# An Ethical Perspective on Nanotechnology, Health and Longevity

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## ABSTRACT

The idea that nanotechnology may be able to aid human health is not new, and there is now considerable literature describing ways that the technology will contribute to human health and to longevity. Barring harmful side effects, these developments seem to be unmitigated goods, but some interesting underlying ethical questions are worthy of examination. Some of these questions concern the ability of humans to cope with the required level of change that longer life spans would entail, the population problem, and perhaps most importantly, the power that humans would have if they could improve health to the extent that the ageing process could be reversed or slowed dramatically. Other questions concern the quality versus quantity of life, the fairness of the distribution of the benefits of improved health and longevity, and some arguments concerning life and death that seem to underpin some of the prevailing views.

***Keywords***: ethics, nanotechnology, health, longevity, fairness

## 1 INTRODUCTION

The idea that nanotechnology may be able to aid human health is not new and it was suggested by Richard Feynman in 1959 that perhaps in the future it might be possible to "swallow the surgeon" [1]. In 2005 Ray Kurzweil argued that in the not too distant future nanotechnology will allow us to radically rebuild our bodies not to mention our experiences with the help of nanobots. Kurzweil believes that nanotechnology will enable us to increase human life spans significantly [2].

## 2 NANOTECHNOLOGY ENHANCED HEALTH

Whatever we make of these claims taken literally, there is now a considerable literature describing ways that nanotechnology will contribute to human health and perhaps to human life spans particularly through improved methods of diagnosis. And additionally there are already products that are not too far removed from those envisaged by Feynman, for example the PillCam™ SB Capsule Endoscope, a naturally ingested device for use in the gastrointestinal tract [3]. This is not nanotechnology, but it does indicate what is possible already.

Nanotechnology will not be the only player but it does appear that as technologies converge its role will be significant. The benefits could come in various ways. First, and lest controversial, nanotechnology will almost certainly have medical benefits through earlier, faster and more accurate diagnosis. Wilson et al [4] talk of nanoreceptors to identify trace amounts of material that indicate the occurrence of some virus or body malfunction. Microelectromechanical (MEMS) lab-on-a-chip technologies (currently micro size) can be implanted in the body for continuous monitoring [5, 6].

More efficient drug delivery will also be enabled by nanotechnology. According to the Royal Society report there might be nanoparticles that can target specific diseased cells and can release therapeutic agents of just the right amount at the right time [6]. The drugs themselves could have better solubility and therefore great absorption [5]. One technique being researched with potential for both diagnosis and drug delivery is plasmonics. Research indicates that the time to complete immunoassay could be slashed to minutes, and perhaps paramedics could "test stroke victims for specific molecular markers on their way to hospital" [7]. Other research has the goal of using DNA to help design drugs that that can mesh no just with specific molecules, but with specific parts of the targeted molecules [8].

Nanotechnology might also contribute to health and longevity through the development, by growth or construction, of body parts to replace those worn out or otherwise damaged. Particularly significant could be the development of materials that the body would not reject. [5, 6]

A more spectacular, but more distant possibility raised by some, is the development of cell repair devices when older people "should be able to regain most of their youthful health, strength and beauty, and to enjoy an almost indefinite extension of life" [9].

A sample of the large number of applications in the USA for patents in the medical area gives an indication of the current research and development:

Nanotechnology for biomedical implants
Nanoparticle delivery system
Nanostructures containing antibody assembly units
Nanoengineered membranes for controlled transport

Nano and micro-technology virus detection method and device

Barring harmful side-effects, these developments all seem to be unmitigated goods, but some interesting questions are lurking here. Is it really a good thing to try to eliminate all suffering? If we make life extremely easy and suffering-free will it begin to be insipid and without challenge? Suppose that health is greatly improved and that life spans increase quite dramatically. What will the consequences of this be, for the individuals, for communities and for the world as a whole? How important is it that we continually seek ways to prolong life, and will it only be prolonged for a privileged few? Given that according to current astrophysics the existence of our solar system and galaxy are finite it is dubious that we could achieve literal immortality as human beings. But a racially extended life span from what we know now might be possible. If it were achievable, is it really something to be desired? And what is so bad about being dead anyway?

Early diagnosis and new cures will certainly have some effect on longevity, and many people, including nanotechnology enthusiasts, see this as obviously a good result. While it is not uncommon for people to raise the possibility of increased longevity as a result of earlier diagnosis and better treatments, most suggest fairly modest life-spans. Hayflick, an expert in gerontological research, argues that eliminating all causes of death that currently appear on death certificates would extend life spans by only about fifteen years, a far cry from immortality [10]. Broderick argues that Hayflick is too conservative, and that eliminating the current causes of death is only the first step. Other developments, including enhancements, will enable dramatically longer life spans, and quotes others who suggest 700, 1,654, and even 69,315 years (admitting that these figures are speculative) [11].

