

Zbornik 26. mednarodne multikonference  
**INFORMACIJSKA DRUŽBA - IS 2023**  
Zvezek I

Proceedings of the 26th International Multiconference  
**INFORMATION SOCIETY - IS 2023**  
Volume I

Konferenca o zdravi dolgi živosti  
Conference on Healthy Longevity

Urednika / Editors

Martin Lipovšek / Boštjan Petrič

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Urednika:

Boštjan Petrič  
Medicinska fakulteta UL, Ljubljana

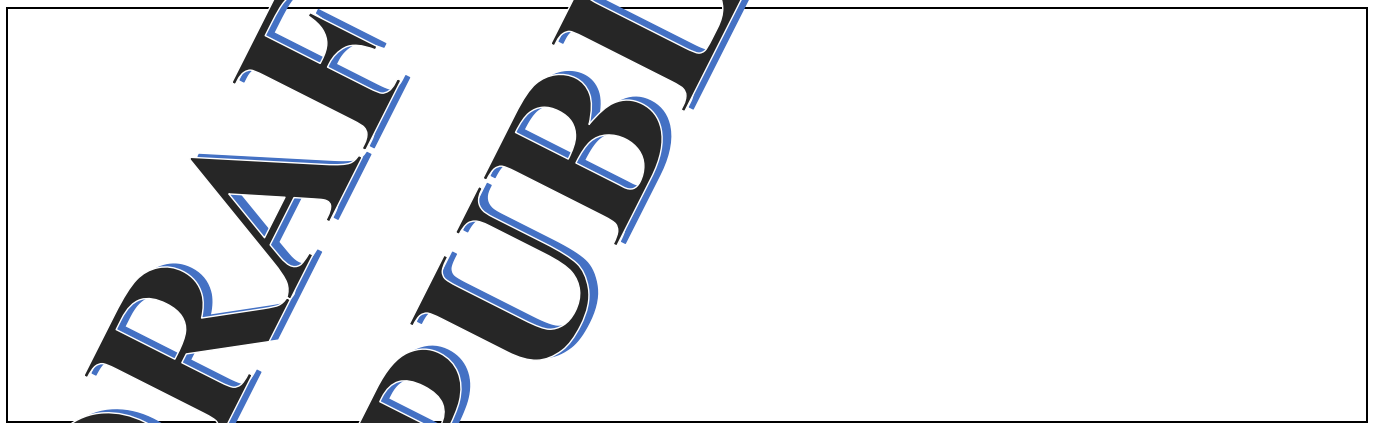
Martin Lipovšek  
Društvo za vitalno podaljševanje življenja, Ljubljana

Založnik: Institut »Jožef Stefan«, Ljubljana  
Priprava zbornika: Mitja Lasič, Vesna Lasič, Mateja Mavrič  
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# PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2023

Šestindvajseta multikonferenca Informacijska družba se odvija v obdobju izjemnega razvoja za umetno inteligenco, računalništvo in informatiko, za celotno informacijsko družbo. Generativna umetna inteligenca je s programi kot ChatGPT dosegla izjemen napredek na poti k superinteligenci, k singularnosti in razcvetu človeške civilizacije. Uresničujejo se napovedi strokovnjakov, da bodo omenjena področja ključna za obstoj in razvoj človeštva, zato moramo pozornost usmeriti na njih, jih hitro uvesti v osnovno in srednje šolstvo in vsakdan posameznika in skupnosti.

Po drugi strani se poleg lažnih novic pojavljajo tudi lažne enciklopedije, lažne znanosti ter »ploščate Zemlje«, nadaljuje se zapostavljanje znanstvenih spoznanj, metod, zmanjševanje človekovih pravic in družbenih vrednot. Na vseh nas je, da izzive današnjice primerno obravnavamo, predvsem pa pomagamo pri uvajanju znanstvenih spoznanj in razčiščevanju zmot. Ena pogosto omenjanih v zadnjem letu je eksistencialna nevarnost umetne inteligence, ki naj bi ogrožala človeštvo tako kot jedrske vojne. Hkrati pa nihče ne poda vsaj za silo smiselnega scenarija, kako naj bi se to zgodilo – recimo, kako naj bi 100x pametnejši GPT ogrozil ljudi.

