on the contrary, does it exceed what we mean by "health care"?

The affirmative answer to this question could be based on the above mentioned broad definition of health, adopted by WHO. According to this definition, any intervention aiming at the "full development" of human abilities is justified, even if nothing pathological is being treated, i.e. when the organism does not suffer from a disease or

accident. In this context, "enhancement" is part of "health".*

A negative answer to the above posed question is linked to the standard aim of medicine, which is to treat the disease (and generally any damage of the organism). This approach accepts a more moderate definition of health, considering healthy anyone living in a balanced physical state, without presenting with any damages or threatened by -unforeseen or not- damages of the organism. In this context, health is not connected with the development of physical abilities -l*et al*one with any desired change in external features- but simply comprises a state of equilibrium.

Both of these positions can be reconciled with the Hippocratic principle of "to do good or to do no harm", which encapsulates the moral duty of the physician during medical practice. However, the two above mentioned positions are problematic as well.

The first position limits in a completely ideal situation, the ascertainment that an organism is "healthy", over- extending the area of "unhealthy" (if not the area of "patient"). Therefore, it seems that the first position ignores that the "full development" of an organism's abilities is strongly subjective. The subjective assessment of our abilities is amplified by the fact that, nowadays, technology provides great opportunities for interventions and therefore for satisfaction of our real or non-real needs. The gradual "medicalization" of life may be a side effect of this problem.

On the other hand, the "moderate" definition of health, marginally, remains unclear. That is because, if the development of a disease or an illness after an accident can be, in general, easily identifiable with objective methods, this is not the case with preventive medicine, that aims at reducing risks: frequently, "risk" is being confused with "health damage" and is amenable to medical care in order to reduce it (e.g. taking drugs to reduce glucose or cholesterol levels). But beyond that, the physical deterioration of the organism with the occurrence of aging is undoubtedly "damage"

* In a similar direction the so-called *transhumanists* do not consider that distinguishing between therapy and human enhancement is important. They comprise a movement which claims that humans must lead their own evolution beyond the limits imposed by biology. Tanshumanists believe that enhancement must be addressed as treatment, i.e. to use freely all the possibilities provided by science and technology for enhancement purposes. Like transhumanists, proponents of human enhancement in general, consider that any delays in the use of technologies, such as genetic interventions to improve cognitive abilities, have harmful effects on our health, quality and life expectancy. In contrast, opponents of human enhancement argue that the new technologies will not solve the problems of inequality and social justice.

and is regularly treated with advanced medical care (in many levels), however, it leads to a fatal "medicalization" of the life of the elderly. But if we accept this natural decay as inevitable, we should define more precisely the limits of medical intervention, finding eventually a "gray zone" to the moderate definition of health.

The so-called "enhancement" raises this general issue on the very own concept of health, and consequently, the nature of the medical profession, which are complemented by two additional ethical issues that must be addressed specifically.

Firstly, there is the question of our own self-determination in health issues. In other words, is "enhancement" a right of the person who wishes it? Namely, does enhancement fall within the realm of biological autonomy, and indeed, is it an aspect of the fundamental right to health? Regardless of the legal dimension of such issues, the moral concern, here, is actually our ability to treat our body and to intervene freely in its' constitution or not. Even if we answer affirmatively to this freedom on our body, we must wonder to what extent a) is it binding for the physician to whom we refer (particularly when an enhancement intervention may have adverse effects), and b) does it allow us to apply enhancement in the field of childcare?

Finally, another question concerns our relationships with others, or else, justice. Frequently, enhancement is attempted by someone in order to deal with the various requirements of social environments, especially in rivalry relationships (sports, education, fashion, etc.). Is there a limit imposed by justice? The answer is, of course, affirmative, but it is not clear whether for example, using pharmaceutical agents is fundamentally different from an intensive workout in sports, or the consumption of natural stimulants (coffee, etc.) during class exams.

Moreover, the issue of justice relates to the objection expressed for enhancement interventions which are costly, and for which equal access cannot be ensured. If such interventions significantly enhance physical abilities, then, marginally, they may possibly result in unequal opportunities (mainly professional) in social life. Ultimately, individuals who can afford such enhancement interventions may acquire privileged positions. The option to resolve the problem by covering the enhancement costs through social insurance is not feasible, not only due to the overall, worldwide crisis of the social insurance systems– which, in many cases, led to cuts in absolutely essential coverage- but mainly because the ambiguity of the term "enhancement" (the

subjectivity of needs) does not offer a safe ground to plan social services for the general population.

4. The position of Law

The general principles concerning human enhancement are identified, firstly, in the constitutional provisions and the provisions of the European Convention on Human Rights (ECHR).

The right to develop freely a personality (art. 5 p.1 Constitution), may be considered as the most certain constitutional basis for human enhancement, provided that one concludes that the individual right to health (art. 5 p.5) covers, in principle, the "narrow" definition of health (see above). However, it would not be unfounded, to cover the issue of enhancement by the right to privacy (art. 9 p.1 section b Constitution, art. 8 p.1 ECHR), arguing that human enhancement is related to changes in the core personality.

