Ethical Evaluation of New Biomedical Technologies Using Past Case Studies in Pharmaceutical Medicine

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Abstract

Biomedical enhancements have the potential to extend human capacities and significantly improve human life. Consequently, their widespread use may yield greater benefits than current interventions in biopharmaceutical medicine. Ethical assessment of novel biomedical technologies prior to widespread adoption is therefore important.

This essay describes a methodology for an ethical evaluation of biomedical enhancement technologies in the light of ethical findings from cases of past pharmaceutical medicine, looking specifically at the oral contraceptive pill (OCP) and selective serotonin reuptake inhibitor (SSRI) antidepressants. OCPs and SSRIs are enhancements in that they can be used to provide additional capacities (prevention of pregnancy and altered behavioural characteristics respectively) in people who are otherwise well—and experience has shown that these medicines have provided many benefits to human society, despite Christian ethical concerns about their use, largely on natural law grounds.

I describe how the development and use of OCPs and SSRIs, as scientific case studies, can be analysed using ethical criteria for the assessment of biotechnological projects proposed by Neil Messer and Elaine Graham. This analysis shows that three other ethical concepts—autonomy, embodiment, and the *imago Dei*—are important in the ethical evaluation of biomedical technologies, in addition to natural law. Therefore, based on previous experience, a fourfold assessment of future biomedical enhancement technologies—examining their implications for nature, autonomy, embodiment and the *imago Dei*—is likely to provide a more comprehensive and reliable ethical framework for their evaluation than one which relies on natural law alone.

Keywords*: enhancements, case studies, therapeutics, bioethics, contraceptive pill, SSRI antidepressants, autonomy, nature, embodiment, imago Dei.*

Introduction

There has been a longstanding ethical imperative associated with the practice of medicine, which is reflected in the Graeco-Roman tradition of medical ethics, as exemplified by the Hippocratic Oath.[1] Moreover, the practice of medicine has long been aligned with the healing tradition of the Christian church, and there has been a strong commitment on the part of Christian workers and organisations over the centuries to alleviate suffering and improve human welfare.[2]

However, there has been some debate recently about the role that religion should play in bioethics in the contemporary secular world.[3] Nigel Biggar notes three objections have been

Stephen Goundrey-Smith, "Ethical Evaluation of New Biomedical Technologies Using Past Case Studies in Pharmaceutical Medicine," *Ethics & Medicine* 37, no. 1 (2021): 28–44.

raised about the role of religious ethics: 1) that they are not universally held, 2) that they are not "reasonable" (by a narrow definition of reason), and 3) that they are incapable of assessing modern technologies. I do not intend to explore this debate in detail here, but in this essay I will be countering the third of these objections: that religious ethics—and Christian ethics in particular—are incapable of assessing modern technologies.

Here I propose a methodology for the ethical evaluation of future biotechnological enhancements in the light two previous cases of pharmaceutical medicine which have characteristics of enhancements—the oral contraceptive pill (OCP) and selective serotonin reuptake inhibitor (SSRI) antidepressants. This methodology will show that a more comprehensive and reliable Christian ethical evaluation of future biomedical enhancement technologies will be enabled using a four-point ethical framework including autonomy, embodiment, and the *imago Dei*, as well as nature.

Medicine—From Therapy to Enhancement

During the last century, increasingly specific and sophisticated interventions in medicine have been developed, which have had a profound impact on human health outcomes. In the field of pharmacology, since the mid-twentieth century, there has been a so-called "therapeutic revolution,"[4] an exponential increase in the number of therapeutic drug molecules produced by the research-based pharmaceutical industry.[5]

As a result of an increasingly sophisticated understanding of biochemistry, genetics, and neurophysiology, various future high-tech medical technologies are now envisaged, which have the potential to alter human life and experience profoundly. Some of these are imminent (e.g., genomic medicine), but some are not yet scientifically feasible (e.g., mind uploading[6] and radical cybernetic reconstruction[7]). The latter technologies, which largely seek to divest the human body, are those that are envisaged by the transhumanist movement.[8]

However, definitions of transhumanism regard the use of biomedical enhancement technology as part of a "life philosophy,"[9] whereas here I will be considering the pragmatic process of ethical evaluation of specific novel biomedical enhancement technologies as they become available. I will therefore focus my argument here on biomedical enhancements in general.

