Submission to the Nuffield Council examination of ethical issues arising in relation to genome editing

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Preliminaries: technologies of enhancement

Before considering the ethics of research on, and the ethics of applications of, the technology of genome editing, it is useful to set this in the context of debates on human enhancement. An appendix to this submission sets out a brief overview of some concerns raised in relation to biomedical enhancement. That paper divides enhancement into three kinds: enhancement beyond therapy, transhumanist enhancement and eugenic enhancement. The paper focuses on the first kind of enhancement (beyond therapy) but genome editing also raises the possibility of the third kind of enhancement – eugenics. Neither that paper nor the present submission aims to demonstrate that all forms of enhancement are inherently wrong (*per se malum*). Nevertheless, such projects have been the cause of historical injustice and are reasonably a matter of ethical concern.

In theory, genome editing could be used as a means to germline genetic engineering, and thus as a form of eugenic intervention. The international debate in relation to germline genetic engineering has hitherto focused on safety and the danger of adverse consequences for future generations. Without prejudice to such debates it should be noted that eugenic proposals, considered precisely as eugenic, are defined not by their consequences but by the intention of the proposals. That is to say, eugenics as a proposal for public policy, as developed by Francis Galton among others, *had as its aim or intention the improvement of the genetic health of future generations*. Understood in this way, the term 'eugenics' would not cover proposals which aim at the treatment of a currently-existing individual for the sake of his or her health (for example by somatic gene therapy) but which have, as a side effect, a possible improvement in the health of his or her progeny. It is important to consider the intention embodied by eugenic proposals as it is arguably such intentions that have led to vicious and discriminatory social policy (as seen, for example, in the history of the eugenic movement in the United States and Sweden and in the popular opposition to eugenic proposals in the United Kingdom in the first half of the twentieth century).

If eugenics (and enhancement more generally) is to be understood primarily in relation to intention, it follows that there is no technology that is, per se, a 'technology of enhancement'. It all depends how the technology is applied and to what end. Nevertheless, certain technologies, because of their power and accessibility, have the potential to be used for certain ends. This is very evident in relation to nuclear technology. Development of civil uses of nuclear technology for energy

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generation can give a nation the power to develop military uses. Powerful technologies can be misused and this gives reason to monitor and/or restrict certain uses which are, in themselves, innocent.

The Nuffield Council is to be commended in the first place for considering a very wide range of possible uses of genome editing technologies, and in the second place for considering the possibility of 'dual use' research. My own professional and academic work is primarily concerned with biomedical ethics, rather than with uses outside biomedicine. Nevertheless, because of the importance of placing these uses within the context of a very wide range of other possible uses, this response will make some brief comments on other aspects. For each aspect the submission will focus on one suggested question.

Perspectives on genome modification

Is there anything special about the genome that makes intervening in it different from other ways of manipulating nature (e.g. selective breeding of plants or animals)?

As mentioned above, a key element in the evaluation of a technology is the intention with which it is used. Nevertheless, some technologies merit attention because the power of the technology can be used well or badly, and also can have unintended effects for good or ill. It should also be noted that sometimes what makes a technology powerful is the parallel development of other technologies or other bodies of knowledge. For example, the danger of nuclear weapons is greatly increased by the development of ballistic missiles. Hence treaties or international actions aiming to restrict nuclear proliferation often seek also to restrict the development or testing of ballistic missiles.

In relation to genome editing, the development of CRISPR/Cas9 and other tools for identifying and replacing strands of DNA needs to be placed in the context of the massive increase in speed and efficiency of gene *sequencing*, the establishment of large *data-sets* mapping the genomes of tens or even hundreds of thousands of individuals, and the prospect of advances in computing to manipulate and analyse these data sets. The Council should therefore consider gene editing in the context of advances in analysis of data sets and what is (misleadingly) referred to as 'artificial intelligence'. It should not be assumed that future interventions (across different species and for different purposes) will be limited to single genes.