We now turn to some of the issues that arise regarding improved health and the resulting increased longevity.

# 3 HAYFLICK'S CONCERNS

Hayflick writes:

> I have long been worried about the enormous power that humans will have if we ever learn how to tamper with the aging process or to extend our longevity – it is unclear whether people could cope with the psychological, economic, medical and cultural changes that would accompany vastly extended life spans, even if they prove physiologically possible. … aging and death … make finite the lives of tyrants, murderers and a broad spectrum of other undesirables. Much of the continuing massive destruction of this planet and the consequent ills that this destruction produces for humans can be traced to overpopulation,

But does Hayflick really present conclusive arguments against significantly increasing human longevity?

## 3.1 Coping with change

In order to know how, or if, people could cope with the changes we would need to know more about what these changes would be, and in particular, the life spans under consideration. Life expectancy has increased quite dramatically in the last one hundred years or so, but this change seems to have had no harmful psychological effects. In the United States of America for example, from 1900 to 2002 life expectancy at birth increased from forty-seven to seventy-seven, and in Australia the figures are similar for non-indigenous Australians. Similarly, the cultural changes necessary for longer life spans now do not seem to be something with which people cannot cope. Economically of course there is a change. As people live longer, the system of retirement benefits that has been developed is beginning to become inadequate. Changes are necessary if these older people are to have a reasonable life. People will have to get used to paying more taxes, or saving more for their old age, or working longer. If life expectancy increased to thousands of years, or more, then of course the problems of coping may well be much greater.

## 3.2 Getting rid of the bad

Longevity would allow tyrants, murders and other undesirables to wreak more harm on the innocent than they can now. However it would also allow others with more benevolent natures more time to develop ways of overcoming the malevolent. It is not clear that longevity would have much effect either way.

## 3.3 Population problem

This is already a problem and one that will increase if all countries achieve a life expectancy at birth of most developed countries, say 77-80 years. The problem would become enormous if life spans reached thousands of years or more, even if technology developed rapidly enough to solve problems of pollution and food production. Even if the population was stable, if life expectancy is long enough there will be very few children around. In a country with a life expectancy of say 70 years, there needs to be one baby born for each adult every 70 years for the population to remain stable. Suppose that the average life span was 210, treble what it is now. To maintain a stable population, for each adult, a baby would be required only every 210 years. People may or may not be happy to spend only a very short part of their lives raising a family, but suppose that they are. There are going to be very few children around relative to the population in general. While many might welcome this, many others would not, those for example, who take delight in young children.

### 3.4 The problem of power

Perhaps Hayflick's real worry is a deeper one. He says "I have long been worried about the enormous power that humans will have is we ever learn how to tamper with the aging process or to extend our longevity". What is this "enormous power"? It seems to be the power to control life in a way that has not been possible before. To see why this might seem to be such a worry, think about how life is now. While we have some control over life and death, how we look, our abilities, health and so on, we also to a large extent must learn to accept things as they are. This acceptance is an important factor in happiness and quality of life. Suppose now that technology gives us the ability to control many of these things, at least to a large extent. Acceptance is no longer necessary. We can choose to be what we want to be, and for how long. While we will have gained power, we will have lost some of the boundaries within which we are comfortable. We might not always have liked our limitations regarding life and death, but at least we understood our situation and learnt to accept it. Without those limitations, decisions will have to be made where they never were before. Decision making, especially in important situations, is stressful. Will I make the right decision, will it have unfortunate consequences for me or for others, will I be able to change my mind? Perhaps his real worry is that humans could not live with this sort of power – we are not equipped for it because of the way that we have evolved. Should we be worried about this? Probably, particularly if relevant technologies develop quickly. If the development is slow, over generations, we may learn to cope, and thrive on it. Perhaps this is a reason for making sure that development is not too fast.

## 4 QUALITY AND QUANTITY OF LIFE

The assumption is that because a certain amount of life is good, more of it would be better. It is obviously not a general principle that if a certain amount of something is good therefore more of it is better. Take alcohol for example. Longevity is not attractive unless the life is largely a pleasant and enjoyable one. Living for a hundred years in poverty, pain, fear, boredom, or old age, does not seem to be desirable. But having an extra hundred years of interesting and happy existence does sound good. Does living happily for 500, 5000 or even 50,000 years seem even better? The longer the time frame, the harder it is to know what to say. Perhaps after a time life would become sterile and boring. And perhaps longevity does not even bring and increase happiness. In a recent study it was reported that the happiest nation in the world was Nigeria, with The USA and Australia being well down the list. Interestingly, Nigeria has a life expectancy at birth of just 41 while in the US and Australia it is around 77 [11]. While there are obviously many other variables, life expectancy does not seem decisive in determining in happiness.