Furthermore, in this essay, I will focus on those potential technologies that act primarily in and through the human body, such as medical nanotechnology (i.e., the use of microscopic particles and tools to interact with the body for medical applications)[10] and genetic enhancements (including germ-line modifications).[11] This is because these technologies are most closely approximated by the two past case studies in pharmaceutical medicine I propose—the OCP and SSRIs—in terms of their potentially widespread impact on human life and society.

These technologies are often presented as "enhancements" to human life; that is to say, their stated objective is to increase human longevity and extend human function beyond current normal limits.[12] However, the distinction between an enhancement and a therapy is hard to make,[13] and, in any case, these objectives are not dissimilar to the use of contemporary medicine to increase life expectancy and improve quality of life.

Some philosophers defend the use of enhancements because chemical interventions that are "enhancements" (e.g., the use of caffeinated drinks to improve concentration) are already in widespread use.[14] However, I would argue that this does not exempt them from ethical reflection concerning their use.

Some commentators take a permissive view of human enhancement. For example, Fuller and Lipinska make a case for accommodation of transhumanist philosophy within Christian theology by appealing to humanity's need for *theomimesis* ("playing God") to promote human wellbeing and improve human flourishing.[15] However, they do not discuss the idea of humanity as a "created co-creator," which has been significant in theological discussions of technology adoption to date, and which is clearly relevant to their argument.[16]

However, various Christian writers have been cautious about biomedical enhancements. One objection is that they will lead to social inequality, injustice and even oppression due to the socioeconomic differences between the enhanced and the unenhanced in society.[17] Tracey Trothen has argued persuasively that a key factor in this oppression and injustice is a lack of self-worth among people of marginalised groups in society.[18]

A second objection is that human enhancement challenges an eschatological approach to the *imago Dei*—that humanity is perfected by God through relationship with Christ—because it provides humanity with an alternative, realised eschatology of biomedical immortality. For example, Brent Waters has examined the implications of the adoption of biomedical technology for Christian eschatology.[19] He argues that theological approaches influenced by postmodernity tend to adopt an open view of the universe. This downplays the notion of predestination, he contends, but it also undermines human purpose and destiny. Waters goes on to argue that, if there is no eschatological goal, or *telos*, for humanity, then there is no concept of divine providence, and therefore no purpose to the ordering of creation.[20] Thus, the adoption of radical biomedical enhancement technologies may lead to a realised eschatology of biomedical immortality, and this will not only undermine a Christian eschatology, but also Christian understandings of an ordered creation and of divine providence.

A third theological objection is the attitude of human enhancement technologies to the human body, given the remarkable significance of bodily life in Christian doctrine. Enhancement technologies are envisaged for the purpose of perfecting human function and experience, but Brent Waters notes that human perfection comes at a high price.[21] "The price of perfection for humanity is its deconstruction," he claims.[22] He notes—wisely, in my view—that, with some technological interventions, there is no going back, and that the consequences of human invulnerability are uncertain. Waters argues that, in the incarnation of Christ, the necessity of human finitude and mortality of the body are affirmed. [23] Furthermore, the resurrection of Christ makes possible the resurrection body of the believer and the renewal of creation. While Waters' arguments apply primarily to transhumanist technologies which fully deprecate the body in favour of disembodied life, they suggest that the attitude to, and assumptions about, somatic human life are an important ethical consideration for any biomedical enhancement technology.

Theologians considering the issue of biomedical enhancement rightly focus their discussions on human flourishing as the *telos* of biomedical intervention and what human flourishing

consists in.[24] Gerald McKenny notes that theologies of human nature have not yet engaged fully with the fact that radical biotechnological interventions make human nature malleable and transformable.[25] He explores objections to biotechnology—that biotechnology does not respect creation, it instrumentalises human nature, it interferes with personhood, and it treats the person as an object—and argues that these are not adequate grounds for a complete rejection of biotechnology. On the other hand, he notes that uncritical acceptance of biotechnology and an emphasis on future human flourishing downplays the goodness of creation at the present time.

McKenny therefore argues that neither a complete rejection nor an uncritical acceptance of biotechnological enhancement is adequate, and concludes that biotechnology, "proceeding in an incremental, dialectic way," is not incompatible with the idea that good is grounded in human nature.[26] Importantly, McKenny points out that the problem with ethical evaluation of proposed future biotechnological enhancements is that the ethical implications of these technologies cannot be fully appreciated until after they have been implemented and their benefits and disbenefits have become clear, by which time, of course, it is too late.