As technologies sometimes need to be evaluated together, so an increase in the power of a technology can make a difference that passes a threshold and creates, as it were, qualitative rather than just quantitative change. It makes new things possible. This again can be seen in relation to nuclear technology. It is not only the long lasting effects of radioactivity that make nuclear weapons 'special'. It is also the increase in the destructive power of the explosion. While weapons are measured in relation to the equivalent power of tonnes of TNT, the possibility that one warhead could level a whole city leads to global concerns and a politics of deterrence which are not seen in relation to 'conventional weapons'. Indeed the very language of 'kiloton' or 'megaton' bomb serves only to emphasise the difference between these weapons and chemical explosives - rather as the language of 'horse power' in relation to motor vehicles only serves to emphasise that the internal combustion engine represents a qualitative change over reliance upon the power of beasts of burden.

The technology of genome editing, taken with other advances, has the potential to cross a threshold similar to the rise of the internal combustion engine or the nuclear age. The supposed analogies

between genome editing and selective breeding or natural selection, or even between genome editing and the first generation of genetically modified organisms, will not be sufficient to analyse such change. It is potentially an altogether new way to manipulate nature and raises 'special' hopes and 'special' concerns for this reason.

Genome editing in plant science

Are there particular issues raised by genome editing in relation to ecological stability, biological diversity, technology transfer between countries, and equitable sharing of the benefits of research?

Genetic modification of organisms has advanced further in relation to plants and agricultural uses than in other areas, and so it is right that the Council consider these in relation to genome editing. It is striking that while the United Kingdom population has by and large embraced biotechnological change in relation to medical and reproductive uses, there is much greater reluctance to embrace biotechnology in agriculture. High technology in medicine is almost universally welcomed whereas high technology in agriculture is frequently viewed with suspicion.

This difference is in part explained by the different roles of nutrition and medicine in relation to health and to the existential concern that is raised by sickness and death. In relation to diseases such as cancer or to neurological disorders it is clear that we have a problem that urgently requires a solution. It is evident to anyone that modern medicine has resulted in a qualitative improvement in health in contrast to previous generations, and the well-recognised need for further progress is a cause that motivates large scale voluntary giving to medical research charities. In contrast it is not evident to everyone that the quality of nutrition has improved with the increase in quantity, and it is not evident that the current quality of food in the developed world is so bad that genetic modification is urgently required. Many people would acknowledge the need for increased *quantity* to match the rise in global population, but they are sceptical and with good reason, that advances in agricultural technology have benefited the poorest sections of the population in developing countries. In Europe the increase in production has been as a result of economic subsidies and a period without war, and these have resulted in overproduction and have occurred without the need to resort to genetic modification.

In relation to GM food the issue is not only the quantification of risk (and the exaggeration of such risks) but also the alleged benefits which, in reality, seem to be primarily commercial rather than nutritional. The alleged risk of contamination and of adverse environmental effects (for example, resistance to pesticides being passed to competing wild species) and of unknown future health effects, is not offset by any clear health benefit. It is reasonable then for the population to ask whether they need and want to take this risk, and whether they could do without this technology without a reduction in their quality of life.

In relation to global food production and the needs of the poorest people in developing countries, it is disingenuous to imply that the cause of malnutrition is technological rather than economic or political. So also the future use of agricultural biotechnology in developing countries needs to be assessed in relation to power imbalances, trade agreements, patent law and social causes of underdevelopment (not least war and corruption). By and large the companies that have developed products in this area act out of commercial interests and are not equivalent to medical charities or development charities. Commercial interests can, of course, lead to wider social benefits but this is not inevitable. These questions are not only ethical but political and concern the way in which decisions are made in relation to the direction of technological change. It is quite reasonable that these decisions should be made democratically where possible.

Genome editing in animals

What overall impact might genome editing have on animal lives? Can genome editing be expected to contribute to or inhibit the replacement, reduction or refinement (the '3Rs') of the use of animals in research?

A reason for the use of genome editing in animals which does not apply to plants is the possibility that this might lead to a reduction in the harmful use of animals in research and/or to an improvement in the welfare of animals used in research or in agriculture.