The Oviedo Convention and the Code of Medical Ethics (CME - law 3418/2005) also include provisions which can be generally applied here.

The regulatory scope of the Convention is the "application of Biology and Medicine" (art. 1). From this perspective, human enhancement falls within the Convention –as it is pursued by medical or biological methods- and is included in the concept of "health interventions" (which is encountered repeatedly in the Convention). This means that most of the Convention provisions are applied here and particularly: a) the rule of Informed Consent (art. 5 et seq) and the protection of privacy (art. 10).

The CME includes regulations regarding the way medicine should be applied, in the strict sense. According to art. 1 CME:

1. A medical act aims at prevention, diagnosis, treatment and restoration of human health, by use of any scientific method.

2. Research can also be regarded as a medical act, provided that it aims at a more accurate diagnosis, restoring or improving human health and the promotion of science.

3. The concept of medical act also includes drug prescriptions, the order to carry out

any kind of paraclinical examinations, issuing medical certificates and attestations and the general counseling of the patient.

This is a comprehensive definition of medical acts by the legislature, which does not include enhancement interventions in order to improve capabilities or aesthetics.

B. ENHANCEMENT OF PHYSICAL CHARACTERISTICS AND CAPABILITIES

I. Plastic (surgical) procedures

1. The data

a) Reconstructive and aesthetic surgery

Plastic surgery is a kind of enhancement of human characteristics, which is already applied to both men and women. The term *plastic surgery* refers to the surgical repair or correction of a feature or function of the human body. There are two types of plastic surgery:

1. *Reconstructive procedures*. Their purpose is to repair or enhance physiological functions and characteristics of the body, which are altered due to accidents, diseases or birth defects.

   The most common reconstructive procedures include reconstructive plastic surgery to correct scars after an accident or burn, restoration of cleft lip and palate and reduction of the breast size.

2. *Aesthetic/cosmetic procedures*, which are divided into *surgical* and *non-surgical* cosmetic procedures. Their purpose is to reconstruct characteristics of the body in order to enhance external appearance. The specificity of cosmetic surgery is that the person interested is physically healthy.

   The most common types of aesthetic plastic surgery is Botox/wrinkle implants, face lift to reshape the forehead/eyebrows, blepharoplasty, breast augmentation, tummy tuck, rhinoplasty, otoplasty and liposuction.

It should be taken account that in some cases, the line between reconstructive and

cosmetic surgery is unclear. Both reconstructive and aesthetic surgeries are, basically, permanent, since it is not easy to reverse the changes without a second surgery (with the exception of Botox). Therefore, the enhancement of physical characteristics in this case, is not temporary.

b) Motivations and psychological profile of the persons interested

The reasons that may lead a person to seek plastic surgery vary, depending on the psychological profile as well as the type of surgery.

It is important to stress that reconstructive interventions are offered to persons who *were patients*, and aim to improve their physical characteristics that were altered because of a medical/pathological condition or an accident. The decision to undergo plastic surgery is mainly driven by the need to restore the initial or normal state.

In contrast, cosmetic procedures are offered to *healthy individuals*, who do not present with pathological findings or abnormal functions. Certainly, in this case one cannot overlook the impact of enhancing physical characteristics on the mental health of these individuals. There are many people who believe that cosmetic surgery will be the solution to the personal and social problems that they face.

Both men and women are increasingly concerned about their appearance, looking for ways to enhance it through cosmetic surgery. The decision is based on several factors, which may vary between adults and adolescents, and include the modern obsession with the body image, the lack of self-confidence, the idols of each era and the icons dictated by fashion. The mass media played a crucial role in this case, by consolidating a global image of what is beautiful, desirable and attractive. The importance of beauty and physical appearance is strongly emphasized in social relationships, both professional and personal. For the aforementioned reasons, aesthetic surgeries pose ethical issues, which are, perhaps, greater than those posed by reconstructive surgeries.

In addition, the number of the so-called "ethnic plastic (surgery) interventions" is increasing, and aim at removing national or racial characteristics. Such interventions are particularly popular in people of Asian descent who wish to obtain European features, or in African Americans or African Europeans who seek Caucasian characteristics.

It is therefore necessary, in a first phase, that a plastic surgeon investigates the motivations that lead a person to seek plastic surgery, especially an aesthetic procedure.

c) Body dysmorphic disorders and plastic surgery

A particular case is when individuals suffer from the so-called *Body Dysmorphic Disorders* (BDD) or otherwise dysmorphophophia (Crerand *et al*., 2006). BDD is a common psychiatric disorder that affects 1-2% of the general population and occurs with equal frequency in men and women. It is characterized by an excessive preoccupation of the person with imaginary or minor physical defects in various body parts. The condition is often associated with frequent hospitalization (48%) and high rates of depression and obsessive-compulsive disorders leading to suicidal tendencies and attempts (Phillips *et al*., 2006).