Arguments for longevity tend to focus on the individual rather than the group or society. While it may be better for individuals, considered just as individuals and not as members of groups, to live longer, different arguments would be required to show that it would also be good for groups of individuals to live longer. How would the group benefit? The highly intelligent and capable can contribute more, but it is not clear what other benefits there might be. And that benefit might be more apparent than real. Death means that there is a turnover of members. Certainly valuable ones are lost, but so are the drones and the dangerous. The new blood continually coming in probably offsets the losses of the valuable, just as it replenishes the stock of the undesirable. Perhaps longevity for individuals has no overall benefits for groups, and therefore looks less attractive to those with a less individualistic stance.

## 5 FAIRNESS

Is it fair if resources are spent on prolonging the life of the affluent when health is so bad amongst the poor in many parts of the world? While it might be nice for a privileged few to live longer, even if not forever, that is very different from improving the health of vast numbers who lead short lives that contain much suffering. Currently most of the funding spent on health goes to those who are already healthy most of the time. Some people talk of the 10/90 gap, where less than 10 percent of research funds are spent on the diseases that account for 90 percent of the global burden of disease [12]. One example, mentioned by Pogge, is that malaria, pneumonia, diarrhea and tuberculosis together account for 21 percent of health problems but receive only 0.31 percent of all funding for health research. Given this situation it seems obvious that if nanotechnology is to be used to improve health, all possible should be done to alleviate the serious problems of the most disadvantaged before making the advantaged even better off with longer lives. On consequentialist grounds alone it seems to be obviously the morally right thing to do. The consequences will be vastly better for many more people in the one case than in the other.

## 6 LONGIVITY AND BEING DEAD

There are two assumptions underlying much of the discussion of health and longevity issues. One is that a significantly extended life span is desirable and the other is that being dead is bad. We have already briefly considered some arguments regarding longevity but now we want to speculate some more on just how desirable it is, and then look more closely at the badness of being dead. If a significantly extended life span is not quite as desirable as is often assumed and if being dead not quite as undesirable then two reasons for using resources, including those involving nanotechnology, for these extended life spans rather than for the current health problems of the worlds poor, are undermined. We will first speculate on longevity.

The main reason, presumably, for time and money being spent on research in nanomedicine, as in all medical research, is that it will result in products and techniques that will alleviate pain and suffering, and make life better for many people. Curing or eliminating disease surely achieves this. This much is obvious, but what is less obvious is that longevity, particularly extreme longevity, would make life better for the beneficiaries. It is assumed, by Roderick and Kurzweil for example, that these are to be desired. The longer that one lives, other things being equal, the better. This assumes that being dead is really quite bad for one. But is it? Dying and the fear of dying might be bad, but it is another thing to say that being dead is bad. Longevity of course does not eliminate my death nor my fear of it. It does not even help me to die less. I still die just once and have longer to fear it.

Is being dead a misfortune for the person concerned? Undoubtedly someone else being dead can be an immense misfortunate for me, but what about my being dead? Is that a misfortune for me? This question was discussed by the Epicureans over two thousand years ago. Their argument was that just as not existing before my birth (or conception) is no misfortune so neither is not existing after my death. After my death there is no *me* for whom it can be a misfortunate [13]. But perhaps I am harmed *now* by being dead in some number of years hence. Perhaps I am worse off now if I am dead in 200 years time than if I am alive in 200 years. If I fear death then in a way I am, but in general it does not appear that, by and large, we fear death more as it gets closer. We do not become less happy as we age and approach death, provided that we are fit and healthy. Perhaps I would be better off now if I am alive in 200 years, not because of any fear of death, but because I can have more plans for the future. This assumes that having plans for the future is a source of happiness. This is probably true to some extent, but actually doing what we had planned and enjoying what we are doing is surely a greater source of happiness. A good life can definitely be lived without plans for the distant future. Some plans are required if we are not to waste time, and death will deprive us of realizing any plans that have not been realized at the time of our deaths, but it is not clear that that is much of a loss for *us*. When we are dead there is no us.

The point of this discussion is to raise questions about whether the goals of longevity and mortality are worth pursuing. According to Broderick they are because "Death itself is more terrible than any 'punishment worse than death', because it is so *final* …". [57] If being dead is worse than sickness, pain or any other suffering, then of course a worthy goal is to overcome it. Broderick continues: "Defeating death and planning rejuvenation are goals no more absurd than finding remedies for short-sightedness or asthma." He seems to be suggesting that defeating death is much like defeating asthma, only better, but of course it is not the same at all, as we have seen. After my death I will not be sitting around regretting that I am no more. Defeating death is nothing like defeating asthma, a much more worthy goal.

In conclusion, nanotechnology will almost certainly have a significant effect on our health and longevity. Our purpose has been simply to raise some of the ethical issues that are often hidden in both technical and popular discussions. Given the probably importance of nanotechnology in the future, the ethical dimension must not be neglected if its benefits are to be maximized.

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