Letošnja konferenca poleg čisto tehnoloških izpostavlja pomembne integralne teme, kot so okolje, zdravstvo, politika depopulacije, ter rešitve, ki jih za skoraj vse probleme prinaša umetna inteligenca. V takšnem okolju je ključnega pomena poglobljena analiza in diskurz, ki lahko oblikujeta najboljše pristope k upravljanju in izkoriščanju tehnologij. Imamo veliko srečo, da gostimo vrsto izjernih mislecev, znanstvenikov in strokovnjakov, ki skupaj v delovnem in akademsko odprtem okolju prinašajo bogastvo znanja in dialoga. Verjamemo, da je njihova prisotnost in udeležba ključna za oblikovanje bolj inkluzivne, varne in trajnostne informacijske družbe. Za razcvet.

Letos smo v multikonferenco povezali deset odličnih neodvisnih konferenc, med njimi »Legende računalništva«, s katero postavljamo nov mehanizem promocije informacijske družbe. IS 2023 zajema okoli 150 predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic, skupaj pa se je konference udeležilo okrog 500 udeležencev. Prireditve so spremljale okrogle mize in razprave ter posebni dogodki, kot je svečana podelitev nagrad. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica (<http://www.informatica.si/>), ki se ponaša s 46-letno tradicijo odlične znanstvene revije. Multikonferenco Informacijska družba 2023 sestavljajo naslednje samostojne konference:

- Odkrivanje znanja in podatkovna središča
- Demografske in družinske analize
- Legende računalništva in informatike
- Konferenca o zdravi dolgoživosti
- Miti in resnice o varovanju okolja
- Mednarodna konferenca o prenosu tehnologij
- Digitalna vključenost v informacijski družbi – DIGIN 2023
- Slovenska konferenca o umetni inteligenci + DATASCIENCE
- Kognitivna znanost
- Vzgoja in izobraževanje v informacijski družbi
- Zaključna svečana prireditve konference

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi ACM Slovenija, SLAIS za umetno inteligenco, DKZ za kognitivno znanost in Inženirska akademija Slovenije (IAS). V imenu organizatorjev konference se zahvaljujemo združenjem in institucijam, še posebej pa udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

S podelitvijo nagrad, še posebej z nagrado Michie-Turing, se avtonomna stroka s področja opredeli do najbolj izstopajočih dosežkov. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Andrej Brodnik. Priznanje za dosežek leta pripada Benjaminu Bajdu za zlato medaljo na računalniški olimpijadi. »Informacijsko limono« za najmanj primerno informacijsko tematiko je prejela nekompatibilnost zdravstvenih sistemov v Sloveniji, »informacijsko jagodo« kot najboljšo potezo pa dobi ekipa RTV za portal dostopno.si. Čestitke nagrajencem!

Mojca Ciglarič, predsednica programskega odbora  
Matjaž Gams, predsednik organizacijskega odbora

# FOREWORD - INFORMATION SOCIETY 2023

The twenty-sixth Information Society multi-conference is taking place during a period of exceptional development for artificial intelligence, computing, and informatics, encompassing the entire information society. Generative artificial intelligence has made significant progress towards superintelligence, towards singularity, and the flourishing of human civilization with programs like ChatGPT. Experts' predictions are coming true, asserting that the mentioned fields are crucial for humanity's existence and development. Hence, we must direct our attention to them, swiftly integrating them into primary, secondary education, and the daily lives of individuals and communities.

