Medicine, ageing and human longevity

The economics and ethics of anti-ageing interventions

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Death, Robert Freitas insists, is “an outrage”. In an essay based on his speech at the Fifth Alcor Conference on Extreme Life Extension in 2002, Freitas, a researcher at the Institute for Molecular Manufacturing (Los Altos, CA, USA), said, “While you were reading this sentence, a dozen people just died, worldwide. There. Another dozen people have perished. I think this is an outrage. I want to tell you why I think so, and what nanomedicine can do to help” (Freitas, 2002). Clearly, Freitas is not someone inclined to ‘go gentle into that good night’. Advancing his argument for ‘dechronification’, he advocates the development of chromosome replacement therapy, tissue engineering, nanomedicine, nanorobotics, cellular repair devices and various genetic modifications. Aubrey de Grey, a geneticist at Cambridge University (UK) and an emerging anti-ageing media guru, is equally offended at the prospect of death. “Ageing really is barbaric. It shouldn’t be allowed. I don’t need an ethical argument. I don’t need any argument. It’s visceral. To let people die is bad” (Gorman, 2003). Freitas and de Grey are optimistic that death can be defeated. Freitas is confident that nanomedicine offers the best prospect for combating finitude. De Grey insists on a multi-pronged assault on ageing through “engineered negligible senescence” (de Grey *et al.*, 2002a,b).

Outspoken advocates of transhumanism, Freitas and de Grey belong to a highly visible but rather marginal community that regards death as a “bad lifestyle option” (Heard,

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1997). They seek to conquer and defeat ageing once and for all. This goes hand in hand with an increasing obsession in affluent societies for staying youthful. There is now a billion-dollar market in products that purport to overcome ageing (Heard, 1997; Duenwald, 2004; Pearce, 2005). The possibility of effective anti-ageing medicines has already created intense debate on the ethical and social issues that such interventions may bring. What is overlooked, however, is the fact that the booming market in ‘anti-ageing’ products is already providing a glimpse of the financial, social and ethical problems to come.

Those who do not want to wait for the posthumanists’ futuristic scenario in which nanomedicine, tissue engineering and stem-cell research halt or even reverse ageing, can turn, for example, to G. Gordon Liddy—of Watergate infamy—who uses his talk show and website to promote Nature’s Youth Rejuvenation Support Formula®. Similarly, conservative talk-show host Pat Robertson offers ‘Pat’s Age-Defying Protein Pancake’. Promising both ‘guilt-free’ meals and ‘light and fluffy’ pancakes, Robertson’s product allegedly “fights disease, protects your heart and tastes great!” Web surfers suspicious of the claim that Liddy and Robertson have discovered the fountain (or pancakes) of eternal rejuvenation can turn to many other anti-ageing products now available for purchase in grocery markets, cosmetics booths and drug stores. Men who find their hair thinning with the passage of time can purchase Propecia® and Rogaine® or undergo hair transplantation. If they experience age-related erectile dysfunction, they can order Viagra®, Cialis® or Levitra® from any one of hundreds of online Internet pharmacies. Women and men seeking to treat wrinkles can find quick relief with creams such as Freeze 24-7™, Ice-Source®, EyeCicles™ eye serum, StriVectin-SD®, Serutox® and Firma-Taux, as well as the injectibles Botox® and Restylane® (Duenwald, 2004). The market for anti-ageing cosmetics alone, according to one marketing research company, is US\$1.15 billion. The products are not cheap: Ice-Source,

for example, costs an eye-popping US\$350 for 22 ml. Ageing may not be good for your health, but it certainly is good for business (Duenwald, 2004).

Whatever differences separate technological utopians and pragmatic purchasers of expensive over-the-counter skin creams, they share a common sentiment: they fear ageing and death and seek ways to remain youthful and vigorous. They are afraid of the ravages of time and are wary of growing old in a society that prizes and pays for youthfulness and perfect bodies. The need to fill this demand is the major driving factor behind serious anti-ageing research and a rapidly growing market of consumer goods. While transhumanists spin stories of an imminent biotechnological utopia, the 'worried well' search for immediate treatment options. Upper West Side and Bel Air devotees of Botox, Restylane and collagen injections are not prepared to wait for the arrival of cyborg bodies and posthuman flesh; they want to eradicate their wrinkles today.

When philosophers, bioethicists, scientists and policy makers discuss prolonging human longevity or 'treating' ageing, they typically refer to one or more possible scenarios. According to one understanding of human ageing, there is, as a result of evolution, a limit to the extent to which it is possible to prolong human life. Demographers such as Bruce Carnes and Jay Olshansky (Olshansky *et al*, 2001; Carnes *et al*, 2003) suggest that we are already nearing the maximum human lifespan. They note the difficulty of achieving further gains in human longevity. In this model, 'anti-ageing interventions' refer principally to efforts that aim to promote a maximum health span and 'compress morbidity' to a period of serious illness shortly before death. Another characterization of anti-ageing interventions envisions the prospect of treating ageing throughout the course of life. In this model, various biomedical interventions are used to slow ageing processes by treating what are, at present, fatal illnesses and thus increasing average life expectancy. The most radical model seeks anti-ageing interventions that are targeted at halting or even reversing human ageing. Aubrey de Grey's concept of "engineered negligible senescence", for example, is linked to a vision in which all biological processes of ageing are halted or reversed.

