

Part 1: _____

Many people object that they wouldn't want to live longer like an old person, but the notion of longevity or life extension is best understood as health extension. Many physical ailments arise out of aging. And interventions to slow, stop, or even reverse aging will be aimed at maintaining health, perhaps even before they are aimed at aging itself.

The life-extension and post-human movement is dedicated not only to maximizing basic health, but in stretching our notion of basic health well beyond its ordinary limits. It is not only a question of not being injured, diseased, or depressed. Our efforts towards life-extension will have us feeling vigorous, physically and mentally hyper-enabled so that we can be the best versions of ourselves.

The most important point I intend to make today - is that it is wrong to view aging as set in stone, and as an immutable part of the human condition. Involuntary aging is just another medical condition caused by biochemical processes in the body that are as open to discovery, cataloging, and intervention as those of any other disorder.

The human body is a biological machine. Like any other simple man-made machine, like car or an airplane, the human body is designed to tolerate a certain amount of damage. But eventually the amount of damage exceeds what we can tolerate, and this is when disease starts to emerge and risk of death increases.

Aging is simply an unmanaged side-effect of being alive. It is the accumulation of damage that the body does to itself as a by-product of its normal operations. In that sense it is exactly the same as the aging process of any simple man-made machine, like car or an airplane.

Aging is not a one single process, but an accumulation of a lot of different types of damage in different organs and body parts as a result of different processes.

The damage that happens is at the molecular and cellular level. Things like cells dying and not being automatically replaced by the division of other cells, or simple molecular byproducts of certain metabolic processes that accumulate because the body doesn't have a system for getting rid of them.

In order to comprehensively tackle all of these types of damage, we have to do a lot of different things at the same time. But what we first need to do is accept that aging is a disease like any other, and with the support of the scientific community, can eventually be cured.

On a very basic level it is unethical to continue human suffering, nobody should be subjected to involuntary aging or inferior health. The major strength of the humanity has always been adaptation, and now it is time to adapt.

The only thing that separates us from effective anti-ageing medicine capable of restoring youthful vigor and health to the old, is the same thing that once separated humanity from a cure for smallpox or effective management of infant mortality. In other words, medical technology.

Bringing aging under medical control and extending both the quantity and quality of healthy years indefinitely is merely a matter of progress in applied biotechnology. The research community is actually much closer to meaningful advances on this front than most people imagine to be the case.

Part 2: _____

Medically approved anti-aging therapies will be available sooner than you think. An analysis of the history of technology shows that technological change is exponential, contrary to the common-sense “linear” view. So we won’t experience 100 years of progress in the 21st century — it will be more like 20,000 years (at today’s rate). The “returns,” such as CPU speed and cost-effectiveness, also increase exponentially.

To think exponentially, is to get your mind thinking beyond all previous limits. That’s a challenge because exponential thinking runs counterintuitive to the way our brains evolved. As futurist Ray Kurzweil explains: our brains evolved 100,000 years ago in a world that was linear and local. But today we live in a world that is global and exponential. That’s why we can’t get our heads around the implications of exponential change. Our brains don’t intuitively make sense of it.

To illustrate the difference between linear and exponential thinking, let’s visualize the following example. If you take 30 linear steps, one, two, three, four, five, after 30 steps you’d end up approximately 30 meters away. That’s easy, it makes sense. That’s how our ancestors in the savannahs of Africa made a projection as to how far away that predator was before it came and ate us. That’s linear thinking.

Exponential growth, on the other hand, if you take the same amount of steps, you would actually go one, two, four, eight, sixteen, by step 30 you’d be at a billion. Or enough steps to go twenty-six times around the planet. That’s a big difference between linear and exponential growth.

Part 3: _____

The question remains how do we develop reasonably effective life-extension therapies in the shortest time possible, so even people who are alive today can benefit.

When it comes to radical life-extension, there exist two popular approaches. First, repairing the damage every so often using a so-called rejuvenation therapy, or changing the genetic code and metabolic processes so the damage is stopped from being created in the first place. Both of these methods will achieve the necessary objective - stop the damage from reaching a level of abundance that is bad for you.

If we administer rejuvenation therapies periodically, then we will be able to maintain someone’s biological age at young adulthood, let’s say 25, indefinitely. A form of preventative maintenance, the same way we do on a car or an airplane.

And of course we already know from cars for example, that this works quite well. We have cars driving around today which are more than 100 years old. They were not designed to last that long, those cars were designed to last 10 or 15 years. And the reason they've lasted so much longer is preventative maintenance.