McKenny's comments highlight the importance of prospective ethical evaluation of biomedical enhancements prior to their implementation. This is not always easy to do because, by definition, such an evaluation is hypothetical. However, in this essay, I propose an ethical framework for the evaluation of future biomedical enhancements in the light of previous experience with pharmaceutical medicine, looking in particular at two case studies—the contraceptive pill and selective serotonin reuptake inhibitor (SSRI) antidepressants (the "Prozac" antidepressants), both of which were significant developments during the "therapeutic revolution" years of the pharmaceutical industry of the twentieth century and which have characteristics of enhancement technologies.

Past Medicine & Future Enhancement: Creating an Ethical Dialogue

Some pharmacological advances during the "therapeutic revolution" years of the twentieth century have had an impact on the whole of society, not just the health outcomes of the individual, because of their widespread use and their profound implications for human relationships as well as for human health.[27]

Two examples of these are the oral contraceptive pill, which was marketed in the United States in 1960, and selective serotonin reuptake inhibitor (SSRI) antidepressants, such as Prozac, which were introduced in the late 1980s and early 1990s. The contraceptive pill was the first medicine that was taken widely in society by people who were otherwise healthy.[28] Furthermore, by preventing pregnancy and enabling planned parenthood, it not only improved the health and wellbeing of the women using the pill but transformed relationships, marriage as an institution, and society as a whole.[29] For this reason, the use of the contraceptive pill rapidly came to the attention of Christian ethicists. The Roman Catholic church opposed hormonal contraception largely on natural law grounds—because the natural end, or goal, of sex and marriage is procreation, and the contraceptive pill frustrated that end.[30]

Prozac and other SSRI antidepressants were developed as specific treatments for clinical depression, but they have been adopted widely for use in situations where a person has few or no symptoms of depression to enhance personality and to help them feel "better than well." This has led to the so-called "Prozac phenomenon," epitomised by the work of psychiatrist Peter Kramer,[31] which has advocated the use of SSRI antidepressants to enhance characteristics that were previously considered to be personality variants—for example, to help someone to be more socially confident or more assertive in their professional life. SSRI antidepressants have arguably had a significant impact on society as a whole due to their widespread use and their fine-tuned effects on personality and relationships.[32] For this reason, psychiatrists such as Peter Kramer and David Healy[33] have highlighted the possible ethical issues arising from the marketing and use of these drugs. As with hormonal contraception, however, SSRI antidepressants have come to the attention of various Christian commentators.[34] The Roman Catholic scholar John Mark Miravalle has developed an ethical evaluation of SSRI use based on Thomas Aquinas's teleological approach to natural law analogous to the approach taken by the Roman Catholic church with the contraceptive pill.[35]

These two medicines have therefore been used as enhancements to normal human function—with the OCP to confer contraception, and with SSRIs to enable healthy people to feel "better than well"—and, as a result, they have had a significant social and cultural impact on human society. A case study analysis of these two past cases of pharmaceutical medicine using objective ethical criteria would therefore be an important tool to develop an approach to the proactive ethical evaluation of future biomedical enhancement technologies.

The use of case studies is an appropriate way to examine what is known about past medical developments to make an ethical evaluation of them to apply to potential future developments. Case studies are a widely used method in practical theology,[36] so it is a natural development for a case study methodology to be used here to enable a Christian ethical response to biomedical enhancements. This is because a case study has the following characteristics:

- It is a unit of human activity embedded in the real world.[37] The use of case studies is therefore consistent with the "real world" nature of biomedical research.
- It can only be studied and understood in context; the case merges into the context, so the case/context boundary is hard to determine. The development of a biomedical enhancement has a scientific and socioeconomic context, and a case study method would therefore take the context seriously, which is important for applied medical ethical analysis.
- It is good for answering "how" or "why" questions, rather than questions with quantitative answers.[38] The case study is therefore well suited to answering ethical questions, as opposed to those questions which require quantitative analysis.
- It can be used to assess multiple sources of evidence.[39] The case studies in pharmaceutical medicine encompass different domains of evidence from different types of literature—the scientific history of drug discovery, the impact of the drug on society, and Christian ethical responses to the drug—in the same case study, so a case study approach would seem suitable for applied ethical analysis.

- Case studies are helpful for naturalistic research—the exploration of human phenomena embedded in the real world, which accounts for real-world complexity.[40] The cases proposed here are naturalistic, in that they use evidence from the real-world complexity of drug development to develop ethical principles.

