PREPARING FOR OUR ENHANCED FUTURE

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ABSTRACT

Rapid advances in human genetics raise the prospect that one day we may be able to develop genetic enhancements to promote a diverse range of phenotypes (e.g., health, intelligence and behavior, etc.). Perhaps the biggest challenge that genetic enhancements pose for medical practitioners is that they will compel us to re-think a good deal of the conventional wisdom of the status quo. Radical enhancements are likely to have this effect for a variety of reasons. First, the status quo is premised (at least in large part) on a sharp distinction between treatment and enhancement; a distinction that at least some genetic enhancements will call into question. Second, the prospect of radical enhancements requires us to keep an open mind concerning how we conceive of the harm of *non-intervention* **(i.e., the harm of the status quo). Third, some enhancements might compromise the preservation of personal identity. All of these issues may have important consequences for state medical boards, ranging from the way we view the aspiration to prevent harm and ensure reasonable standards of care, to malpractice, continuing competency and medical specialization.**

> *Wherever they may be invented and manufactured, most new biotechnologies, including those serving goals beyond therapy, will probably enter ordinary use through the offices of the medical profession. Should this occur, the pursuit of happiness and self-perfection would become part of the doctor's business, joining many other aspects of human life that formerly had little to do with doctors and hospitals.*
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> President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Happiness*, p. 305.

INTRODUCTION

The last half a century has witnessed rapid advances in our understanding of human genetics. From James Watson and Francis Crick's discovery of the structure of DNA in 1953, to the first officially sanctioned human gene therapy trial in 1990, our understanding of the role genes play in the development of disease and other phenotypes are rapidly increasing. There are currently 790 approved gene-therapy trials in America and 338 in Europe.[1] The approval of the first commercial gene therapy product (in China) was reported in the September 2005 issue of the journal *Human Gene Therapy*. The Chinese Company Shenzhen SiBiono GeneTech, located in Shenzhen, China, now distributes Gendicine, a biological agent that treats patients with head and neck cancer. "As of July 31, 2005, Gendicine has been used to treat more than 2,600 patients, with a projected 50,000 patients to receive this product by 2006."[2]

With a greater understanding of our biology comes the prospect we may, in the not too distant future, be able to manipulate our genetic constitutions not only to prevent or cure disease, but also to radically enhance human capabilities. Such enhancing interventions could permit people to live longer, healthier lives. We may also be able to enhance our memory, cognition and influence a range of behavioral characteristics (e.g., propensity for violence, etc.).

Consider, for example, advances that have been made with genetically enhancing mice. Harvard University has created a genetically modified mouse called the "Arnold Schwarzenegger" mouse[3] and Princeton University has created the "Doogie" mouse.[4] The Schwarzenegger mice have a gene inserted that retards the muscle degeneration caused by aging. The Doogie mice were inserted with a gene, NR2B, which controls the production of a brain chemical involved in learning and memory. The Doogie mice outperform regular unmodified mice in a variety of cognitive tests.

Researchers at the Scripps Research Institute in La Jolla, Calif. have been able to increase, by 20 percent, the life expectancy of mice by lowering their body temperature by 0.3 to 0.5 degrees.[5] The lower body temperature was achieved by inserting an uncoupling protein 2 gene into the brain cells of a mouse's hypothalamus, the region that senses and controls body temperature. The gene then tricked the mouse's internal thermostat into thinking it was heating up and thus the body was cooled.

Genetically engineering mice is one thing, but what are we to make of the possibility of *human* genetic enhancements? How can medical organizations best prepare for addressing the myriad of concerns that would arise with respect to regulating such enhancements, should they become possible? The prospect of radical human genetic enhancements will have a number of important consequences for state medical boards, ranging from the way we view the aspiration to prevent harm and ensure reasonable standards of care, to malpractice, continuing competency and medical specialization. To best ensure we are prepared to meet these future challenges, we should encourage responsible and diligent dialogue and reflection on how genetic enhancements would likely impact the medical profession.

A good deal of the abstract ethical debates concerning the prospect of radical human enhancements, like genetic enhancements, are quite removed from the realm of real practice, where regulators and legislators will face a myriad of challenges in terms of ensuring such technologies could be safely and effectively regulated. This divide between theory and practice is perhaps unavoidable when the topic of discussion is possible future enhancing technologies that may or may not become a reality. If ethicists hope to contribute some viable moral insights that can inform real policy formation on radical human enhancements, then ethical theory must also address the complexity of issues medical boards, for example, are likely to face. This article should provide an ethical analysis of radical human enhancements, an analysis that seeks to shed light on a few of the challenges medical boards must address.