Genetic engineering is the second approach. We already know from the experiments conducted by Cynthia Kenyon from the University of California, that radically extending the lifespan of at least some biological creatures is possible with a single gene mutation. She made *C. Elegans*, a species of worms, to live twice their normal apparent biological limit.

Aging is not an inevitable fact of life – many other animals, have already found ways to extend their lifespan. Consider that there are animals, and even mammals alive today that exhibit negligible senescence, or have the ability to change to a more youthful state with ease.

A notable example would be the naked mole-rat, they don't go on to develop cancer when they get old, and display exceptional longevity. In captivity, they live for more than 28.3 years, ~ 9 times longer than similar-sized mice.

Let's talk about CRISPR. CRISPR/Cas9 is a method that allows scientists to edit genomes with unprecedented precision, efficiency, and flexibility. Invented in 2012 by scientists at the University of California, Berkeley, CRISPR/Cas9 has received a lot of attention this year. Its main advantage over its gene-editing predecessors, is that it is extremely easy to use and can be applied to any type of cell.

CRISPR uses specially designed molecules that run along the strands of DNA in an organism's genome, and seek out specific sequences of code. Once found, they snip out the old code, and paste in the new. Cas9 is an enzyme that snips DNA (like a pair of scissors) - and CRISPR is a collection of DNA sequences that tells Cas9 exactly where to snip. All biologists have to do is feed Cas9 the right sequence, called a guide RNA, and then you can cut and paste bits of DNA sequence wherever you want. We now have the power to quickly and easily alter DNA.

Because CRISPR is cheap and easy to use, it has both revolutionized and democratized genetic research. Thousands of labs are now experimenting with CRISPR-based editing projects.

Only few weeks ago, a study by researchers from the Duke University was published where they have used CRISPR/Cas9 to treat an adult mouse model of muscular dystrophy. They've turned off a gene responsible for production of toxic proteins that lead to the degeneration of skeletal muscles. This marks the first time that CRISPR has successfully treated a genetic disease inside a fully developed living mammal with a strategy that has the potential to be translated to humans.

There should no longer be any doubt about whether humans will one day be genetically modified. Genetic engineering could be used to change physical appearance, and even improve physical capabilities and mental faculties such as memory and intelligence.

Genetic engineering will inevitably be used to enhance human condition and capabilities. People like olympic athletes or noble prize winners are clearly born with certain natural advantages. CRISPR will make it possible for anyone to attain features like increased muscle performance or higher IQ. States of sublime well-being are destined to become the genetically pre-programmed norm of health.

Among many other applications, CRISPR could also be used to improve our ability to cope with environmental factors such as pollution, temperature changes, radiation, and low gravity conditions. Stephen Hawking notably claims that evolution by scientific design is necessary for the continued survival of humanity.

Homo sapiens is the first truly free species - with the knowledge and tools to effectively decommission natural selection, the force that made us. We must look deep within ourselves and decide what we wish to become.

Part 4: _____

2015 has been an impressive year for scientific advancements, especially when it comes to life-extension technology. Researchers have proven that a common diabetes drug metformin, which costs just 10 cents a day, extends the life of animals. The Food and Drug Administration in the US has now given a green light for a trial to see if the same effects can be replicated in humans.

Researchers convinced FDA officials that if the trial succeeds, they will have proved that a drug can delay aging. That would set a precedent that aging is a disorder that can be treated with medicines. The diabetes medication metformin will be tested as a possible “anti-aging” drug in human trials in 2016.

When Belgian scientists tested metformin on the tiny roundworm *C.elegans* the worms not only aged slower, but they also stayed healthier longer. They did not slow down or develop wrinkles.

Mice treated with metformin increased their lifespan by nearly 40%. Last year, Cardiff University found that when patients with diabetes were given metformin, they in fact lived longer than others without the condition.

Part 5: _____

If people were to live longer, wouldn't overpopulation become an issue? Definitely not. If we look at the recent history of humanity, we see that is not a problem. Whenever any nation reaches a certain level of female education, emancipation, and prosperity, birth rates go down rapidly because women choose to have fewer kids on average.

But the most important thing of all is that the carrying capacity of the planet, the number of people that we can support without an unacceptable environmental impact, is not a fixed number. That number increases as technology improves. As we make better use of renewable energy and develop nuclear fusion, we will diminish our bad effects on the climate. And that is just one example. These things will happen in a relatively short time frame, whereas the demographic changes that may occur as a result of bringing aging under control will only happen very slowly.