Individuals suffering from BDD often resort to plastic surgeries in order to enhance their appearance. According to studies, 50%-76% of these patients seek plastic surgery, while 58%-66% of them eventually undergo plastic surgery and 26% of them undergoes more than one plastic surgery (Crerand *et al*., 2006). Nevertheless, studies show that only a small percentage of these patients - just about 2% - are eventually satisfied by their body image after plastic surgery, while most of them continue to have symptoms of BDD. In most cases, these patients showed no improvement on their symptoms, while they often threaten or even sue the plastic surgeon who carried out the surgery (Crerand *et al*., 2010).

Unlike plastic surgery, the therapy which is indicated for individuals who suffer from BDD is the use of certain drugs, mainly selective serotonin re-uptake inhibitors, and psychotherapeutic methods, and in particular, cognitive psychotherapy (Crerand *et al*., 2010).

For the aforementioned reasons, it is essential that the plastic surgeon who suspects that a person seeking plastic surgery may present with BDD symptoms, refers the patient to a psychiatrist for proper mental help. However up to now, data coming from the U.S.A. show that plastic surgeons are aware of the BDD and often refuse to offer plastic surgeries in these patients at a percentage ranging from 21 to 84%, depending on the survey (Phillips *et al*., 2001; Crerand *et al*., 2005; Sarwer 2002). Nevertheless,

there are no similar studies in European countries.

d) Gender characteristics and plastic surgery

Plastic surgery is applied as a treatment to change gender characteristics in specific cases, which include:

- *Gender identity disorder* (or *gender dysphoria*). This is a neurodevelopmental disorder, in which individuals with the phenotype of one gender have the psychism of the opposite gender (GIRES 2008). These individuals do not present with hermaphroditism. The recommended treatment in such cases is hormonal treatment or plastic surgery or psychotherapy, or a combination of the above. The World Professional Association for Transgender Health (WPATH) is an organization that provides guidelines for the care of people suffering from gender identity disorder. WPATH recommends standards of care that include psychiatric, psychological, medical and surgical care that may help in these cases (Coleman *et al*., 2011).
- *Hermaphroditism*. Plastic surgery remains the treatment of choice for people who are hermaphrodites. In hermaphroditism, the karyotype of the individual is not in accordance with the external genitalia, which are of the opposite sex. In any case, for the gender selection that follows, psychological and social factors as well as the karyotype of the individual are taken into account.
- *The Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome*. It is a rare congenital malformation characterized by agenesis of the vagina and uterus, while the individual has a normal karyotype 46, XX. Treatment of the vaginal agenesis includes plastic surgery in order to create a vagina (Morcel *et al*., 2007).

2. The Greek reality

According to statistics, cosmetic surgeries in Greece are particularly popular. According to the biennial survey of the International Society of Aesthetic Plastic Surgery (I.S.A.P.S.) held in 2010, Greece occupies the 2nd position for cosmetic procedures, behind South Korea, after taking into account the percentage of the latter

relatively to the population.[*] In absolute numbers, Greece holds the 20th position on aesthetic surgeries, among the top 25 worldwide.

It is estimated that a total of 159,002 cosmetic procedures were held in Greece, of which 76,471 were surgical cosmetic procedures and 82,531 were non-surgical cosmetic procedures. Breast augmentation, eyelid surgery and liposuction was the most popular surgical procedures (14,300, 12,907 and 12,896, respectively) while interventions with hyaluronic acid, botulinum toxin type A (Botox Dysport) and autologous fat transplantation were the three most popular non-surgical interventions in Greece (28,171, 26,352 and 6,283, respectively). The total number of plastic surgeons (286) ranks Greece in the 20th place worldwide.

3. The dimension of ethics

Although plastic surgery raises new and complex ethical dilemmas, the relevant literature is limited. The ethical issues arising from plastic surgery vary.

Could a physician freely refuse such services, after judging that they are not part of his/her moral duty? The answer should not be taken for granted by the fact that plastic surgery is already a recognized medical specialty. The object of this specialty is not only to correct characteristics for aesthetic reasons, but also to repair damaged tissues and complete a treatment (e.g. mastectomy, reconstruction of severe burns etc.). In this context, it is, in principle, legitimate for an expert to select which surgeries to perform, having certain moral duty only for those who are therapeutic, in the above mentioned sense. Cosmetic surgery does not create a comparable strong commitment to the doctor, since refusal of performing an aesthetic procedure does not put endangers a patient's health.

Another issue is posed by plastic surgery procedures that alter facial features, as they may alter identity. Apart from the psycho-emotional consequences (an extreme form is a complete face transplant, which can also affect others - relatives of the donor), changes of the facial characteristics are associated with public interest, since the image of a person "identifies" that person in many social relations and relations with

[*] International Society of Aesthetic Plastic Surgery (ISAPS) Biennial Global Survey 2010. http://www.isaps.org/

the state. On the other hand, it is undisputable that selecting an "image" is associated with the right to develop freely a personality, and, indeed, is in the core of this right. The ascertainment that our image accompanies us in any private or public relation, thus it affects directly our dignity and self-esteem, is a convincing argument for a person to accept a moral priority in the freedom of choosing an image.