Consideration of the ethics of the use of nonhuman animals often suffers from a confusion of different kinds of concerns – animal rights, conservation of wild species and animal welfare. The possibility of vegetarianism and legislation to prevent cruelty to pets and livestock might be thought to imply that human beings could have a peaceful and non-competitive co-existence with all non-human animals. This neglects the impact of human beings on the environment and also the need to restrict other species consuming and/or spoiling crops grown for human use. It is also difficult to imagine medical progress without some use of nonhuman animals. There are societies that are largely vegetarian but there are no societies that have developed modern medicine without having to use nonhuman animals.

In the immediate term research on genome editing is likely to increase the use of nonhuman animals (as they will be needed for such research). Figures for the past decade or so seem to show that the introduction of GM animals in research in the mid-1990s has been associated with a rise in the total number of procedures, despite policy drivers seeking to reduce the use of animals in research.[2] Numbers are smaller than the peaks of the late 1960s and 1970s, and this is against a background of increased spending on research. Nevertheless, there is no evidence that the introduction of GM animals in research has reduced scientific dependence on the use of animals in research and it is highly questionable that the technology of genome editing in nonhuman animals is inherently less likely to require use of animals than other conventional pharmacological research. Arguably a major impact of genome editing will occur in conjunction with other techniques (pharmacological, surgical, cell based etc.) and so will act as a stimulant to research (including further animal based research) in these areas. Efforts to reduce or replace use of nonhuman animals in research will affect research generally and thus also research in this area, but there is no reason to imagine that genome editing technology will, of itself, greatly reduce the use of animals in research. It rather seems to offer new avenues for such research.

It may be that genome technologies may increase the accuracy and effectiveness of animal research if, for example, the creation of chimeric and other human-nonhuman mixed organisms could provide better models of human disease (the 'r' of 'refinement'). In theory such increased efficacy might result in more focused use of nonhuman animals and therefore less use of nonhuman animals. However, the experience of the past is that increasing effectiveness of a research tool leads to greater use of that tool, increasing the overall benefit but not reducing the cost in terms of use of animals. It is possible that means will be found to reduce greatly reliance on nonhuman animals in research, and genome editing could be a part of that, but the most obvious uses of the technology would not reduce the use of nonhuman animals but might even drive an increase in such use (i.e. it does not suggest either 'replacement' or 'reduction').

[2] Figures from the website of 'understanding animal research' an organisation that promotes understanding and acceptance of the reasons that nonhuman animals are used in biomedical research http://www.understandinganimalresearch.org.uk/animals/numbers-animals/

Genome editing in microorganisms

Are there particular opportunities for genome editing research to contribute to bioremediation (e.g. mitigating the negative effects of pollution or climate change) or, alternatively, risks relating to habitat destruction or species extinction? If so, what are the risks associated with developing these opportunities and how serious are those risks?

In relation to microorganisms, genome editing together with *advances in synthetic biology* may make it much easier to design micro-organisms with specific ecological purposes, for example reducing pollution. Such developments offer great potential for new technological solutions to pressing problems.

If contained within controlled environments these developments would still carry risk (as industrial manufacturing process typically carry risk) but such risks could be assessed and managed. Of much greater concern is the use of modified organisms in the natural environment because of the danger of unexpected ecological consequences, including the danger of adaptation. These dangers are greater the more novel the organism, and genome editing is dangerous precisely in that it allows more radical modification than is possible with selective breeding.

The devastating effect of introducing rabbits to Australia, or rats and cats to islands with no equivalent predators, or new diseases experienced by colonists in Africa or new diseases brought by colonists to the Americas have shown repeatedly the dangers of introducing a novel organism into an ecosystem. The impact of diseases that originate in non-human animals (zoonosis) is but an instance of the same phenomenon.

It is true to an extent that any use of GM organisms (whether modified by new forms of genome editing or by some older technology) will carry some risk to the environment. This is a concern that has been raised in relation to agricultural use of GM crops. However, the use of GM microorganisms is inherently more dangerous because of the short life cycle and hence increased adaptability of such organisms. This is especially true where the organisms used have a relationship with human beings (whether pathogenic or symbiotic) in the natural environment.

The danger inherent in releasing micro-organisms into the natural environment should not be underestimated and calls for international regulation. If genome editing technology were ever to become easy to perform at relatively low cost then this would greatly increase the dangers of unregulated research and applications and of accidental release.