However, case study methodology has its drawbacks, and has been criticised for various reasons.[41] First, case studies may lack rigour in some situations; they can be constructed in a non-systematic way, so that equivocal evidence or biased views could affect the conclusions of the study. Second, case studies provide little basis for generalisation; the case study is not a statistical sample as scientific methodology might use, and it is generalisable only to a theoretical proposition, rather than to a population. Third, case studies can be limitless and are in danger of being aimless in their scope.

The first and third of these critiques—the danger of a lack of rigour and the need to define the material—can be averted by applying a clear structure and process to the presentation and evaluation of the case study in its context. The second criticism, about generalisability, might, at first sight, appear to be a legitimate criticism of this methodology. Just two cases of past chemical therapeutics—oral contraception and SSRI antidepressants—are being used to inform ethical reflection on any possible future transhumanist biomedical technologies. Can these two past case studies be representative of all past medical developments?

However, as discussed above, these case studies are more naturalistic than empiricist, and their conclusions concerning ethics of future technological projects are inductive rather than deductive. In any case, as mentioned previously, the two case studies proposed for this project have been carefully chosen because they have the potential to be most relevant to future biomedical enhancement technologies.

Furthermore, the ethical evaluation of the case studies is made robust by examining the cases using objective criteria for ethical acceptability of a biotechnology project. Criteria (from the Greek *krinos*—points of judgement) are important because they provide an objective view from which to evaluate specific cases or instances and provide structure to the resulting discussion. The importance of structure in a case study methodology has already been discussed. Criteria are a means of making information coherent and intelligible;[42] a way to make existential questions universally intelligible.[43]

The objective of universal intelligibility may be contentious from a Christian perspective; because of the notion that Christian ethics are derived from revelation, which is not universally accessible, I maintain that this universal intelligibility is important for three reasons. First, the Christian Gospel claims to be universally applicable to human society, regardless of whether or not it is universally understood or accepted; second, in popular culture, scientific knowledge is often treated as a specialist, esoteric domain and the objective of this project is to develop a public ethical discourse on the evaluation of biomedical enhancement technologies; and third, the ethics of medicine to date have often employed concepts that are not primarily religious in character, and I hope to find common ground and continuity between past and future ethical approaches to medical technology.

I have identified two sets of ethical criteria which would be valuable for determining whether a biomedical technology is acceptable from a Christian ethical perspective. The first of these sets is based on the work of theological ethicist Neil Messer, who has developed four diagnostic questions about whether a biotechnological project is aligned with God's saving work in the world or not.[44] These diagnostic questions would be applicable to biomedical enhancements, as they are essentially biotechnology projects. These questions are as follows:

1. Is the project good news for the poor?
2. Is the project an attempt to be "like God" (in respect of Gen 3:5) or does it conform to the image of God? (Gen 1:26)
3. What attitude does the project embody towards the material world? (including our own bodies)?
4. What attitude does the project embody towards past failures?

The second set of criteria are based on the work of Elaine Graham,[45] who identifies three theological issues that are problematic with the concept of transhumanism and that should be explored with any new biomedical technology. These issues are:

1. Autonomy—new biomedical technologies enable unbridled autonomy in a negative manner.
2. Subjectivity—new biomedical technologies are focused too much on the individual and the individual's subjective experiences.
3. Embodiment—new biomedical technologies interfere with the integrity of the individual body and can therefore have a disruptive effect on the corporate body—the community.

The purpose of these two sets of criteria from theological ethics is to define what aspects of biomedical technology are problematic in respect of Christian ethics. When applied to the case studies, they will help to determine which aspects of these technologies are desirable or permissible from a Christian ethical perspective and which are not.

Messer's criteria are useful because they have been proposed in the context of a study of ethical issues with biotechnology, which is a good place to start in evaluating biomedical interventions as material phenomena. The strengths of these criteria are that they are clearly ethical in nature (concerned with attitudes, justice, and the goods of human life) and that they are firmly located in a Christian view of relationships between humanity and God, and within human society. A weakness of Messer's criteria is that they do not explore the issue of personal autonomy. Regardless of one's commitment to principlism, autonomy is a significant concept in modern medical ethics,[46] and effects on personal autonomy are a matter of concern with future biomedical enhancements given their potential to give rise to injustice and oppression in society.

As criteria with which to assess transhumanist biotechnologies, Graham's three theological issues are not comprehensive in their scope but are significant in their impact. One concerns autonomy, which helpfully complements Messer's criteria. Another concerns subjectivity, which would be useful for exploring the phenomenon of individual experience in transhumanist

technology use and the issue of objectification of the human body by technology at the expense of the human as a personal subject. The third, on embodiment, overlaps with Messer's criteria, but introduces the helpful additional concept of corporate "embodiment" as the community.