On the other hand, alongside fake news, we witness the emergence of false encyclopaedias, pseudo-sciences, and flat Earth theories, along with the continuing neglect of scientific insights and methods, the diminishing of human rights, and societal values. It is upon all of us to appropriately address today's challenges, mainly assisting in the introduction of scientific knowledge and clearing up misconceptions. A frequently mentioned concern over the past year is the existential threat posed by artificial intelligence, supposedly endangering humanity as nuclear wars do. Yet, nobody provides a reasonably coherent scenario of how this might happen, say, how a 100x smarter GPT could endanger people.

This year's conference, besides purely technological aspects, highlights important integral themes like the environment, healthcare, depopulation policies, and solutions brought by artificial intelligence to almost all problems. In such an environment, in-depth analysis and discourse are crucial, shaping the best approaches to managing and exploiting technologies. We are fortunate to host a series of exceptional thinkers, scientists, and experts who bring a wealth of knowledge and dialogue in a collaborative and academically open environment. We believe their presence and participation are key to shaping a more inclusive, safe, and sustainable information society. For flourishing.

This year, we connected ten excellent independent conferences into the multi-conference, including "Legends of Computing", which introduces a new mechanism for promoting the information society. IS 2023 encompasses around 150 presentations, abstracts, and papers within standalone conferences and workshops. In total about 500 participants attended the conference. The event was accompanied by panel discussions, debates, and special events like the award ceremony. Selected contributions will also be published in a special issue of the journal *Informatica* (<http://www.informatica.si/>), boasting a 46-year tradition of being an excellent scientific journal. The Information Society 2023 multi-conference consists of the following independent conferences:

- Data Mining and Data Warehouse - SIKDD
- Demographic and Family Analysis
- Legends of Computing and Informatics
- Healthy Longevity Conference
- Myths and Truths about Environmental Protection
- International Conference on Technology Transfer
- Digital Inclusion in the Information Society - DIGIN 2023
- Slovenian Conference on Artificial Intelligence + DATASCIENCE
- Cognitive Science
- Education and Training in the Information Society
- Closing Conference Ceremony

Co-organizers and supporters of the conference include various research institutions and associations, among them ACM Slovenia, SLAIS for Artificial Intelligence, DKZ for Cognitive Science, and the Engineering Academy of Slovenia (IAS). On behalf of the conference organizers, we thank the associations and institutions, and especially the participants for their valuable contributions and the opportunity to share their experiences about the information society with us. We also thank the reviewers for their assistance in reviewing.

With the awarding of prizes, especially the Michie-Turing Award, the autonomous profession from the field identifies the most outstanding achievements. Prof. Dr. Andrej Brodnik received the Michie-Turing Award for his exceptional lifetime contribution to the development and promotion of the information society. The Achievement of the Year award goes to Benjamin Bajd, gold medal winner at the Computer Olympiad. The "Information Lemon" for the least appropriate information move was awarded to the incompatibility of information systems in the Slovenian healthcare, while the "Information Strawberry" for the best move goes to the RTV SLO team for portal [dostopno.si](http://dostopno.si). Congratulations to the winners!

Mojca Ciglarič, Chair of the Program Committee  
Matjaž Gams, Chair of the Organizing Committee

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## PREDGOVOR

Nekatera področja znanosti in tehnologije se razvijajo daleč od oči javnosti, povečini zato, ker se javnosti njihov vpliv na družbo ne zdi dovolj pomemben, da bi zaslužil kako posebno javno debato ali pa nasprotovanje. Področje raziskav o dolgoživosti ne deli te usode. Posamezni pristopi, kot so npr. celične terapije, restrikcija kalorij ali pa reaktivacija telomeraze, znajo pritegniti precej medijske pozornosti, pri čemer dobijo prostor za izražanje svojega mnenja tako zagovorniki kot nasprotniki posameznega pristopa. Največji kamen spotike pri podaljševanju življenja pa je še vedno osnovna ideja sama. Naj znanost stremi k temu, da podaljša človeško življenjsko dobo preko trenutnih bioloških meja? Ali naj se omeji na zdravljenje bolezni in lajšanje bolečin?