Biomedical research and human applications

What other important questions should or might we have asked in this section?[3]

Genome editing techniques have obvious biomedical potential for use in research and medicine. The idea of somatic gene therapy is not new and there have been a number of clinical trials in this area. The risks with somatic gene therapy relate to off-target genetic effects and adverse systemic effects. The development of CRISPR/Cas9 has great potential to address the first of these problems. It seems to have far fewer off-target effects. The problem of inadvertent systemic effects relates to the issue of delivery – how to ensure that only selected cells or tissues are affected. This remains a challenge though progress is being made in this area and other developments, such as nano-technology, may significantly address this issue.

Genome editing could also help other interventions, for example the prospects of xenotransplantation or of growing human tissue or organs in nonhuman animals. Such developments would have implications for animal welfare (another avenue of research on animals and potential use of nonhuman animals for human medicine) – in addition to those listed above.

Genome editing could also be used in conjunction with stem cell therapies, for example the editing of induced stem cells taken from the patient. In such a way cell treatments could be developed which were both corrective and matched to the patient. This is perhaps the most promising area for development of novel therapies. However, while the promise is real, care is needed during such developments that the promise is not made to appear closer than it is, or that desperate patients are not exploited to gain political or economic leverage for proposals which have little prospect of benefit in their own case.

One focus of interest in genome editing is the possibility of altering gametes or zygotes to prevent inheritance of genetic disease. Such an intervention would alter the germline. It would be eugenic in that it would aim not aim to treat an existing person with a disease but to create new people who were free from a disease (not to make people better but to make better people). In some ways this proposal is analogous to pre-natal screening and abortion of disabled infants, to pre-implantation diagnosis and discarding of affected embryos, or to pronuclear transfer into a zygote which is free from mitochondrial disease. The proposal for eugenics originated in England with Francis Galton and this would be a further eugenic use of technology.

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[3] Questions already asked: What is the current state of the art in the field? What are the current technical limitations and constraints/ bottlenecks?
What are the main directions of travel? What are the envisaged endpoints/ applications?
What is the rate of travel? What are the expected timescales for realising the envisaged endpoints?
What are the main 'drivers' and 'obstacles' in relation to envisaged endpoints?
What bearing do international ethical debates and agreements (e.g. high level statements or calls for moratoria) have on the pace or organisation of research?
Who should lead and who should be involved in setting policy for research and human applications of genome editing? Is this significantly different from other kinds of experimental or reproductive medicine?
Have advances in genome editing affected what research is funded, what research strategies are used (e.g. derivation of stem cells) or the comparative development of therapeutic strategies?
What are the significant decisions that need to be taken before therapeutic use of genome editing may be contemplated (for non-heritable and heritable genetic changes) and who should have the responsibility for those decisions?
Are the benefits and costs of treatments that involve genome editing likely to be distributed equitably (or any more or less equitably than existing or alternative treatments)? In what way might genome editing differentially affect the interests of people in vulnerable or marginalised groups?

In some ways germline genetic engineering would be less problematic than techniques currently in use (in theory it need not involve destruction of human embryos, though in practice it is extremely likely to do so). In other ways it would be a more direct and overt form of eugenic engineering than others and would not be legal under the current law in the United Kingdom.

It has been suggested that there are good reasons to be cautious about enhancement in general and eugenics in particular. Eugenics represents a prioritisation of imagined future people over the needs of those who have the disease (or actual future people who will have the disease). It is also a more distant prospect practically and socially than research and therapy of a somatic kind. Germline genetic engineering is an interesting topic but it is of less immediate practical importance, and arguably to devote too much attention to it is to neglect areas of more benefit.

This is not to say that there is no need to look at the issue of eugenic enhancement, the history of the eugenic movement, and the complicity of the scientific establishment in the United States, Sweden and Germany (even before the Nazis) and indirectly in the United Kingdom, with historic injustices. However, that is a project which is larger in scope and best separated from the immediate practical issues raised by genome editing. Germline genetic engineering is also an area where the current ethical-theoretical resources are thin and much analysis is reducible to conjecture about risk. The ethics of eugenic enhancement thus requires substantial further consideration in its own right rather than treatment in passing as one of a number of ethical issues raised (in theory but not immediately) by genome editing. In regard to biomedical applications of genome editing, the focus of the current Nuffield Council investigation should rather be on somatic gene therapy and the use of genome editing to complement existing pharmacological, surgical, organ or cell based therapies.