Medical Ethics for the Twenty-First Century—A Four-Point Ethical Framework

The use of case studies in conjunction with objective criteria for ethical assessment of biomedical technologies has the potential to facilitate a fruitful dialogue between previous experience in pharmaceutical medicine and future biomedical enhancements and to enable the identification of ethical issues with these future technologies.

I have used this methodology to make an ethical evaluation of two past cases of pharmaceutical medicine—the oral contraceptive pill and SSRI antidepressants—both of which have some of the characteristics of proposed biomedical enhancements. Both these developments have been criticised in the past from a natural law perspective and yet, despite these criticisms, experience has shown that both medicines have had a positive impact on human flourishing.

Application of Messer and Graham's criteria to these two case studies shows that the ethical concepts of autonomy, embodiment, and the *imago Dei* are relevant to the ethical evaluation of biomedical technologies as well as considerations of nature and natural law. I contend that this fourfold ethical framework of nature, autonomy, embodiment, and the *imago Dei* will enable a more comprehensive and reliable ethical evaluation of future biomedical enhancement technologies than an approach based solely on natural law alone, as has been used in pharmaceutical medicine to date.

A detailed analysis of the case studies and discussion of the themes of these four domains will be the subject of future publications, but the remainder of this essay provides a preliminary description of the findings.

Autonomy

Autonomy concerns the capacity of a moral agent for self-government or self-rule,[47] and has been cited as a principle of medical ethics, along with beneficence, non-maleficence and justice, in a principlist approach to medical ethics.[48] The concept of autonomy was developed at length in the modern era, but Christian ethicists have been wary about autonomy in the healthcare setting because of concerns about the limits of its goodness[49] and the obligation that it might place on the clinician.[50] However, I maintain that personal autonomy is a prerequisite to the adequate exercise of Christian moral responsibility, and the concept of autonomy is an important point of connection between a future biotechnological world and medical ethics and practice to date.

On application of the criteria to the case studies, issues of autonomy are raised directly by Graham's first point about autonomy, and also indirectly by Messer's question about whether the technology is good news for the poor. In addition, Graham's third point about subjectivism in the use of technology has implications for autonomy in that the significance of human subjective experience may be related to the importance of autonomy in liberal modernity.

There are autonomy-related issues with both the contraceptive pill and SSRI antidepressants. Widespread use of the contraceptive pill has, in theory, increased personal autonomy in life choices for women using the pill. However, introduction of the pill has also led to the "coital imperative"—where women have felt compelled to have sex because there is no clear reason not to.[51] Furthermore, the methods of distribution of the contraceptive pill in developing countries have previously been criticised as coercive in a way that does not respect the rights of local women.[52] Similarly, while SSRI antidepressant treatment may enable people with depression to think more rationally and make better choices, in some circumstances these drugs may limit personal choice—for example, because of their withdrawal effects which may make it harder for a user to stop treatment when they want to or because of their potential for suicidal ideation in rare cases, leading to loss of insight and responsibility and possibly criminal acts.[53] Both these cases show that effects of the drug on personal autonomy are varied and need to be carefully evaluated.

Future biomedical enhancements will therefore need to account for the impact of the technology on the autonomy of the user and other stakeholders in society. It is often supposed that future biomedical enhancements will enable unbridled autonomy on the part of the user.[54] On the contrary, experience with past pharmaceutical medicine indicates that, while biomedical technologies may be implemented ostensibly with autonomy, autonomy may be eroded by unintended consequences in the light of ongoing technology use or the way the technology is implemented across society. Concerning the impact of a technology on autonomy, therefore, rather than wondering what liberties the technology might *permit*, it would be advisable also to consider what aspects of human life it might *restrict*. This will enable ethicists—and indeed all stakeholders—to determine the full effects that adoption of a biomedical technology might have in a social context and pre-empt any issues relating to oppression and coercion related to universal availability of the technology.

Nature

Natural law theory is based on the idea that "the good of every organism is to attain fully its natural activity,"[55] and has been a significant factor in medical ethics to date. While there have been various approaches to natural law over the centuries, the Thomist approach to natural law—that formulated by Thomas Aquinas—is most applicable to medical ethics, and this is what I refer to here. The Thomist approach is *teleological*—or goal-oriented—in that the nature of a creature is directed to good ends, which enable the creature to flourish.