Another common objection, “life-extension will only be affordable by the wealthy”. This will not be the case. Every new technology goes through an adoption life cycle, at first it’s a luxury, then economies of scale drive down the cost and it becomes affordable. The cost of sequencing one human genome in 2001 was roughly \$100 million. Today it’s closer to \$1000. Same with smartphones, they used to be expensive. Today 66% of people in Africa have one. By 2019, the number of people in Africa who own a smartphone will grow to 85%.

Life-extension therapies will not be expensive. They will be made available to everyone who needs them. Because unlike today's high-tech medicine which is very expensive, these therapies will pay for themselves. They will save us all of the money we are currently spending trying to keep people alive with medicine that doesn't work. This will also have an enormous number of very effective indirect economic benefits. One is that the children of the elderly will be more productive because they won't have to spend any time looking after their sick parents. The older but healthy people themselves will be continuing to contribute wealth to society instead of just consuming it.

Part 6: _____

Even today you can be proactive about extending your life. You want to minimize the possible damage to your body, and maximize the chances of still being around once life-extension therapies have reached the market.

A great place to start would be mindful meditation. It’s surprisingly effective. Practicing mindfulness improves both mental and physical health. After three-month intervention, scientists found that those individuals who meditated had increased activity of the enzyme telomerase than those who didn’t meditate.

Telomerase acts on telomeres, the structures located on the ends of chromosomes, which, like the plastic tips of shoelaces, prevent the chromosome from unraveling. Each time a cell divides, its telomeres become shorter and less effective at protecting the chromosome. This process, researchers believe, contributes to aging.

Exercise and nutrition belong to key factors in maintaining optimal health. But what does it actually mean to have a nutritious diet? The answer is in the genes. Individuals express great

genetic variability in the way they process fats, carbohydrates and proteins. The proportion of nutrients in our daily diet plays a key role in maintaining healthy weight, optimal energy levels, and overall wellbeing. Every person responds differently to the same food, and this is why diets are so often a vicious topic of debate. Nutrition has the most important life-long environmental impact on human health.

An example, some of you might be vegetarian, and also to carry a mutation at gene called Fucosyltransferase 2, this means that you have an increased risk for developing vitamin B12 deficiency. Genetic testing could also help you in diagnosing various food allergies, such as lactose intolerance or celiac disease. If you find out that avoiding certain ingredients such as milk or gluten makes you feel better, embrace your new diet and lifestyle. Don't view it as a limitation, but an enabler of healthier and longer life.

Another notable application of genomic data is pharmacogenomics. It uses information about a person's genetic makeup to choose the drugs and drug doses that are likely to work best for that specific person. If you submit your genomic data for a pharmacogenomic analysis, it has several major benefits for you: a decreased risk of experiencing unwanted side effects from medication, a decreased cost of medical care, and your doctor now has the ability to make more informed medical decisions - potentially saving your life

By expanding the field of personal genomics, we can supply the world with a wealth of data and financial incentives for the fight against involuntary-aging and genetic diseases. Genetic testing is cheaper and faster than ever. Yet, the genomic data interpretation is not quite there, patients and doctors still struggle to make full use of it.

Juraj and I are working on a project which aims to bring personal genomics into the mainstream. A solution for transforming your genomic data into actionable information. A personalized nutritional, fitness, and health risk overview based on your genetic code. It's a very simple process.

A small sample of saliva is collected and sent to the lab. In few weeks, you can access your results online. If you are interested in better understanding your own health and extending your life, please consider subscribing to our mailing list. You will receive an email when our product becomes available. If you want your results as soon as possible, you can already obtain a similar style of analysis from US based company called 23andMe.

If you sympathize with the goals of life-extension movement, there is a number of ways how you can show your support. Research - educating yourself about recent advances in longevity science, as well as its social implications. Study relevant fields - biotechnology, medicine, nutrition, and other fields related to longevity. Join others - discuss longevity research with friends. Participate - volunteer or donate for academic and public organizations involved in longevity research. Last but not the least - practice a healthy, life-prolonging, life-style.

I will end this talk with a quote from David Pearce: "If we get things right, the future of life on our planet can be wonderful beyond the bounds of human imagination: a "triple S" civilization of superlongevity, superintelligence and superhappiness."

Thank you.