RADICAL ENHANCEMENTS AND THE STATUS QUO

Perhaps the biggest challenge that human genetic enhancements pose for medical practitioners is that they will compel us to re-think a good deal of the conventional wisdom of the status quo. Particularly, the way we view the aspirations to prevent harm and ensure reasonable standards of care. Genetic enhancements have the potential to force a re-think of the status quo for a variety of reasons. First, the status quo is premised (at least in large part) on a sharp distinction between treatment and enhancement; a distinction that at least some genetic enhancements will call into question. The therapy/enhancement distinction can be described as follows:

> "Therapy", on this view as in common understanding, is the use of biotechnical power to treat individuals with known diseases, disabilities or impairments, in an attempt to restore them to a normal state of health and fitness. "Enhancement," by contrast, is the directed use of biotechnical power to alter, by direct intervention, not disease processes but the "normal" workings of the human body and psyche, to augment or improve their native capacities and performances.[6]

A second reason why the prospect of radical enhancements challenges the status quo is the possibility of such interventions requires us to keep an open mind concerning how we conceive of the harm of *non-intervention* (i.e., the harm of the status quo). And this will have important consequences concerning the standards of possible risk we should tolerate for different enhancing interventions. Finally, the prospect of cognitive enhancements might raise concerns about the preservation of personal identity, which raises numerous difficulties when it comes to the issue of standard of care.

EXISTING ENHANCING INTERVENTIONS

Before we turn to the subject of genetic enhancements, it is worth reflecting on our attitudes towards existing enhancing interventions. A good deal of our day-to-day existence involves pursuing environmental interventions that enhance our well-being in numerous ways. It is important to bear in mind that even these environmental enhancements often have some degree of risk associated with them. This can be illustrated by considering the following hypothetical day of a university student. Let us call him Bob. Imagine Bob's average day consists of the following:

> **9:00 a.m.** Bob wakes up and the first thing he does is drink a few cups of coffee. Coffee has caffeine, which is a stimulant and is the world's most popular drug. Caffeine offsets the effects of sleep deprivation and aids Bob's concentration.

10:00 a.m. After the jolt from his coffee, Bob goes off to the university. He reads, goes to lectures and writes papers, etc. … By exposing himself to these educative influences, alterations occur in his brain; learning makes the nerve cells more efficient and powerful.

6:00 p.m. Bob goes to the gym; he lifts weights and goes for a run. These physical activities promote his bone density, boost his immune system and reduce the chances of depression.

During his typical daily activities Bob pursues a variety of enhancing activities. He enhances: his mood by consuming caffeine, his cognition through learning, and his strength and health through exercising. Some of these enhancing interventions have some degree of risk of harm associated with them. For example, consuming lots of coffee can increase the risk of heart attack. A recent study on the association between coffee intake and risk of myocardial infarction (MI)[7] concluded that intake of coffee was associated with an increased risk of nonfatal MI, but only among individuals with slow caffeine metabolism, and this suggests that caffeine does play a role in this association.

Furthermore, strenuous strength training (like weight training) cannot only result in an injury, but it could also be a cause of aortic dissection. John A. Elefteriades, et. al. (2003)[8] recommends caution in patients with known aneurysms or connective tissue diseases, a family history of aneurysm or dissection, or underlying hypertension. The risks of harm associated with drinking coffee and weight training are extremely small; however it is important to note that we permit some degree of risk of harm for often-marginal enhancing benefits.

Immunizations are examples medical practitioners use to improve the quality of people's lives. They enhance our immune system and have brought about dramatic declines in vaccine-preventable diseases such as measles. In the case of smallpox, immunizations are responsible for the eradication of this disease. Other enhancing interventions include Viagra and laser eye surgery. All of these enhancing interventions have some risk of harm associated with them, but they can also improve the quality of people's lives. When the potential benefits far outweigh the possible risks, it is hard to make a case against permitting such interventions.