The same issue includes gender reassignment surgeries or surgeries that aim to eliminate ambiguous features in transsexual individuals. The singularity of these interventions -especially when compared to those that restore the body after accidents or serious diseases- is that, even if they do not restore "damage" of the organism, they "restore", in a broad sense, the personality, mainly within the context of a normal participation in social life: this fact clearly distinguishes gender reassignment surgeries or surgeries that aim to eliminate ambiguous gender features from simple cosmetic procedures.

In addition, a moral issue is raised by research on humans studying the effectiveness of novel plastic procedures, as well as by not providing adequate information to the participating individuals. The ethics of conducting such clinical research (which constitutes a serious legal issue too, e.g. in view of the Oviedo Convention), should be based on known principles, particularly a) the moral assessment of the research purpose, b) the lack of alternative means of experimentation, c) the exact assessment of the benefits and the potential hazards for the person participating, d) the strict version of "informed consent" and e) approval by the relevant ethics committee.

As a final point, the way plastic surgery is advertised, mainly aesthetic surgery, plays an important role in informing the public. These advertisements cannot be equated with advertisements of other services or products, since they are interventions in the human organism, which are hard to reverse or even irreversible. Although they are not considered as illegitimate (as in the case of advertising therapeutic agents to the general public), these advertisements must be under tighter ethical review regarding the accuracy of the messages as well as the methods of conveyance.

4. The law

According to the definition described in Law 3418/2005 (CME) art. 1, only plastic

surgeries that complete a treatment (and therefore do not constitute "enhancement") fall within the relevant regulations.

On the other hand, art. 11 para. 3 CME (on the obligation to inform the patient), explicitly includes "aesthetic or cosmetic surgeries" in the "special surgeries", for which intensification of attention is required during the process of informing the patient. From this formulation, the legislator seems to imply that these interventions are included in the term of medical act, even if they do not satisfy the definition of art. 1.

The conclusion is that the latter, at least, are the only authentic enhancement interventions, for which the analytical CME regulations are applied, particularly regarding the rights and obligations of patients and physicians (art. 2-15). For all the other interventions that were mentioned above, the serious issue of medical liability is not covered by a specific legislation, but by the general legislation, basically the Criminal and the Civil Code or the Act 2251/1994 (on the liability of service providers). Essentially, the analogous application of the CME during the analysis of this general law, is imposed in an interpretative way, especially when taking into account that, in some enhancement methods, the health of the person concerned may be in danger.

Plastic surgeries that change the gender and aim to restore a normal social life for the person involved, have been legally associated with the issue of modifying public documents and, particularly, registry office records. This amendment was accepted by the ECHR (decision Goodwin v. United Kingdom, 2002), even if the rule of keeping unchanged such registry documents (which serves the security of law) is bended, precisely because the right to freely develop a personality is a priority.

Finally, the law for tissue transplantation (Act 3984/2011) is applicable for plastic surgery procedures, as long as it is not an autologous transplantation (the donor is a third party, living or not). This law provides special conditions aiming to protect the donor and the recipient of the transplant, with informed consent as the central concept here.

II. Enhancing performance

1. The Facts

a) Overview

The concept of enhancing performance includes skills, such as the physical strength, speed, agility, stamina, accuracy and movement coordination as well as dexterity. In this case, enhancement is mainly accomplished by the use of pharmaceutical agents, whereas in the future, one cannot preclude that performance enhancement will be achieved by the use of genetic technologies.

b) Enhancing performance at work

The wish to strengthen performance in the working environment may have significant effects on work, which require careful consideration by the policymakers, employers and employees themselves. Enhancement technologies could change the way people work, making it possible to work under difficult conditions (e.g. extreme climate conditions, low light conditions and low oxygen concentration), to increase strength and reduce physical fatigue even during prolonged labor or to reduce recovery and return earlier to work after illness (Academy of Medical Sciences, British Academy, Royal Academy of Engineering and Royal Society joint Workshop Report, 2012).

c) Enhancing military performance

The history of conducting experiments in order to enhance the performance of soldiers started almost a century ago. After the use of yperite (also known as mustard gas) during the First World War, there were reports of yperite trials on soldiers in the U.S.A. that examined resistance to yperite depending on race. It was just five decades later, in 1991, that the U.S.A. government admitted these experiments (Smith, 2008). Reports of experiments with nuclear energy and psychotropic drugs then followed (Parasidis, 2012).