These three models (Juengst *et al*, 2003) reflect increasing degrees of technological

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optimism. The first model imagines a lifespan very close to the maximum documented age already reached. The second model envisions the prospect of treating ageing but accepts that even effective biomedical interventions will not make humans immortal. The third model suggests the prospect of 'virtual immortality'. Skeptics, however, will question all three scenarios. Epidemiologists and public health scholars challenge the widespread faith that gene therapy, stem-cell research and regenerative medicine will one day lead to substantial gains in human longevity. They argue that humans are complex biological organisms situated within particular economic, political, social and cultural environments and that ageing is a multifactorial, multidimensional process unlikely to be significantly influenced at the population level by gene transfer or other biomedical technologies. By contrast, some bio-demographers note that due to the potentially devastating consequences of emerging lethal viruses, nutritional excesses, and deteriorating social and economic environments, average life expectancy may very well decline in the future.

Nevertheless, the marked increase in life expectancy since the 1950s—a result of improvements in medicine, agriculture and public health—is already changing the social fabric of developed societies. Much has been written on the economic implications of the epidemiologic and demographic transitions during the last half century and the long-term transition from agrarian societies to urban, industrial and post-industrial society (Vaupel *et al*, 1998; Horiuchi, 2000; Tuljapurkar *et al*, 2000; Wilmoth *et al*, 2000). Further success in extending the lives of the oldest members of these societies will exacerbate the problems that now threaten social programmes for the elderly in Western Europe, the USA and Japan. Unlike the economic challenges associated with the demographic bulge of the post-Second World War baby boom—the effects of which are discrete and predictable in historical terms—the economic implications of increased numbers of elderly individuals living with multiple illnesses are

not yet fully clear (Bosworth & Keys, 2004). Regardless of the ultimate results of this demographic transition, the practical consequences of gains in life expectancy are rippling through social, political and economic institutions.

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The major problem is that the ratio of the retired population to the working population is rising in developed economies, because of both increasing life expectancy of the elderly and slower growth in the supply of young adults to the workforce. In the context of an economic growth pattern at equilibrium, the former will increase consumption at the expense of saving, whereas the latter will reduce the need for capital investment into the workforce, which has considerable potential for social conflict. Although it is difficult to generalize because of cultural differences in higher-income countries, there appears to be little room for optimism that the social benefits of an anti-ageing breakthrough will exceed the societal costs. Considering the reduction of mortality rates among the elderly throughout the developed world (Wilmoth, 1998; Wilmoth *et al*, 2000), there is already considerable uncertainty about how to revise public and private pension programmes and create economic incentives to increase the average age of retirement. Failures to adapt public and private health and welfare programmes over the past decades have already compromised their future viability and have made continuation of the *status quo* virtually impossible (Whitney, 1996; Rhoads, 2003; Cowell, 2004).

Even if no major breakthroughs in biotechnology occur, social institutions and economies in Western Europe, Japan and the USA already need to undergo major adaptations. Too many social programmes—public pensions, retirement programmes and healthcare coverage—are built on models that rely on a demographic situation from 35 years ago, rather than what is relevant today. Major advances in biotechnology, as unlikely as such developments might be, would further destabilize social support systems. A substantial increase in life expectancy and lifespan would thus require even more major

reforms. Such changes hold considerable potential for social conflict. Many scholars who explore the social implications of anti-ageing interventions draw attention to the “tragedy of the commons”, as gains in longevity would inevitably be expensive initially and thus benefit only the affluent while causing recognizable social harms for those who cannot afford them. Paradoxically, the value of economic well-being from a one-year increase in average lifespan for the 1.2 billion inhabitants of OECD countries would be astronomical, based on estimates of how much individuals would be willing to pay for a small reduction in mortality risks (Murphy & Topel, 2003).

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Effective anti-ageing medical products, agents and techniques based on genomics research have yet to emerge in the practice of medicine (Hall, 2003). Accordingly, discussions of how and to what degree genomics-based healthcare will be introduced onto the market are largely speculative. What is known is that medical treatments and pharmaceutical products from the past 50 years have had a significant, identifiable effect on the health and life expectancy of the world's population (Cutler & McClellan, 2001; Lichtenberg, 2003). New treatments will therefore find a commercial environment in which cost-benefit standards are well established and will be held to a fairly high standard. Consequently, the commercial viability of presumably costly products that emerge from genomics research could be increasingly difficult to judge. This in turn will make it more difficult for start-up firms to secure capital for research and development. For this reason, some economists suggest that it will be necessary to publicly subsidize the first phases of anti-ageing research and development (Danzon & Towse, 2000). This is not the only economic challenge. Consumers of medical care in the USA, the majority of whom have health insurance—although more than 40 million do not—have recently experienced increases in their out-of-pocket cost of care. Any new medical technologies introduced in the USA will thus face a far more price-sensitive environment than in the past (Garber & Goldman, 2004).