The Roman Catholic church's ethical concerns about both the oral contraceptive pill and SSRI antidepressants have largely rested upon a Thomist natural law approach.[56] However, the Roman Catholic church has been accused of using an interpretation of natural law that is too physicalist in its opposition to the use of the contraceptive pill;[57] that is to say, it focuses too much on the physical operation of the body rather than the relational or moral goodness of the natural ends to which the body is directed. Furthermore, the application of natural law to SSRI use reveals various flaws in the applicability of natural law in medical ethics, for example, the potential for selective application of natural law to different medical interventions.[58]

Moreover, natural law will become more problematic as a source of medical ethics as more biomedical enhancements become available because future biomedical technologies may increasingly render human nature malleable and indeterminate.[59] It will therefore be harder to see what goods are grounded in human nature when radical biomedical technologies are applied. It will be especially problematic for technologies that are a) more invasive (e.g., neural threads to enable digital connectivity of the brain), b) less tangible (e.g., gene therapy), or c) where there is a high degree of low-level hybridisation (e.g., the use of nanotechnology for surgery and cell repair). Nevertheless, as stated earlier, McKenny has argued that "incremental" adoption of biotechnology is not incompatible with the idea that good may be grounded in human nature.[60]

As already mentioned, the application of Messer and Graham's criteria to the case studies does not directly give rise to issues concerning human nature and natural law. Nevertheless, there are nature-related aspects of the case studies—for example, the significance of the "biological model" of depression, which states that the phenomenon of clinical depression is rooted in an imbalance of neurotransmitters in the brain.

Because of this, my view is that natural law, and effects on nature, will remain a relevant area of discussion with future biomedical enhancement technologies, and should be part of the proposed ethical framework. In this vein, Michael Shapiro comments that the question of how natural an enhancement is may be a good entry point into an ethical evaluation of a new biomedical technology, even if it cannot constitute the whole discussion.[61] Indeed, I would suggest that there may be a case for the development of a natural law approach that is more virtue-based and appropriately teleological for a world of radical biomedical technologies.

Embodiment

Some proposed future biomedical enhancement technologies—such as the use of cybernetic prostheses—denigrate the human body, and therefore have been criticised from a Christian ethical perspective because of the significance of the material body in Christian theology.

It is therefore reasonable to determine the likely effects of a biomedical enhancement on the importance of the body. This is addressed by Messer's question on the attitude of the biotechnology project towards the material world (including our own bodies); furthermore, Graham's third criterion accounts for the impact of the technology not just upon the individual human body, but the corporate body of society.

The use of both the contraceptive pill and SSRI antidepressants are largely unproblematic from a perspective of individual embodiment in that both agents exert their positive effects for human life and flourishing in and through their actions on the human body. However, there are complications; the effects of the contraceptive pill have not been regarded in a wholly positive light from a perspective of embodiment. For example, Jutte has claimed from a feminist perspective that the use of the contraceptive pill has "disembodied" women in that it has denigrated their bodily value by rendering their bodies solely objects for male sexual desire[62] when, in fact, proper desire should be for the whole person, not just their material body. Furthermore, while both the contraceptive pill and SSRI antidepressants may be relatively

unproblematic concerning its effect on the individual body, they have both, to some extent, disrupted the corporate body of human society because of the effects of their widespread use.

It is important, therefore, that future biomedical enhancement technologies are characterised by a positive and affirming approach to the material world and to the human body, both individual and corporate. Such an approach would honour the remarkable significance of somatic life in Christian theology and the importance of the resurrection body in the eschatological destiny of the believer. In addition to ensuring appropriate embodiment, the technology should ensure that the identity of the transformed human person is preserved, since identity is closely aligned with bodily form, both theologically and psychologically.

A key question to ask of a biomedical technology is not just how will it change an individual person's body, but how will it change the corporate body of the community in which they live or of human society as a whole? The right approach to the value of the individual body in relation to the material world will, in turn, ensure that the corporate body of humanity—human society—is able to flourish and is not compromised. Another key line of enquiry of a biomedical technology is not just how it might change a person's body but how it might change their identity.