However, enhancement of military performance has evolved due to the possibilities offered by biomedicine and biotechnology. For example, the U.S. Department of Defense and the Advanced Research Projects Agency Defense (DARPA) fund research on pharmaceutical agents that keep soldiers alert, reducing the need for sleep. Research is also conducted on nutrient preparations that fulfill the nutritional needs of

soldiers for several days. DARPA's program "Persistence in Combat" includes the development of a vaccine that would block pain, accelerate wound healing and stop bleeding soon after wounding (Parasidis, 2012).

d) Enhancing athletic performance

During their preparation, athletes are trained by qualified coaches, they follow a special diet that includes supplements and they have access to physiotherapy in order to improve their athletic performance. However, since professionalism came to be part of sports, the pressure for better athletic performance, imposed by either the athletes' personal ambitions or by their athletic clubs including their coaches, is stronger. Thus, hard training, even from an early age, seems to be insufficient, and consequently, athletes turn to doping in order to enhance their athletic performance. "Doping" is the most common and oldest form of enhancing sports performance, while nowadays, it has many aspects, e.g. drug doping, gene doping, etc. "Doping" is defined as the use of prohibited substances or methods intended to artificially enhance the sports-racing skills of athletes, both during a game and during the preparation for a game.

In 1928, the International Amateur Athletic Federation set the first official ban of substances that enhance athletic performance, despite the lack of relevant methods to detect the substances (House of Commons, Select Committee on Culture, Media and Sport. 2004). In 1967, the International Olympic Committee (IOC) created the Medical Commission aiming to supervise and deal with the problem of doping in the Olympic Games. In 2004, the World Anti-Doping Agency (WADA) undertook the role of the main anti-doping coordinator at an international level. Since then, the banned substances and methods are defined by the List of Prohibited Substances and Methods, which is reviewed annually by WADA and applies to all sports and all countries. According to the World Anti-Doping Code "Doping is defined as the occurrence of one or more of the anti-doping rule violations set forth in Articles 2.1 through 2.8 of the World Anti-Doping Code".[*] In Greece, the National Anti-doping Council (ESKAN) is the National Anti-Doping Organization.

According to the World Anti-Doping Code, the current criteria for including

[*] WADA, World anti-doping Code, 2009. http://www.wada-ama.org/Documents/World_Anti-Doping_Program/WADP-The-Code/WADA_Anti-Doping_CODE_2009_EN.pdf

substances and methods on the prohibited list are:

1. The potential of the substance or method to enhance athletic performance.
2. The use of the substance or method represents an actual or potential health risk to the athlete.
3. The use of the substance or method violates the spirit of sport.

If two of the three criteria are met then the substance or method is classified as prohibited. None of the three criteria alone is considered sufficient to establish a substance or method as prohibited.

Although doping via drugs is systematically being checked and reviewed on a regular basis by the relevant international and national organizations since the 1960s, other novel technologies/methods are difficult issues for the anti-doping authorities.

For example, the following may constitute enhancement of the athletic performance:

i) The application of genetic technologies in athletes, such as gene therapy or gene transfer.

Enhancement of athletic performance by using genetic technologies is a relatively recent issue needed to be considered by the competent anti-doping authorities, which treat genetic interventions as a form of doping. The modification or intervention of genetic material is a promising method of treatment which could be very useful for Medicine in the future. Potentially, however, it is possible to abuse such methods in order to enhance athletic performance. Normal genes or segments of genetic material could be transferred to athletes to enhance the function of normal cells or to overexpress specific genes.

Genetic manipulations can be applied in two types of cells:

Somatic cells. Altering the genetic material in somatic cells involves only the organisms where the changes are made –in that case the athlete-, and such modifications are not inherited in the subsequent generations.

For example, genes could be altered in somatic cells in order to create or modify muscles to become stronger. The insulin-growth factor helps the muscles to develop and restore injuries. Experimentally, the genes expressing insulin-growth factor can be transferred via a viral vector in mice, promoting muscle

growth (Barton-Davis *et al*., 1998). Although this specific research was conducted with the aim to treat diseases such as muscular dystrophy, the results could be used to enhance the muscle mass of athletes.

Erythropoietin is also a characteristic example, which is used to enhance the strength of patients who are under chemotherapy and present with anemia. Athletes receive injections of erythropoietin to enhance their athletic performance, but they could also go under gene transfer to receive the same gene and produce more red blood cells (Svensson *et al*., 1997).

Germ cells. Genetic modifications in the genetic material of germ cells, namely gametes, are inherited by the offspring.

For example, the genes that produce insulin-growth factor may be modified in such a way that they are overexpressed. Parents will pass these genes on to their children who will be born with an advantage in their muscle growth.

Although the use of such genetic technologies is not possible at present, concerns are being expressed about the possibilities that will be available to create "super-athletes" in the future. Since the gene transferred to the athlete's body is inserted in his/her genome, a major question which concerns the anti-doping authorities in this case is how to detect genetic modifications. About 10 years ago the Medicine Commission of IOC (IOC, 2001) and WADA launched consultations and created working groups aiming to examine "gene doping" in sports, which includes gene therapy and gene transfer (WADA. Health, Medical and Research Committee Meeting. Minutes. 2001). Since then, WADA organizes meetings of expert working groups on gene doping, whereas plentiful money have been invested on testing for modern methods of detection that will identify athletes who will abuse this technology (WADA 2002; 2004; 2005).