V javnosti je še vedno veliko nesporazumov glede podaljševanja življenja, kljub desetletjem naporov, da bi jih zatrli. Največji od nesporazumov je ta, da raziskovalci na področju dolgoživosti poskušajo podaljšati starost, se pravi senilen, dementen in k boleznim nagnjen del človeškega življenja. Resnica je seveda ravno nasprotna: cilj podaljševanja življenja je drastično podaljšati zdrav del človeškega življenja – v angleščini t. i. “healthspan” – do in preko meja, pri katerih ljudje trenutno umirajo zaradi bolezni. To je seveda ambiciozen projekt, zato pa je tudi razumljivo, da od znanstvenikov samih ne moremo pričakovati, da bodo polovico svojega časa namenili za bojevanje javnih debat.

Da bi promovirale raziskave na področju dolgoživosti, obenem pa pomagale gojiti informirano debato o namenih in ciljih podaljševanja življenja, so nastale številne nevladne organizacije v različnih državah. Mednarodno združenje, ki jih povezuje med seboj, se imenuje ILA oz. “International Longevity Alliance;” od leta 2021 je včlanjeno v združenje ILA tudi Društvo za vitalno podaljševanje življenja Slovenije, ki sicer obstaja od leta 2017. Eden glavnih ciljev društva je povezovati slovenske raziskovalce, podjetnike in državne uslužbence, ki so aktivni na področju podaljševanja življenja. V ta namen je društvo že leta 2020 organiziralo konferenco v sodelovanju s Filozofsko fakulteto, pri tem pa povezalo številne ključne svetovne osebnosti z omenjenega področja. Konferenca, naslov katere je bil “Biti mlad sto let,” je bila zaradi koronskih omejitev izvedena preko interneta.

Pričujočo konferenco organiziramo skupaj z Inštitutom Jožef Stefan in bo potekala v živo v prostorih inštituta. Tokrat je naš partner LongevityForum, češka sestrška organizacija, ki se ukvarja s promocijo ideje podaljševanja življenja. Poleg vodilnih slovenskih in čeških raziskovalcev s tega področja bomo ponovno slišali tudi predavanja glavnih svetovnih zagovornikov podaljševanja življenja, med drugim ikono področja Aubreya de Greya. Ker namen združenja ILA in njenih članic ni predavati ex cathedra, temveč promovirati diskusijo o vrednotah za podaljševanjem življenja, se bo konferenca zaključila z okroglo mizo, na kateri bo prisoten po en predstavnik iz sfer javne uprave, znanosti, ter podjetništva.

## FOREWORD

Some fields of science and technology develop in obscurity and far from the public eye, mostly because their impact on society is not considered big enough to merit particular debate or opposition. The field of longevity research does not share this fate. Individual approaches, such as cell therapy, calorie restriction, or telomerase reactivation, might receive considerable media attention, with proponents and opponents of each approach both getting substantial coverage. However, the most contested part of life extension is the basic idea itself. Should science strive to extend the human lifespan beyond present biological limits? Or should it limit itself to treating diseases and suppressing pain?

Several misconceptions about life extension are still rife among the public, despite decades of effort to stamp them out. The most important of these misconceptions is that longevity researchers strive to prolong old age, i.e. to extend the senile, illness-prone and demented part of human life. The truth, of course, is exactly the opposite: longevity researchers aim to dramatically extend the healthy part of the human lifespan – “the healthspan” – up to and beyond the age that people currently die of disease. This is itself a tall order, so it makes sense that the scientists themselves cannot be expected to spend half of their time fighting public debates.

To promote longevity research among the public and foster a well-informed debate about the whys and hows of extending lifespan, several advocacy groups have been formed in different countries. The umbrella organization that joins them together is called ILA, or International Longevity Alliance; as of 2021, one of ILA’s members is the Slovenian Society for Vital Life Extension, based in Ljubljana, which has itself been in business since 2017. One of the Society’s main aims is to connect Slovenian researchers, entrepreneurs and governmental employees who are working in the field of life extension, as well as establishing ties between the Slovenians and their colleagues abroad. To this end, the Society has already co-organized a conference in 2020 together with the Faculty of Arts in Ljubljana, bringing together several key global figures from the field of life extension. The conference, titled “Being Young for a Hundred Years,” was held online due to Covid restrictions.