Immunizations, like most things in medicine, are not 100 percent effective, nor are they 100 percent safe. Pointing this out is important as it reminds us that standards of reasonableness, rather than overtly stringent demands concerning safety and efficacy, should inform the regulation of medical interventions. These same standards of reasonableness should apply when it comes to regulating possible genetic enhancements. Such interventions raise challenges, as they could alter the stakes typically involved in applying the standards of reasonableness to enhancing interventions.

When it comes to caffeine, Viagra or laser eye surgery, most would agree that an overtly risk-adverse position to these enhancing interventions is untenable. If the bar is set too high for safety we would not be able to do anything (especially things we find enjoyable and enhance the quality of our lives). However, people are often ready to discard these reasonable standards for safety when one raises the question of regulating human genetic enhancements. The philosopher will point out our need to be consistent in terms of the values we believe should inform human enhancements (both existing and future interventions). Pointing out that there is a theoretical risk with genetic enhancements, for example, is not a compelling reason to ban them. If it was then we should ban coffee, immunizations and laser eye surgery, etc.

RISK AND GENETIC ENHANCEMENTS

Two factors specifically are important to note in the context of regulating the risk of harm with future possible genetic enhancements. First, we must acknowledge that there is risk of harm in the status quo. Aging, for example, not only affects our vision and sexual performance, it also increases our risk of disease and illness. Eventually, aging will kill us.

Consider, for example, the impact age has on our risk of developing cancer. According to the National Cancer Institute,[9] the lifetime of males (for all races) of being diagnosed with cancer is currently 45.67 percent. The lifetime risk of dying from cancer is 23.56 percent. However, these statistics need to be placed in the context of the risks we face during the different stages of the human lifespan. So one's age will influence their risk of developing cancer. Males who are cancer-free at 20 years old only have a 1.11 percent chance of being diagnosed with cancer in the next 20 years, whereas males who are cancer-free at 50 years old have a 21.40 percent chance of being diagnosed with cancer during the next 20 years.

Age has an enormous impact on our risk of developing disease and other impairing ailments. Almost half (45.1 per-

cent) of the population older than 75 years fall into the category of people considered to have a limitation of activity caused by chronic conditions.[10] This statistic is particularly concerning for a population that is increasing in terms of the number of elderly people. Aging has significant socio-economic costs, and the prospect of being even partially successful in waging a war of aging itself requires us to critically reflect on the assumptions of the status quo: We should accept aging and its debilitating consequences as a fact of human life.

Consider, for example, the proposed benefits of succeeding with the more modest aspiration of slowing aging by just seven years.

> If we succeed in slowing aging by seven years, the age-specific risk of death, frailty and disability will be reduced by approximately half at every age. People who reach the age of 50 in the future would have the health profile and disease risk of today's 43-year-old; those aged 60 would resemble a current 53-year-old, and so on. Equally important, once achieved, this seven-year delay would yield equal health and longevity benefits for all subsequent generations, much the same way children born in most nations today benefit from the discovery and development of immunizations.[11]

The danger of becoming content with the status quo is that it makes us content to take the harms of the status quo as a "given"; as a simple truism of the human condition. But the prospect of radical human enhancements will call these assumptions into question.

The second important factor to emphasize is that the level of acceptable risk should be determined, in part, by the magnitude of the benefits such interventions might confer. If we are willing to tolerate some minimal level of risk for something as trivial as the jolt from caffeine, should we not be willing to tolerate a proportionate level of risk for an intervention that could confer much greater benefits (e.g. radically extending the health span)? Reasonableness prescribes that a determination of what constitutes an acceptable level of risk should be largely determined by the magnitude of the benefits such interventions might confer, as well as the likelihood that these benefits will be realized and that the harms of non-intervention would be realized.

Given the current human condition, we can be almost certain that the debilitating effects of aging will (barring radical enhancing interventions) affect most people. And in most cases these disadvantages will be visited upon us before we reach 80 years old, despite our best efforts to combat these effects through conventional medicine and other environmental interventions (e.g., exercising, diet, etc.). So it is imperative to realize that the choice we currently face is not between the status quo, with no risk of harm, and the enhanced future, with risk of harm. The question is really one of figuring out how we responsibly manage the harms (and risks of harm) we currently face and those we might face in the genetically enhanced future.