Military and security considerations

Is there a military interest in genome editing research? What is its nature?

If these technologies have application to biomedicine then they will be of interest to the military insofar as they may be relevant to military medicine. It might seem that, as military medicine is primarily concerned with treating trauma in otherwise healthy subjects, then it would have little interest in genome editing as this focuses on treating pathologies of genetic origin. On the other hand, the largest impact of genome technology may well be in conjunction with other 'conventional' therapies and as a research tool, and this may well be of relevance to the military, for example in improving understanding of processes of healing and of physiological reactions to trauma.

Inasmuch as combat exposes people to extreme physiological and mental stresses and the need, for example, to maintain concentration for long periods, the military has an interest in improving the physiological and psychological resilience of its personnel. This is largely effected by selection and training but a question arises as to whether genome editing could increase the potential resilience of recruits. Such a potential military interest falls squarely under the heading of 'enhancement' and raises ethical questions as to the longer term health effects of such interventions. One has only to think of the effect of steroids and other chemical enhancement (and indeed the risks of cosmetic surgery – to reference another Nuffield Council enquiry) to see that short term desires can have longer term adverse consequences. In any case, on the basis of current knowledge and technology (even given a revolution in genome editing techniques) the prospects of enhancement by genome

editing is science fiction and conducting research in this area would not be justifiable as a use of resources.

Of more immediate relevance is the prospect that genome editing of microorganisms or viruses could be used as a form of biological weapon (perhaps mixing sequences from known viruses or bacteria). Despite international attempts to prohibit the development of such weapons it seems likely that some states already have programmes to develop biological weapons. The ability to design and edit a pathogen also raises the possibility of attempting to identify genomic targets (and design specific countermeasures) or to design-in time-limited effects or other means to neutralise a biological agent (i.e. means which might make the weapon appear more controllable and make its use more imaginable). Furthermore, if genome editing technology becomes easier on a small scale, and potent lethal biological agents can be developed in this way, then there is increasingly a likelihood that they will be used by terrorists. One has only to think of how computer viruses have been used by states and terrorist organisations.

An obvious military concern in relation to genome editing will be the development of protection and countermeasures against novel biological agents.

Appendix: What is wrong with Human Enhancement?[4]

'Striving to better, oft we mar what's well' William Shakespeare , King Lear

What is meant by 'human enhancement' such anyone would object to it? If these terms are understood at their most general, human enhancement would mean becoming a better human being, helping others to become better human beings, or helping build a society in which human beings can flourish. In this sense one can wholeheartedly agree with Julian Savulescu that 'To be human is to strive to be better'[5]. Human enhancement in this sense is the central aim of religion and of any serious school of philosophy. It would be difficult to find any philosophers who object to human enhancement, understood in this broad sense, though of course philosophers disagree about what makes a human being good and what is the best way to pursue this.

As well a broad philosophical or religious sense of enhancement, however, there is a narrower technological sense of human enhancement. In this paper 'human enhancement' will be taken in this narrower technological sense to mean *a technical intervention to improve human physiological or psychological performance*.

This sense of enhancement concerns not those virtues which are integral to being a good person (such as honesty or fair-mindedness) but techniques used by the person which, even when performed efficiently and effectively, can still be used well or badly[6]. Because technologies can be used well or badly and their development can embody wise or foolish desires, it is possible to object to some such technical enhancements, and it is these kinds of objections that the present paper explores.

Three controversial forms of enhancement

Human enhancement in the technological sense is the bread and butter of medicine, and as with all medicine is good insofar, but only insofar, as it is done in an effective and ethical manner. Furthermore, enhancement is also the subject of particular ethical concern in (at least) three areas: In the first place enhancement is ethically controversial especially where the reference state (the starting point) is a person who would generally be considered healthy or reasonably well-functioning by conventional standards. For medicine has traditionally been understood not as improving the lives of the relatively healthy but specifically with the application of knowledge and skill 'for the benefit of the sick'[7].