In 2003, WADA included "gene doping" for the first time on the list of prohibited substances and methods. More specifically, the list of prohibited substances and methods 2012 includes "The transfer of nucleic acids or nucleic acid sequences" and "The use of normal or genetically modified cells". According to a comment on Art. 4.3.2 of the World Anti-Doping Code, the use of genetic technology should be prohibited as it satisfies the two criteria of enhancing athletic performance and violation of the spirit of sport, even if it does not represent a risk for the athlete's

health. However, one of the major concerns about gene doping is the impact of new - and often experimental- methods of gene transfer on the athlete's health.

ii) The use of genetic tests that assess athletic performance.

Specific genetic tests identify genetic markers of athletic performance and define an athlete's predisposition to stamina, strength or speed based on his/her genetic profile. Although these genetic tests do not involve physical modification or introduction of genetic material into the athlete's body, however they may be used by scouts to choose "1st class" athletes. One of the conclusions reached by WADA during the meeting of the working group on gene doping in 2005, is that "the use of genetic information to select for or to categorize athletes must be strongly discouraged" (WADA 2005).

iii) The use of athletic equipment with a specific design and technology that modify various conditions and enhance performance.

Some sports require the use of equipment such as racket etc. New technologies and new materials led to the development of equipment, such as:

- Better design of the tennis racket with differences in size, weight (material), elasticity and mechanical stresses.
- Modification of the pole for pole vault, with differences in thickness, the materials of the handle and fibers made of carbon for greater flexibility.
- Athletic swimsuits made of synthetic fibers that resemble fish skin and reduce both water resistance and absorption.

iv) The use of plastic surgery.

The use of plastic surgery to enhance athletic performance ranges from relatively simple cases, such as breast size reduction e.g. in female tennis athletes for better performance and laser surgery for vision enhancement e.g. in golf athletes, to more dangerous experimental surgeries to achieve quick restoration of injuries.

v) Training at high altitude and the use of artificial hypoxic environment.

The preparation of athletes at high altitudes, amongst others, reduces blood pressure and heart rate, and an increase in erythropoietin, resulting in an increased number of red blood cells and acceleration in fat metabolism (Garcia, Verdugo, 2005).

Consequently, athletes who train in low oxygen conditions aim at a better use of the available oxygen and enhancement of their physical stamina during the games. According to a comment on Art. 4.3.2 of the World Anti-Doping Code, training in high altitudes only meets the criterion of enhancing athletic performance, and hence, is not considered a prohibited method. However, there is no specific reference in the Code concerning the use of artificial hypoxic environments (e.g. hypoxia chambers) that simulate conditions of high altitudes.

2. The dimension of ethics

The use of pharmaceutical agents to enhance physical abilities is associated with both the likelihood of putting the athlete's health in danger and the corruption of justice in athletic games (doping) or tests.

As to the first issue, a person's autonomy in his/her health is in principle absolute. The imposition of a moral "duty" to take care of the good state of our health and avoid risks, for reasons related to collective interests (the good of our family, our productivity at work, public health or even to avoid extra burden on the public health insurance systems), does not seem justified. On the one hand, such an obligation would drastically restrict the enjoyment of many freedoms (especially in the context of professional and private life). On the other hand, endangerment is a structural feature of today's "risk society", to the point that it becomes impossible to lead a "healthy" life. In this sense, there is no essential ethical basis in the criticism of "self-destruction", at least as far as the concept of autonomy presupposes the rational -and non-arbitrary- use of our freedom.

As to the second issue, our relations with third parties set limits on the enhancement of physical abilities by using pharmaceutical agents. Ideally, ensuring equal access to any mean that can enhance performance is a characteristic of justice. If this is not possible, the prohibition of specific means is, in principle, legitimate, in competing procedures (e.g. in education or in sports - especially championship games, where the interests of third parties is stronger).

In contrast to pharmaceutical enhancement, interventions in an individual's genome are "with no return", namely they generate permanent effects on the organism. As

long as there are relevant applications (as already discussed for championships), the concerns are stronger here, since many gene functions remain mostly unknown. Therefore, genetic manipulation imposes a greater risk on the state of the organism. Precisely due to this uncertainty, it is ethically questionable whether genetic manipulation methods are justifiable ("protective principle") as a form of acceptable options within a person's autonomy, because under such circumstances the "rational" use of freedom proves problematic. Certainly, however, the matter of providing the necessary and accurate information concerning the use of genetic manipulation methods is crucial.

3. The law

Drug administration is subjected to the provisions of the pharmaceutical legislation (Directive 2001/1983, as incorporated by the ministerial decision DYG 3a/83657/24.1.2006, Act 1316/83, as in force, Act 96/1973, as in force) which are particularly relevant to the responsibility of physicians, pharmacists and traders, also controlled by the National Organization for Medicines (NOM). In this legislation, the prohibition of advertising prescription drugs to the public and the strict terms on the physicians' updating about these drugs, are of particular importance.