When considering the benefits of genetic enhancements we must also consider, as mentioned above, the community-wide socio-economic benefits that could come from slowing the aging process or improving human intelligence. "By extending the time in the lifespan when higher levels of physical and mental capacity are expressed, people would remain in the labor force longer, personal income and savings would increase, age-entitlement programs would face less pressure from shifting demographics, and there is reason to believe that national economies would flourish".[12] Enhancing human cognition could bring about greater efficiency and problem-solving skills that could be applied to an endless number of disciplines (e.g., physics, medicine, chemistry and engineering, etc.).

Applying standards of reasonableness to the regulation of possible genetic enhancements means that each genetic intervention must be considered on a case-by-case basis, rather than treating enhancements as a homogenous group. This is so because the potential risks involved with different interventions will doubt differ, as will the potential benefits of intervention. The stakes involved in modifying our genetic constitutions to extend our health span are different from those involved in enhancing our cognition, or altering behavioral characteristics.

Furthermore, the type of modification involved — somatic vs. germline enhancement — also will complicate the story. In the case of somatic enhancements the intervention will only impact the wellbeing of the patient undergoing the intervention. However in the case of germline interventions the modification will affect the genes passed down to future generations. And this raises a number of further ethical concerns that I do not have the space to pursue here. But any regulation of germline genetic enhancements would have to consider the effects such interventions would have on future offspring. And that will further complicate the task of determining what reasonableness prescribes in this case.

STANDARD OF CARE

Standard of care issues are a vital concern to medical practitioners and are essential to the integrity of quality health care. The prospect of human genetic enhancements poses a number of potential difficulties for the medical establishment. This is so because such interventions transcend the therapy/enhancement distinction upon which standard of care issues are typically premised. Furthermore, given the complex interaction between gene-gene interactions and genes and the environment, determining the causal impact particular genetic alterations will have on distinct phenotypes (e.g., disease, weight, intelligence and health, etc.) will be extremely difficult, perhaps impossible. And this raises concerns with both standard of care issues and medical malpractice.

When people are diagnosed with having the later stages of a cancer we know suffering and disadvantage will be visited upon them rather quickly if we do not pursue the necessary medical interventions. Intervening, through chemotherapy for example, is seen as part of a patient's right to health care because such an intervention is necessary to ensure "normal species functioning". But this biological understanding of human health, which is the foundation upon which the therapy/enhancement distinction is premised, imposes an unnecessarily restricted conception of therapeutic interventions.

Aging itself is perfectly natural. Our biology is designed in such a way that, over time, the risk of our developing disease increases dramatically. Siegfried Hekimi (2006) offers the following definition of aging:

> Aging is the increase in the probability of dying with the passage of time. It is also the increased susceptibility for any of a number of diseases, regardless of whether they are ultimately responsible for the deaths of the individuals developing them. In addition, aged individuals are less resistant to injury, whether from physiological accidents (for example, surviving a heart attack) or environmental accidents (for example, bone facture), and they are less resistant to infection. Aging is a phenotype (of which life span is one feature); consequently, the pattern of aging depends on the genotype and on the environment: different species, as well as different strains from a single species, such as the mouse, and different human populations, develop different physiological or anatomical alterations with age and die from different age-dependent diseases.[13]

Like the provision of vaccines and Viagra, genetic enhancements could offer people the opportunity to increase the quality and quantity of years they can expect to live. So we need to begin to take seriously the question of how such interventions would fit into the current model of medical treatment. This raises complex questions ranging from the funding of such research and the training of practitioners to deliver such interventions, to the education of the general public and the standards of care appropriate for such interventions.

One could envision a diverse range of potential concerns that could arise with respect to malpractice with genetic enhancements. If such enhancements are somatic-genetic interventions, for example, there will be difficult questions concerning how we should address the potential unexpected (and undesired) impact manipulating our biology could have. Manipulating our genes to bring about one desired outcome (e.g., increased strength) could have unintended consequences with respect to the development of other phenotypes. These could range from altering other behavioral characteristics to increasing the risk of developing a multifactorial disease. So rigorous standards must be in place to ensure that the proposed efficacy of enhancing interventions meet acceptable safety standards. The prospect of undergoing a radical human enhancement to improve our wellbeing will no doubt appeal to many. Medical boards must ensure that such interventions are backed by sound science and regulated by the high standards for physician licensure and practice.

