Altered Carbon, actuarial escape velocity, and insurance in a post-human world

Hans K. Leida, Principal and Consulting Actuary, Milliman Inc.

While the new Netflix television series *Altered Carbon*[1] explores well-trodden ground by science fiction standards – it's a murder mystery set in a future where people can upload their minds into virtual worlds or new bodies whenever their current one dies – it does take a few interesting detours from the action to explore the thorny ethical and legal issues that such life extension technology might create.

Sadly, the series spends very little time delving into how insurance works in a world where individuals can die and then restore their last saved copy of themselves, or even embody multiple copies of their minds. A central theme in the show is that only the very rich can afford to purchase new bodies for their consciousness when their existing one dies. Middle or lower class people seem to be able to purchase some sort of insurance that might allow them one or two extra lives, but often in a body that does not align well with their prior identity (for example, a seven-year old girl is reincarnated in an old woman's body).

To me, science fiction is at its best when it encourages us to contemplate ethical, moral and legal challenges we are likely to face in the future – and by doing so it also holds a mirror up to those that already exist. Moreover, although the mind downloading technology in *Altered Carbon* and other similar stories can seem far-fetched, the significant and potentially discontinuous progression of technology affecting both the interface of mind and machine (Wise, 2017, and Wu and Rao, 2017) as well as life expectancy may mean such questions loom nearer on the horizon than one might think.

The search for life extension methods has its history of enterprises of dreamers and schemers. However, these days, a burgeoning longevity science industry – backed by significant venture capital and other funding – is actively working on solving the problem of senescence, whether by preventing ageing or reversing its effects. Some of these researchers are making rather startling claims in the media about how near we may be to achieving radical increases in life expectancy and increased quality of life during our later years. Perhaps the most well-known evangelist of the subject, the gerontologist Aubrey de Grey, has said he believes that the first human who will live to the age of 1,000 has probably already been born (de Grey, 2004). David Sinclair, a researcher at Harvard Medical School, is not quite as optimistic but believes that the first human who will live to 150 has been born (Nuland, 2005).

While these predictions make for fantastic headlines, it can be hard to gauge how realistic such assertions might be. Justifications for such statements often tend to rely on faith in anticipated (often unspecified) technological advancements, or on optimistically extending a graph of historical changes in life expectancy to reach 'actuarial escape velocity' – the point at which life expectancy is increasing by more than one year per year – sometime in the next few decades or centuries.[2]

Changes in life expectancy are complex and generally occur because of multiple underlying drivers. To date, most of the observed increases in life expectancy stem from decreases in mortality at various demographic points below the maximum observed age rather than extensions of maximum lifetime itself. Under that paradigm (sometimes called 'squaring the survival curve'), there are diminishing returns to increased life expectancy. One can imagine a future population in which most live until they are about 120-130 years old, but nobody lives beyond then.

Since 2013, Google has invested substantial funds setting up a research and development biotech company called Calico that is investigating ageing (Regalado, 2016). Calico's mission is to 'harness advanced technologies to increase our understanding of the biology that controls lifespan' and to 'use that knowledge to devise interventions that enable people to lead longer and healthier lives' (Calico, 2018). At the time of writing, the most recent scholarly publication cited on Calico's website is entitled 'Naked mole-rat mortality rates defy Gompertzian laws by not increasing with age' (Ruby, Smith and Buffenstein, 2018) which to me sounds a prime candidate for required actuarial exam reading.

1. Based on the 2002 novel of the same name by Richard K. Morgan.
2. At least for the super-rich who can afford cutting-edge treatments.