The present conference is being co-organized with the Jožef Stefan Institute and will be held live at the Institute’s premises. This time, one of our partners is LongevityForum, the Czech sister organization working on promoting the idea of lifespan extension. Apart from leading Slovenian and Czech voices from the field, we will once again hear from key global advocates of longevity research, including the doyen of life extensionism Aubrey de Grey. As the aim of ILA members is not just to speak ex cathedra, but to promote discussion about the values behind extending lifespan, this conference will conclude with a round table featuring one representative of each from the spheres of government, research, and business.

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Martin Lipovšek

Boštjan Petrič

**Organizacijski odbor / Organizing Committee**

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Mitja Luštrek

Patrik Milić

Laura Vuga,

Kristýna Zábojová



**Enej Kuščer**

## **Evidence-Based Interventions to Prolong Healthspan and Lifespan**

In recent years, longevity science has emerged as one of the most captivating and pivotal areas of research, capturing the imagination of scientists, healthcare professionals, and the general public alike. The quest to extend human lifespan and, more importantly, enhance the quality of human healthspan, is a challenge that has intrigued humanity for centuries. Now, with remarkable advancements in science and technology, this aspiration is becoming increasingly achievable.

This presentation will shed light on the dynamic field of longevity science and latest insights into the biological processes of aging. It will explore evidence-based precision interventions based on systems biology and multi-omics data to optimise health and improve vitality. The fusion of machine learning and AI-powered personalized recommendations opens up new horizons for proactive health management.

In this era of longevity science, the boundaries of what's possible are constantly expanding, offering the tantalizing prospect of a future where not only do we live longer, but we also thrive throughout our extended years. This presentation will aim to explore the frontiers of evidence-based interventions that hold the promise of a healthier, longer, and more fulfilling life for all.

## **Aleš Kenda**

### **Dolgoživost in družba; odzivi politik, opravljeno delo in aktivnosti pred nami**

Spadamo v generacijo, ki se ji v veliki meri uresničujejo davne želje človeštva po daljšem življenju. Konec leta 2022 je v Sloveniji živel desetkrat več stoletnikov kot ob osamosvojitvi. Daljše trajanje življenja se torej že dogaja in je posledica napredka v zdravstvu in znanosti, boljših delovnih pogojev, bolj raznovrstne in kakovostne prehrane, izboljšane higijene itd.. Zaradi daljšega trajanja življenja narašča število starejših, narašča pa tudi njihov delež v celotnem prebivalstvu, saj so mlade generacije maloštevilne. Pravimo, da se prebivalstvo stara, pogosto ta pojav opišemo z besedo dolgoživost. Staranje prebivalstva pa je več kot le demografija, tudi več kot le biologija. Je velik izziv za celotno družbo in tudi posameznike. Tovrstne spremembe namreč temeljito spreminjajo družbo.

Po začetnem pesimizmu ob napovedani "demografski katastrofi" se je začelo iskati rešitve, kako družbene sisteme in podsisteme prilagoditi novim demografskim pogojem. Posebej aktivni na tem področju so že vrsto let Združeni narodi. Do sedaj je bilo največ pozornosti po državah posvečeno prilagoditvam pokojninskih sistemov, zaposlovanju starejših in dolgotrajni oskrbi.

Tudi starejši niso več takšni, kot so bili nekoč; so bolj aktivni, bolj zdravi, zavedajo se svoje vloge in tudi pravic v družbi. Niso več zadovoljni zgolj z dodanimi leti življenja, ta leta želijo zapolniti z vsebino. Ni jim vseeno, v kakšnem okolju živijo, niti kakšen je odnos družbe do njih.