The Imago Dei

The Christian doctrine of the image of God—that humanity is made in the image and likeness of God (Genesis 1:26)—has important implications for understanding human nature, and the relationship of human beings to God, and to each other. However, the meaning of the *imago Dei*, as it may be derived from biblical exegesis, has been hotly debated.[63] Nevertheless, in the history of Christian thought, four main approaches to the *imago Dei* have been proposed: the substantive, functional, relational, and eschatological approaches.[64]

An analysis of the effect of the technology on the *imago Dei* in humanity is directly invited by Messer's second criterion: Do biomedical technologies enable humanity to conform to the image of God, or are they an attempt to be like God? Answers from the case studies to Messer's fourth question, on the attitude of the technology to past failure (in effect, the extent to which the technology is hubristic), also contribute to this discussion on imaging God versus being like God. In addition, the answers to Graham's third criterion concerning subjectivity have a bearing on the approach to the *imago Dei* that a technology might embody, given that some approaches to the *imago Dei* are more individualistic than others.

Analysis of the two case studies indicate that, while the use of the contraceptive pill and SSRI antidepressants in society have enabled humanity to wield considerable power and, in a sense, be "like God," these biomedical technologies have also had benefits for interpersonal relationships and enable users to fulfil their vocations in the world. Use of these technologies therefore enable humans to image God in ways that are functional, relational, and possibly eschatological, not just substantive. This contrasts with some approaches to human enhancement that emphasise, or are solely concerned with, human attributes, and therefore reflect mainly a substantive approach to the *imago Dei*. Indeed, rather than enabling humanity to fully conform to the image of God, some biomedical enhancement technologies are clearly a means of being like God in that they

emphasise the use of technology to manipulate, redesign, and "re-create" the body at will.

It is to be hoped that, rather than being attempts to be like God, applications of future transhumanist technology would enable people to conform more fully to the image of God. It would therefore be problematic from a Christian perspective for a biomedical technology to actively enable a person to remodel their body and mind according to their will, in their own image (*imago hominis*).[65] Furthermore, the enhanced person should reflect the *imago Dei* in all its dimensions, as developed in the theological literature to date.

A useful question to ask is: What kind of *imago Dei* does the technology reflect? Is it concerned entirely with individualistic, material human attributes, or does it also reflect and uphold the relational element of what it means to be human and the vocational aspect of humanity carrying out God's purposes in the world? Furthermore, does the technology enable the eschatological development of the person towards an awareness of a transcendent destiny, or does it merely aim to abolish human finitude, with no reference to its effects on overall flourishing of the person?

This four-point ethical analysis has the potential to provide a more robust framework for the ethical analysis of biomedical enhancements than natural law has done with previous medical technologies. It has been firmly grounded in previous experience with medical technologies with enhancement characteristics and is designed for the proactive evaluation of a proposed biomedical enhancement technology to obtain an outline evaluation of its Christian ethical acceptability prior to its implementation. While it may not be adequate for every possible future enhancement technology, it will provide a good preliminary assessment and will help to identify any new ethical issues that may not be apparent at the outset. In the next section, I provide a preliminary worked example of how the four-point framework might be used.

The Four-Point Ethical Framework: A Worked Example

As discussed previously, some pharmaceutical technologies to date—for example, the contraceptive pill and SSRI antidepressants—have had significant effects on human society, as well as individual health and wellness. In the future, more radical biomedical technologies may be introduced that are essentially pharmacological interventions.

For example, in the future, it may be possible to have a "magic implant" fitted which releases a combination of metabolically active nanoparticles and gene therapy substances (viral vector and nucleotide substances) that would have the effect of radically extending the human lifespan to, say, 200 years, improving physical functioning during that lifespan and effectively eradicating dementia and cognitive decline. Once such an implant has been developed commercially, it could be inexpensive enough to distribute to all adults in the population and could be fitted as a simple, minor surgical procedure at a local hospital or clinic.

Such an intervention would clearly have enormous health and wellbeing benefits for the individual. It would also have a profound impact on society and could lead to the various social ethical issues related to extended longevity described earlier. These are issues to which governments, policy makers, and corporations would need to respond.

However, how does this technology look when analysed according to the domains of autonomy, nature, embodiment, and the *imago Dei*? In terms of autonomy, it is unlikely that such an implant acting at the biochemical level would exert effects on freedom of decision-making, unlike some psychoactive drugs. The implant could be fitted at will—but could it be removed at will, with no adverse effects other than the loss of its longevity benefits, if the user no longer wished to use it?

As far as nature is concerned, the insertion of such a "magic implant" with radical whole-body systemic effects constitutes an intervention that prevents the person fulfilling their natural attributes and function, in the same way as hormonal contraception does, if viewed from a natural law ethical perspective. However, such an intervention appears to be more aligned with the natural ends of human bodily life than, say, radical cybernetic remodelling, and there would be significant potential ethical benefits of the implant if it were used well by the user, to good ends in relation to flourishing of the whole person and of society. The "unnatural" nature of the implant therefore does not necessarily render the intervention unethical from a broad Christian ethical perspective.