Particularly for doping in sport, both the International Convention against Doping in Sport (UNESCO, 2005) ratified by Act 3516/2006, and the Anti-Doping Convention (Council of Europe, 1989) ratified by Act 2371/1996, are applied. These legislations, are "procedural" in nature and provide control, information, education and transnational cooperation, but without general substantive criteria for classifying substances as "prohibited". The characterization as "prohibited" is left to the absolute discretion of WADA and directly adopted from the states that ratified the aforementioned legislation. It is interesting to note that athletes are permitted to use prohibited substances for therapeutic purposes. The first Convention was specialized in our country with the YA 3956/19.2.2012, specifying, in particular, the national anti-doping controls for all sports under the responsibility of ESKAN. The Anti-Doping Convention of the Council of Europe includes a first list of prohibited substances (with varying classifications), which has been updated from the relevant WADA list (included in the WADA Code 2003).

In the field of genetic enhancement (as long as it becomes feasible, especially in sports) the restrictive provision of Art.13 of the Oviedo Convention is crucial, according to which interventions in the genome are permissible "only for preventive, diagnostic or therapeutic purposes", and interventions that alter the gametes and therefore, the offspring's genomes, are prohibited. Combined with the UNESCO Universal Declaration on the Human Genome and Human Rights, this provision leaves no substantial room to cover the interventions for pure genetic enhancement (e.g. correction of phenotypic characteristics, as long as it is feasible). On the contrary, this provision allows preventive interventions, through DNA modifications.

III. Motorized exoskeleton

1. The data

The use of motorized means (robotic means) that assist or enhance movement and human locomotion is a field of research in biomedical technology, with potential medical and military applications. The motorized means are mechanical components or external frameworks, which require an external source of energy -at least partially- to operate the engine and hydraulic systems that they include. They are attached to or worn by an individual providing motion.

In medicine, the use of motorized means may help to restore functionality in organs or joints, so that patients can return to a healthy or average level of function. Patients with neurological problems, with stroke or spinal cord injuries who present reduced mobility could benefit from the use of motorized exoskeletons in order to partially restore their locomotion (Lo and Xie, 2011).

However, mechanical means often provide capabilities beyond restoration to a normal healthy state, favouring the acquisition of additional capabilities. A typical example is the case of Jesse Sullivan, who was given a robotic limb after surgery at the Rehabilitation Institute of Chicago in 2005. Jesse Sullivan not only managed to restore motion in his shoulder and arm, but also to perform movements that were not

possible with previous robotic limbs.[*] Apart from robotic limbs, there are several companies that manufacture exoskeletons for medical use, for example the "robotic suit HAL" which was designed to complement or enhance human mobility.[†]

In the military field, the use of motorized exoskeleton can enhance a soldier's strength and stamina while carrying heavy loads. Already, several companies have designed motorized exoskeletons for military purposes, such as Raytheon and Lockheed Martin, and indeed often with government funding. Similar uses for motorized exoskeletons could be found in rescue groups, such as firemen that need to carry and rescue victims.

2. The dimension of ethics

As in the case of using motorized exoskeleton for enhancement purposes, the question that arises is whether a person's autonomy allows the expansion of physical capabilities beyond normal.

The answer is, in principle, yes, since in this case there are –usually- no issues of modifying the human organism. Expanding a person's capabilities may resemble the assistance provided by the usual mechanical means that make us enjoy our freedom, for example by increasing our movement (car, etc.), our senses (glasses, headphones, etc.), our expression (microphones etc.), and so on.

3. The law

Especially for equipment that requires interventions in the organism of the person concerned, the legislation about medical products (Directive 93/42, incorporated by JMD DY8d/GP. oik.130648/2.10.2009, Directive 90/385, incorporated by JMD DY8d/GP. oik.130644/2.10.2009) contains provisions for secure application of implants. Therefore, it also involves the technological interventions that aim, for example, at the musculoskeletal support.

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[*] Design news 2005. http://www.designnews.com/document.asp?doc_id=226412&dfpPParams=ind_182,aid_226412&dfpLayout=article

[†] Cyberdyne. Inc. http://www.cyberdyne.jp/english/robotsuithal/

IV. Prolongation of life

1. The data

The idea of longevity or eternal youth has always been fascinating for mankind, regardless of the era, culture and religion. This interest derives mainly from man's fear about the diseases presented in old age but also from the death itself, as well as the quest for youth. It is a fact that, the best social and economic living conditions as well as better medical care increase the average lifespan of humans.

Over the past two centuries, human life expectancy is more than doubled, from 25 years to 65 for men and 70 for women, while some estimate that for some populations this number will reach 100 years in six decades (Oeppen and Vaupel, 2002). In the European Union particularly, life expectancy has risen by an average of 10 years over the last fifty years.[*] According to statistics in 2009, the average life expectancy in the EU of 27 states is 79.4 years (76.4 for men and 82.4 for women). In Greece, the average age is 80.2 years for the total population (77.8 for men and 82.7 for women).