V Evropski kulturi besedi star in staranje še vedno povezujemo z upadom, počasnostjo, nepotrebno, boleznimi, odvisnostjo, in smrtjo. Realnost je drugačna, saj je starost samo eno obdobje v življenju človeka, ki je enakopravno z drugimi obdobji; lahko ti veliko da, pa tudi nekaj vzame. Človek lahko osebno raste do zadnjega diha. Na tem področju je še veliko izzivov, pogosto ugotavljamo, da sta staranje in starost v precejšnji meri še neodkrita kontinenta. Šele v zadnjem času, npr. podrobneje spoznavamo škodljiv vpliv osamljenosti in starizma na zdravje ljudi. Pomembno vlogo pri našem doživljanju starosti imajo tudi prepričanja, ki jih o starosti in starejših gojimo v sebi.

Namen prispevka je prikazati, da dolgoživost, ki se že dogaja, odpira vrsto izzivov, tako za celotno družbo kakor za posameznike. Pri odzivih je treba iskati rešitve, ki upoštevajo interese, koristi in obveznosti ljudi vseh generacij, tudi še nerojenih.

—

### **Longevity and society; policy responses, work done and activities ahead**

We belong to a generation in which humanity's ancient wishes for a longer life are largely being realized. At the end of 2022, there were ten times more centenarians living in Slovenia than at the time of independence. Longer life expectancy is therefore already happening and is a result of progress in health care and science, better working conditions, more varied and high-quality nutrition, improved hygiene, etc. Due to longer life expectancy, the number of elderly people is increasing, and their share in the entire population is also increasing, as the young generation is few in number. We say that the population is aging, and we often describe this phenomenon with the word longevity. Population aging is more than just demography, but also more than just biology. It is a big challenge for the whole society and also for individuals. Such changes fundamentally change society.

After the initial pessimism at the predicted "demographic catastrophe", the search for solutions to adapt social systems and subsystems to the new demographic conditions began. The United Nations have been particularly active in this field for many years. Until now, the most attention



by country has been devoted to adjustments of pension systems, employment of the elderly and long-term care.

Even the elderly are not what they used to be; they are more active, healthier, aware of their role and rights in society. They are no longer satisfied with just the added years of life, they want to fill these years with content. They don't care what kind of environment they live in, nor what society's attitude towards them is.

In European culture, the words old and aging are still associated with decline, slowness, unnecessaryness, disease, addiction, and death. The reality is different, because old age is only one period in a person's life, which is equal to other periods; it can give you a lot, but also take something away. A person can grow personally until his last breath. There are still many challenges in this area; we often find that aging and old age are still largely undiscovered continents. For example, we only recently learned more about the harmful impact of loneliness and old age on people's health. The beliefs we hold about age and the elderly also play an important role in our experience of age.

The purpose of the paper is to show that longevity, which is already happening, opens up a series of challenges, both for society as a whole and for individuals. When responding, it is necessary to find solutions that take into account the interests, benefits and obligations of people of all generations, even the unborn.

## **Stephen Minger**

### **Futuristic possibilities of personalized medicine**

There has been significant interest in the therapeutic and scientific potential of stem cells since reconstitution of the haematopoietic system was first realized by bone marrow transplantation in the 1960s. The isolation of tissue-specific, multipotent stem cells from adult organs and the derivation of pluripotent human embryonic stem cells and more recently induced pluripotent stem cells offer the potential for regeneration of several different tissues and organs susceptible to age-related degenerative conditions and traumatic injury. In the not-too-distant future, it will be possible to repair heart tissue damaged by myocardial infarction, to replace neuronal cells lost in Parkinson's disease and traumatic brain injuries, to transplant new insulin producing cells for diabetics and myelinating cells for individuals afflicted with multiple sclerosis, and to replace bone and cartilage lost through aging and inflammatory disease. In addition, the generation of specific populations of defined subtypes of human cells has tremendous potential to revolutionize the fields of drug discovery and investigation into the cellular bases of human disease. The newly emerging field of Regenerative Medicine will fundamentally alter clinical medicine and significantly influence our perceptions of aging, health and disease, with a myriad of consequences for society at large.