Economists have developed mathematical models to predict how new and expensive treatments will fare in the healthcare marketplace. Within the framework of mainstream theory, the individual consumer is thought to have substantial control over his or her health, in the form of lifestyle choices and personal investments. A unique property of the hypothesized behaviour is that the demand for healthcare is a result of the demand for health ‘capital’. The demand for health capital, in turn, is derived from the individual's attempt to maximize ‘lifetime utility’. Medical care services and products are then combined with the individual's time to produce a desired outcome within the constraints of income, existing pathologies and age-related depreciation of health capital. This health production model, first introduced by Michael Grossman (1972), has gone through several iterations over the years but is unrivalled among economists who attempt to understand the workings of the health economy.

However, a recent formulation (Ehrlich & Yin, 2004) discards the assumption that life's end is known with certainty. This new model assumes that age-specific mortality risks—and the time of death—are a result of individual investments in health with respect to making lifestyle choices. The key assumption is that, through self-protective inputs, “age specific mortality risks can be lowered at the margin from biologically endowed levels that continuously rise with age” (Ehrlich & Yin, 2004). Although the model needs to be generalized to accommodate life-protection investments that lead to durable effects, the implications of the current model are unexceptional. In brief, the demand for anti-ageing products and treatments would come more from young adults, the better educated, wealthier and higher income individuals and those with higher initial endowments of health (Ehrlich & Chuma, 1990; Ehrlich & Yin, 2004). Provided that the model has some validity, socioeconomic and health-related inequalities that exist in most industrialized societies would therefore be amplified.

The problem of creating an effective market and covering research and development costs could be resolved more easily in countries where public health insurance covers access to new treatments. In addition, limitations set by the size of home markets will lose much of their restrictive force due to the increasing globalization of the supply and marketing of health services. Life-extending medical procedures, devices

and care that are extraordinarily costly and constrained by narrow home markets will thus find a ready global market among elites in developed and developing countries. However, they are unlikely to be available to poorer members of society.

Although we have emphasized economic consequences of anti-ageing interventions, there are also a number of ethical issues. First, research to find and develop safe and effective anti-ageing interventions raises all the usual questions in biomedical ethics: How will the safety and efficacy of life-prolonging interventions be tested? Who should assume risks during biomedical research and safety testing? Are particular populations more vulnerable to harm during the early stages of research? The research and medical community should acknowledge these concerns while the safety, toxicity and effectiveness of particular anti-ageing interventions are unknown.

Second, effective biomedical anti-ageing interventions will probably be quite expensive. Who will have access to such therapies? In many developed countries, publicly funded healthcare systems use social redistribution schemes to allocate access to healthcare on the basis of need. Although many of these systems are overburdened and under-funded, they nonetheless have an important role in ensuring equal access to healthcare across socioeconomic divisions. However, in some societies, the individual's ability to pay out of his or her own pocket has a significant role in determining access to healthcare. In these societies, existing health inequalities will be exacerbated if social healthcare systems deny citizens access to effective anti-ageing interventions. The development of biomedical interventions invariably raises questions concerning priority setting and resource allocation. Thus far, bioethicists have not thoroughly and competently addressed these issues of fairness and justice.

Third, discussions of anti-ageing interventions neglect the ethical issues raised by the market for anti-ageing products that already exists (Lucke & Hall, 2005). Countless injections, pills, food products, dietary supplements and lotions are advertised on the basis of their purported anti-ageing properties. Wrapped in hyperbole, the effectiveness of most of these products is altogether unclear and unproven. While we do not offer here a detailed ethical analysis of this market, we suggest that many of these pills, injections

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and lotions require much greater moral, legal and scientific scrutiny.

Although many scholars have addressed some of the ethical issues that relate to the development of anti-ageing interventions, moral and social issues have received only cursory attention. Commentators, such as Glannon (2002), Callahan (2000), Kass (2001) or Fukuyama (2002), identify ethical issues related to the possible emergence of anti-ageing therapies. For example, they raise questions about fairness and social justice, blocked opportunities in the workplace, social conflict between generational cohorts, and the boredom and malaise that might accompany increased longevity. But all these analyses, whatever their usefulness, neglect the relationship between anti-ageing interventions and the marketplace. In particular, they ignore the current reality in which anti-ageing therapies with no established benefits are marketed and sold, often to naive consumers.

For decades, biotechnology has been wrapped in hyperbolic commentary about its likely long-term benefits. We are not therapeutic nihilists who deny the role that various biomedical interventions have played in reducing morbidity and mortality; clearly, there is much to be said in favour of biomedical research. Still, as consumers seem to be convinced that effective anti-ageing therapies exist—when the benefits of most of these products are far from established—the ethics of the current marketplace deserve careful and critical analysis. Most of the issues that are debated centre on therapies that may become available only after long and expensive research. But the social and economic problems associated with prolonging life are already here and need to be addressed. Such a discussion would benefit from a focus on specific and existing interventions, such as hormone replacement therapy, and a more thick-grained analysis of basic issues in biomedical research, priority setting, resource allocation and social justice considerations.

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