Enhancement of the healthy takes us *beyond therapy*[8]. Enhancement may also be controversial if the desired effect is to produce a level of functioning greater than found even in elite performers. The attempt to move beyond the current range of human abilities is the aspiration of *transhumanism*, and even as an aspiration this has attracted philosophical and ethical criticism. Finally enhancement may be controversial if it aims not at helping existing people but at selecting or

[4] The author presented a version of this paper at a seminar on 'Human Enhancement' at Green Templeton College in November 2011, other contributors at that event included Prof Nick Bostrom, Prof Julian Savulescu, and Charles Foster.

[5] Savulescu, J. 'New breeds of humans: the moral obligation to enhance', *Reproductive BioMedicine Online* Vol 10. Supp 1. 2005: 36–39, at 36.

[6] This distinction of *arête* and *techne*, developed by Aristotle, remains applicable even in a modern context.

[7] A phrase taken from the Hippocratic Oath, see Jones, D.A. 2003. 'The Hippocratic Oath I: its content and the limits to its adaptation' *Catholic Medical Quarterly* Vol. 54, No. 3.

[8] The title of an influential report critical of some forms of human enhancement: President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Happiness*. New York: HarperCollins, 2003.

engineering future people so that they have higher performance than existing people. That aim could be paraphrased as 'not to make people better but to make better people' and for more than a century this has been promoted by the *eugenics* movement, a movement that has also attracted its fair share of ethical controversy.

Human enhancement in the technological sense is especially controversial when:

- The starting point is regarded as healthy by conventional standards (beyond therapy)
- The end point is super-human, i.e. exceeds current performance even of the elite (transhumanism)
- The aim is to select or engineer future persons (eugenics)

Note that these three possibilities are independent variables which may occur together or separately and which may be controversial for different reasons. Thus people who have objections to one of these kinds of interventions will not necessarily object to the others. Because transhumanism and eugenics are each significant topics in their own right it is useful to start with the first category. This possibility, what one might call *enhancement beyond therapy*, will be the primary focus of the remainder of this paper, though some of the issues raised will apply in an analogous way to tranhumanist and eugenic interventions.

Who is objecting?

But before looking at some objections to enhancement beyond therapy it is useful to ask: 'who is doing the objecting?' In contrast to issues around abortion, euthanasia, or the definition of marriage, it is noticeable that objections to enhancement are not prominently associated with religious communities or religious authorities. The Vatican has shown scarcely any interest in the area; when germline genetic engineering is mentioned this is always in passing and generally tends to do little more than reflect conventional fears about safety.[9] Neither is enhancement a 'hot-button' issue for Evangelical Christians, the few Evangelical Christians who have taken an active interest in human enhancement have found it to be an uphill battle engaging with their own religious constituency. There are few relevant fatws from Islamic authorities and little significant discussion among orthodox Rabbis. It should be noticed that, despite suffering at the hands of racist eugenicists in Nazi Germany, Jewish authorities do not generally express in-principle objections to genetic selection of future offspring where this is done on the basis of health. Indeed, Israel has the highest level of pre-implantation genetic screening of any country in the world.

Those objecting to enhancement are thus not primarily religious and furthermore they do not represent a united movement or school of thought. The term 'bioconservative', which has sometimes been used to bundle together critics of human enhancement, is not a self-designation and, like many external labels, it obscures as much as it illuminates. In particular, this term obscures the diversity of perspectives among critics of human enhancement.

[9] Jones, D.A. 'Germ-line genetic engineering: a critical look at Magisterial Catholic teaching', *Christian Bioethics* 2012; doi: 10.1093/cb/cbs016.

Even were it possible to do so in a short paper, it would therefore be misleading to seek to give a comprehensive list of arguments and objections as if they represented a single position.[10] Instead this paper will focus on a particular group of related objections.