But why this constant increase in life expectancy?

Genetic factors, such as the HLA-DRw9 and HLA-DR1 alleles in the Japanese population (Takata *et al*., 1987) and the e4 allele of the APOE gene in Finnish (Schachter *et al*., 1994) and the French population (Louhija *et al*., 1994), are associated with increased life expectancy.

Environmental factors, such as smoking, alcohol consumption and diet have not been proven to reduce the average life expectancy but their effect on the development of diseases, such as cancer and cardiovascular disease indirectly reduces life expectancy. In addition, the way the social status, wealth and educational level can affect life expectancy, is not clear (Christensen & Vaupel, 1996).

Demographic and geographical studies showed that the increase in life expectancy is, in part, due to the advances in Medicine and *geriatrics* that study the diseases of old

[*] Eurostat. Mortality and life expectancy statistics. Data from October 2011. http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Mortality_and_life_expectancy_statistics

age, such as cancer and cardiovascular disease, aiming at prevention and better management of common diseases (Christensen & Vaupel, 1996).

However, along with the best medical care, modern biomedical research offers insights that allow humans to understand and intervene in the aging mechanisms. *Biogerontology* studies the aging mechanisms and provides information to reduce the rate of aging and prolong life beyond 122 years, which is the maximum limit today.[*] A typical example is the discovery that the enzyme telomerase can be used to increase cell divisions and delay their aging (Hayflick, 2003), and that substances that stimulate a calorie-restricted diet can increase life expectancy by 30% in mice (Ingram *et al*, 2004).

In this context, intervening in the aging process is scientifically feasible, while man has a special interest in the existing possibility to extend lifespan by using biomedical technologies. As mentioned in the introduction to this Report, taking into account the distinction between therapy and enhancement, intervening in the aging mechanisms in order to extend lifespan beyond the upper limit constitutes human enhancement, not prevention or treatment of diseases presented in old age that aim to increase average lifespan.

The use of biomedical technologies is expected to further increase the average lifespan or the maximum age reached, a fact that fuels debates about the bioethical issues raised from life prolongation as a form of enhancing human characteristics, by means which are already available or that will be available in the future.

The aging process is characterized by a slow reduction in normal body rhythms, progressive loss of functionality, reduced fertility, increased susceptibility to most diseases and significant mortality. Technological interventions that affect the process of aging and can be considered as enhancement of human characteristics include (Barazetti and Reichlin, 2011):

Restricting caloric intake, hormone administration or replacement, reduction of oxidative stress and activation of telomerase (Barazetti and Reichlin, 2011). Studies in various species showed that these interventions are possible to increase life expectancy and delay the aging process. However, these studies do not provide convincing data that can be applied to humans.

[*] The Guinness Book of Records, 1999 edition, p.102.

Life expectancy predictions vary. A study with 60 participants including demographers, gerontologists and researchers of aging, showed that life expectancy for a person born in 2100 is on average 292 years, while the range of predictions was large. Half of the predictions see humans not to exceed 100 years, while the more optimistic ones, which are the minority, predict that man will live up to 500 to 5,000 years (Richel, 2003). Participants in this study were among others, Michael Fossel, researcher of the effect of telomerase on delaying cell aging, Roy Walford who studies the effect of limited calorie consumption to prolong lifespan and Aubrey de Grey, a biogerontologist and a great supporter of life prolongation.

2. The dimension of ethics

One cannot dispute that control of the aging mechanisms and prolongation of life are within the limits of a person's autonomy. In principle, it is legitimate to pursue such a thing in the context of autonomy, as, indeed, it is legitimate to treat any cause that leads the body to weakness and ultimately to death. Therefore the relative ethical issues do not differ substantially from the issues raised by the other forms of physical enhancement.

However, a crucial issue that remains is the future social consequences of a dramatic increase in life expectancy, as demographic data already confirm serious effects e.g. on the sustainability of health insurance systems, even on the adequacy of natural resources.

Assuming that these data reflect the limited strength of modern societies, not only in a broader macrosocial scale but even in the scale of a family, it is possible that maintenance of a "fourth" generation of ancestors will be against human reproduction. Indeed, this generation will continue to burden the family budget, effectively discouraging child bearing, which will marginally lead to a progressive aging of societies. In this case, the effects on the viability of societies will be unknown.

3. The law

It is difficult to detect law restrictions regarding the fundamental rights of personality

development and health (5 par. 1 and 5, Constitution) in this specific field.

If the reservation relates elusively to the future interest of societies in age renewal, the only reference that could be made concerns our responsibility towards the future generations. This responsibility -is mainly mentioned in the non-binding environmental law (see Report in the Opinion of the NBC “Management of biological wealth”, 2009)- however, an ethical issue still remains: this responsibility will lead us to accept our biological limits (hence the finite of our lives), which could not be determined by legal rules.

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