What are actuaries and others to make of these extraordinary claims and visions of the future? Life-extension technologies – or success in achieving other 'post-human' forms to inhabit – would require a re-engineering of many financial and insurance products on a scale that makes the possible disruption caused by self-driving cars seem minor by comparison. Here are just a few questions that spring to mind:

- Will comprehensive health insurance cover life extension technology? Is access to such treatment 'medically necessary' or not? Is it a basic human right? Will coverage depend on the type of technology or the particular problem being fixed?
- How will 'life' and 'death' – as defined in existing life insurance policies, income annuities, and disability income policies – be interpreted if the life extension involves moving consciousness to a new body (carbon or silicon)?
- If disability policies provide income only to a given attained age, or if pension plans provide benefits in relation to a given attained age, will public policy force a reinterpretation of those contracts to reflect a belief that 'the new age 65' is now age 75?
- Might life insurers offer to fund life extension in order to postpone paying death benefits into the future? Will whole-of-life policies need to reflect a non-zero probability that the insured never dies?
- How might underwriting need to change for life insurance and for annuities (or other longevity products)? What new product practices might develop as medical science expands the list of ailments it can cure and disabilities it can reverse?
- If life extension comes at the price of increasing long-term nursing care needs or income support needs, will society be equipped to provide that care and support?
- Similarly, how will companies and individuals adapt to the changes? Radical changes to lifespans would greatly increase existing pension and annuity obligations, and could also increase healthcare spending. Conversely, claims on life policies might be greatly reduced. Might life companies find it advantageous to pay for advanced medical treatment for certain policyholders to achieve those claim reductions? Might health insurers find it advantageous to pay for people to upgrade or replace their bodies when they become sick, to avoid costly end-of-life care?

Besides being a pleasant diversion, contemplating how actuarial methods might be applied to solve new societal problems in various potential futures is good mental exercise. It might also be a good source of fresh ideas about how to tackle continuing problems of financial inequity and lack of access to required financial security products for large portions of the global population today. By virtue of the nature of their products, many insurers must necessarily operate on longer time horizons than most other businesses, and therefore have more incentive to take the potential of disruptive technology seriously and plan accordingly. As a result, actuaries may have a vital role to play in ensuring we end up in a utopia rather than the alternative.

References

Calico (2018). We're tackling aging, one of life's greatest mysteries **https://www.calicolabs.com** [Accessed: 31 May 2018]

Nuland, S. (2005). Do you want to live forever? Aubrey de Grey thinks he knows how to defeat aging. He's brilliant, but is he nuts? *MIT Technology Review,* 1 February 2005 **https://www.technologyreview.com/s/403654/do-you-want-to-live-forever** [Accessed: 31 May 2018]

Regalado, A. (2016). Google's long, strange life-span trip: Why does a mole rat live 30 years but a mouse only three? With $1.5 billion in the bank, Google's anti-aging spinout Calico is rich enough to find out. *MIT Technology Review,* 15 December 2016. **https://www.technologyreview.com/s/603087/googles-long-strange-life-span-trip/** [Accessed: 31 May 2018]

Ruby, J.G., Smith, M., and Buffenstein, R. (2018). Naked mole-rat mortality rates defy Gompertzian laws by not increasing with age. *eLife* [online], 24 January 2018. **https://doi.org/10.7554/eLife.31157**

Wise, J. (2017). Brain-computer interfaces are already here. *Bloomberg Businessweek*, 7 September 2017. **https://www.bloomberg.com/news/features/2017-09-07/brain-computer-interfaces-are-already-here** [Accessed: 31 May 2018]

Wu, J. and Rao, R.P.N. (2017). How close are we to Elon Musk's brain-computer interface? CNN, 12 April 2017. **https://www.cnn.com/2017/04/12/health/brain-computer-interface-partner/index.html** [Accessed: 31 May 2018]

Biography

Hans Leida is a Principal and Consulting Actuary with Milliman, Inc. Hans consults with clients on many aspects of healthcare financing, particularly those related to healthcare reform in the USA and to applications of predictive modelling to health data. With Bill Bluhm, he wrote the textbook *Individual Health Insurance* which has been required reading on the Society of Actuaries exam syllabus for many years. Hans is frequently quoted in the news, and a paper he wrote was cited by the Chief Justice of the US Supreme Court in a major decision on healthcare reform.