Ethical challenges for modern health care systems

One set of reasons for expressing caution or concern about technologies of enhancement relate to the key ethical challenges facing contemporary healthcare. In a modern context, healthcare is essentially cooperative and systematic. It cannot be delivered by a single physician serving an individual patient. It requires hospitals and research facilities, networks of primary care and centres that can respond to emergencies. The structure of the National Health Service within the United Kingdom will change but the systematic character of healthcare is a feature of every developed country.

Of the many ethical challenges facing the NHS (and indeed any modern healthcare system), three merit particular attention, these are: to allocate of resources fairly; to treat vulnerable patients (especially the dependent elderly) with respect; and to refrain from excessive, futile and harmful interventions.

These three represent enormous challenges and it would not be difficult to provide examples of failure, harm and injustice under each heading. For a number of deep structural reasons the cost of healthcare continues to rise and there is no end in sight. Investment in one area of healthcare thus necessitates explicit or hidden disinvestment in other areas. In practice allocation of resources largely follows historical precedent itself reflecting the power of interest groups. It does not reflect need.

Furthermore, those in most need of healthcare, the elderly and those with chronic conditions, are precisely the groups who suffer from the most shocking neglect and ill-treatment, as evident in a string of official reports. Ironically while some patients suffer neglect others (or even the same patients at other times) suffer from unnecessary and intrusive overtreatment. This is especially true in emergency medicine with its ethos of intervention, but is also reflected in common patterns of over-prescription from sedatives to antibiotics.

These systemic problems are fundamentally ethical, rather than technical, and are the product, at least in part, of excessive fears and unrealistic desires distorting the culture. The tendency to overtreatment is, at least in part, due to a failure to face the reality of the limits of medicine and of human life, and in particular, a failure to acknowledge the reality of death. The virtues evident in the palliative care movement have as their foundation the acceptance that all patients will die and that the failure to acknowledge this can lead to unnecessary suffering.

If death is feared, perhaps even more feared are sickness and dependency and the very process of aging and this, arguably, is one further factor (among many) that leads to the marginalising of those in most need of healthcare. People are not the subject of respect because they are the objects of fear, a fear rooted in unrealistic desires for unlimited perfect health.

As Aristotle observed, virtue typically lies between vices of excess and defect, and there is certainly a vice in complacency and in being satisfied with the status quo. However, in relation to modern healthcare, the predominant vice seems to be a refusal to acknowledge limits and an excessive

[10] For further reading on the wide range of objections put forward to various forms of enhancement see the bibliography provided at the end of this paper.

desire for the next marginal benefit. Efforts to satisfy this desire both take resources away from those who most need them, and reinforce a fear of real sickness. As evidence for this analysis one need only consider the difficulties every developed country has experienced controlling, and fairly distributing, healthcare spending.

In this context the suggestion that the relatively healthy should be encouraged to use biomedical interventions to 'enhance' their health is a recipe for further distortion of desire. The relatively healthy are generally the richer and more powerful members of society who already have a tendency to prioritise their own interests. Furthermore persuading the relatively healthy that they have undiscovered healthcare 'needs' they did not hitherto recognise creates a market mechanism which stimulates yet further desire. Thus the healthiest in society become dissatisfied with their lot and spend more of resources on themselves. The main ethical concern here is not that this leads to over-prescription and iatrogenic ailments (though such consequences would seem to follow inevitably), nor even that this shift in attention would divert yet more resources away from those who have a greater need for healthcare. The main ethical concern is that encouraging this kind of activity will further stoke those desires and inflate those fears which lie at the root of much current injustice in healthcare.

In short, why should one be wary of pursing what is better? Only because, in Voltaire's words, the 'better is the enemy of the good'[11] and an unrealistic pursuit of perfection can imperil the real and present achievement of the good. The objections to enhancement raised in this paper do not concern what should be prohibited, or what is wrong in itself (*per se malum*), but concern aims that are unwise and, arguably, unworthy of us. If we wish to 'strive to be better' and to build a better society then we should be concerned first with those among us who are in need and with a sustainable healthcare system that can support them, and not with encouraging a market for the technological enhancement of the healthy.

[11] Cited by Hauskeller, M. 2011. 'Human Enhancement and the Giftedness of Life'. *Philosophical Papers* 40 (1):55-79.

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