Different kinds of genetic interventions will raise different kinds of concerns when it comes to ensuring the quality, safety and integrity of health care. For example, an intervention to enhance a person's memory could impact other features of our cognition. Perhaps an increase in our capacity for memory means that some other cognitive skill will be less developed than it would otherwise be. Modifications to a person's propensity for certain behavioral characteristics (e.g., violence) could also impact other features of a person's behavior. These concerns could even arise with respect to treating or attempting to reduce or prevent the development of complex diseases. Given the fact of genetic complexity,[14] serious consideration must be given to concerns of malpractice that could arise with respect to undergoing a procedure involving genetic manipulation.

COMPETENCE AND SPECIALIZATION

If safe and effective genetic interventions that promote

human health should become a reality, medical boards would have to invest a great deal of thought and planning into addressing issues like continuing competency and medical specialization. What we now view as acceptable average morbidity risks for populations and individuals may, in a just few decades time, come to be viewed as states-of-affair in need of medical intervention. Thus genetic enhancements could be considered as simply an extension of the goals sought through existing prescribed enhancements, like immunizations.

As the prescriptions for mitigating our biological vulnerabilities evolve and change, so too will the expertise required of those entrusted to administer such prescriptions. Thus medical boards would have to consider what constitutes continuing competency for physicians as well as the need for medical specialization. Given the seemingly endless potential applications of genetic manipulation, to different aspects of our physical (strength, vitality and longevity, etc.) and mental (memory, intelligence, etc.) health, there could be a need for a specialty in genetic modification.

Another potential concern with radical enhancements, like cognitive enhancements, is that they could threaten personal identity. This concern is addressed by the President's Council of Bioethics report *Beyond Therapy*. The Council notes that enhancements might foster self-alienation:

> As the power to transform our native power increases, both in magnitude and refinement, so does the possibility for "self-alienation" — for losing, confounding, or abandoning our identify. I may get better, stronger, and happier — but I know not how. I am no longer the agent of self-transformation, but a passive patient of transforming powers.[15]

The prospect of self-alienation must be added to the complex list of things to consider when determining what would constitute a reasonable trade off between the potential harms and benefits of different genetic interventions. This trade-off scheme is further complicated by the fact that in some cases *non-intervention* might also bring about a state of self-alienation. For example, patients suffering a mental disorder like Alzheimer's might experience self-alienation. Aging is a major risk factor with dementia. So the aspiration to retard the cognitive impairments in aging could foster (not threaten) autonomy. The harm of self-alienation could potentially arise with intervention and non-intervention. Responsible regulation of potential therapies must consider the likelihood and magnitude of these different harms and benefits. Each genetic intervention must be considered on a case-by-case basis, rather than making generalizations across a range of possible genetic interventions. Medical practitioners already face similar concerns, for example, with the regulation of psychotropic drugs that affect memory, mood and behavior.

In order to determine what the thresholds should be for genetic enhancements, in terms of the efficacy and safety of such interventions, medical practitioners must take due care to consider the different types of enhancing interventions, as well as the different stakes at issue with enhancing different phenotypes. This has implications for how medical boards interpret the requirements of continuing competency, as well as the need for medical specialization in genetic manipulation.

CONCLUSION

Many different factors influence our health prospects. The food we consume, the lifestyle we live (e.g., sedentary or active), our economic prospects, our gender, our age and our education all influence our expected life-time acquisition of what John Rawls (1971)[16] calls our "natural primary goods" (e.g., health, vigor, imagination and intelligence). Our well-being is also influenced by the natural endowments we inherit from our parents. Every person has two copies of most genes, one from their mother and one from their father. Genes are the fundamental physical and functional unit of heredity; they "specify the proteins that form the units of which homoeostatic devices are composed".[17]

The prospect of human genetic enhancements offers potential benefits and potential hazards. Different kinds of intervention and different types of enhancement (e.g., increase in physical strength, cognition, health span) will raise different stakes and distinct concerns. To help society navigate a sound middle ground between the distinct pros and cons of different genetic enhancements medical boards must ensure that such innovations are informed by sound science and regulated by sage moral judgments.

The genetic revolution of the late 20th and early 21st centuries, like all major revolutions in human history, will call into question the conventional wisdom embedded in the status quo. In this paper I have suggested that we need to keep an open, and yet cautious, mind in terms of the attitude we take towards concerns of safety, standards of care, malpractice, continuing competency and medical specialization, as these are all areas of the health care profession

which would be impacted by human genetic enhancements. The sooner we begin investing our energies into addressing these concerns, the better prepared we shall be to meet the diverse challenges that lay ahead in the decades to come.

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