**Lucie Vidovičová**

**Five (or so) questions that the pre-longevity society should be asking, but it is not...**

Health and longevity are important topics for medicine and biology, but they do not exist in a social vacuum. On the contrary, recent studies suggest that social networks, socio-environmental factors, population structures and socio-demographic characteristics play a key role in health and longevity efforts and outcomes. Moreover, any major breakthrough in the field of longevity will inevitably trigger an urgent need to rethink our individual life trajectories as well as social structures and institutions.

In this presentation, I will offer eclectic points based on a sociological perspective and an understanding of how societies are (un)prepared for the next big step(s) towards longevity. Using surveys of attitudes towards how we (including lay actors, professionals, policy makers...) think about life, education, knowledge or the labour market today, I will present specific challenges for longevity societies. I will reflect on whether "hatred of old age" and "preference to stay young" are "sufficient ". Last but not least, I would like to engage in a conversation about who are the (un)expected proponents of anti-ageing and how this may affect longevity as a concept.

**Petr Sramek**

## **Healthy Longevity solutions landscape and the sector outlook**

Expanding our healthspan is a complex problem requiring complex solutions and an interdisciplinary approach. We need to support the translation of scientific advances, allow regulatory approvals related to aging itself, and build business infrastructure for a full democratization of access.

My lecture will frame the main problems and opportunities and also describe promising solution examples from the LongevityTech.fund portfolio, including diagnostics methods and therapeutic solutions. We will see advanced solutions addressing mitochondria function, DNA repair, telomere shortening, senescent cells, protein deregulation, tissue engineering, and signalling molecules in the blood. Diagnostic methods will include novel biomarkers based on single-cell sequencing, brain analysis and cheap proteomics.

The main part will focus on estimating the most successful solution trajectory, including various options on how to affect the broader worldwide population.

## **Didier Couernelle**

### **Steps to implement Open Longevity GPT**

In the realm of data, where a staggering 30% of big data is comprised of invaluable health-related information, the processes of sharing and curating these vast resources have been characterized by a sluggish and intricate nature. Addressing this issue, a promising avenue emerges: the development of a tool akin to ChatGPT, armed with a substantial repository of scientific articles and extensive health data. Such a tool holds the potential not only to facilitate but also to actively engage in theoretical research pertaining to longevity therapies. Crucially, this tool's deployment should align with principles of openness, manifesting as both an "open source" platform and one that promotes accessible results. The upcoming presentation will delve into several key facets of this proposal, including the current challenges associated with insufficient data accessibility and the prevailing trend of privatization in health data. Additionally, it will explore the perspectives within the European Health Data Space and delve into specific projects led by open AI initiatives aimed at advancing longevity research. Lastly, the presentation will consider the potential costs and benefits inherent to this transformative approach.

## **Patrick Linden**

### **The ethics of longevity and how to change pro-death attitudes**

The general public is often quite hesitant to support radical life extension and the notion of biological immortality seems to frighten many. The resistance is often seemingly morally motivated. People worry about adverse social consequences of living longer, and see the search for a longer life as selfish and morally suspect. There is, as I have argued in my book *The Case against Death*, in fact a perennial philosophy of death-acceptance and even celebration of death, running alongside the human wish to transcend the naturally given limit to our life. In this talk I will describe this death-ist ideology and argue that morality is on the side of those who seek to expand the human life span by curing aging.

## **Aubrey de Grey**

### **Taking rejuvenation research to escape velocity**

People are living longer - no longer because of reduced child mortality, but because we are postponing the ill-health of old age. But we've seen nothing yet: regenerative medicine and other new therapies will eventually be so comprehensive that people will stay truly youthful however long they live, which means they may mostly live very long indeed. Advances in this direction by my research teams and others have sharply accelerated in recent years, and at LEV Foundation we are combining them to identify a panel of interventions that promise to deliver the ultimate goal of biomedical gerontology: longevity escape velocity.





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