Then there is there is the question of embodiment. While the "magic implant" would be an invasive intervention, it would still exert positive effects in and through the human body and would enhance bodily life rather than undermine it, as opposed to mind-uploading and radical cybernetic remodelling, which negate the body and marginalise its significance. Indeed, drug-eluting stents and implants are already in use primarily to increase life expectancy—for example, the use of anticoagulant-eluting stents to improve life expectancy in coronary disease or stroke. These are essentially enhancements, albeit more minor than the "magic implant" proposed here, in terms of quantitative effects on longevity. Consequently, in terms of embodiment, such a "magic implant" is, in fact, similar to some of the implants used at the current time in terms of ethical status, even if its clinical utility is greater.

What are the implications of such a "magic implant" in terms of the *imago Dei*? The answer here is more complex. A "magic implant" would offer considerably extended longevity, yet with the possibility of eventual death and finitude. Such longevity has the potential to transform family and societal relationships in the same way that hormonal contraception has done and lead to positive opportunities for individuals to do good and improve society. This would be positive in terms of a relational approach to the *imago Dei* and would also possibly benefit a functional approach to the *imago Dei*—extended longevity would probably benefit someone's ability to serve God in the world and exercise their God-given vocation. The potentially interesting effect of such a technology is on the eschatological approach to the *imago Dei*. The question is whether the technology would enable the person to achieve their eventual destiny of Christlikeness and being with Christ after life in this world. The longevity provided by the technology might indeed help the user to grow towards Christlikeness but, if longevity became extended indefinitely, then when would the person achieve their eventual destiny of being with Christ beyond this world?

This would be a particularly significant issue if it were possible, for example, to extend life even further by replacing the "magic implant" contents every 100 years, thus enabling the person to

delay death indefinitely and be effectively immortal. This would not only render obsolete many aspects of medical care in the face of human suffering but would undermine an individual's finitude and hinder their ultimate fulfilment of a destiny with Christ beyond this world.

However, it would be a man-made immortality. A situation might arise where there were insufficient implant replacements for all citizens, either due to lack of availability or funds. How then would it be decided who lives and dies? Of course, similar ethical decisions about resource allocation are currently made about expensive treatments for rare diseases on a consequentialist basis. However, current resource allocation decisions are concerned with providing a therapy for a disease which may only have a marginal impact on a person, whereas this future situation is about withholding a life-giving enhancement, which is much more problematic.

If, on the other hand, the "magic implant" gave a single finite increase in longevity, then the key question for potential users of a such an implant would be: when and how might death come? Of course, some "magic implant" users might be killed in a road traffic accident at the untimely age of 120. There is then the question of whether there might be any adverse—or indeed potentially fatal—unintended consequences of long-term use of the implant. Unintended consequences have been a common issue in ethics of medical treatment to date, and there is no reason why this might not still be the case in future.

The analysis of the "magic implant" technology according to this four-point ethical framework indicates that, while a single-use medical technology that increases longevity may be culturally alien to current society and will introduce some ethical issues, it is not necessarily a technology that is unacceptable from a perspective of Christian ethics and a Christian view of human life. The key caveat is the effect of the technology on human finitude; the problem with medical technologies that confer "immortality" is that, firstly, they delay the person's realisation of their ultimate destiny in Christ and, secondly, they bring with them the ethical problems of an "immortality" that is dependent on human initiative.

Conclusion

In this essay, I have shown how a case study methodology, using past cases of pharmaceutical medicine that have characteristics of enhancement technologies, analysed by specific criteria, can be used to provide a four-point ethical framework for ethical evaluation of future biomedical enhancements. I have also provided a preliminary discussion of some of the findings and a worked example of a "magic implant" for life extension.

This four-point ethical framework has the potential to provide a more robust and fruitful ethical evaluation of future biomedical technologies than a natural law approach alone, such as that which has been applied in pharmaceutical medicine. This will provide a holistic evaluation of a biomedical technology in its societal context and ensure that future biomedical technologies with potentially far-reaching implications for human life and flourishing can be given a robust Christian ethical evaluation in the context of medical ethics to date.

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Declaration of Interest: The author has no conflicts of interest to declare in the authorship and publication of this essay.