Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's *"Aging: Science, Technology and Healthy Living"* Inquiry

" While life span has increased over recent decades, health span, the period of time people live in good health, has generally not kept pace, and so older people are living longer with ill health. This inquiry will investigate how approaches from science and technology could be used to increase health span, to mitigate some of the negative effects of ageing, and to support older people living with poor health." ~ House of Lords Science and Technology Committee

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Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

One-Page Summary

House of Lords Ageing: Science, Technology and Healthy Living Inquiry was correct to identify a global problem with economic and social consequences. This problem has two proximate consequences:

- A lack of productivity among the elderly working population.
- A lack of access to the basic resources necessary for a life of meaning and of dignity. Many others confront multiple barriers that prevent their full participation in society.

Here the committee has identified what is frequently referred to by financial publications globally as "the silver tsunami" or "grey tsunami" : the economic and social devastation soon to be inflicted by a global aging demographic. Furthermore the committee is correct to identify the need for concerted government action as the next step. Increased global longevity per se is a "problem of success", an inevitable consequence of sharp increases in sanitation, diet, health care, elderly care, and geriatric medicine, a set of changes which have occurred suddenly within the lifetimes of today's elderly. We will not relinquish these gains, so what does the only logical alternative to the silver tsunami look like? In order to float rather than sink, Longevity must become an asset. And this means altering the nature of aging entirely, reducing the period of financially and socially inactive decrepitude at the end of life. Specifically, it means utilizing technology to ensure that these longer lives are also healthy, productive, financially active lives, and creating a system of government frameworks and financial incentives to create and sustain this case of affairs. Aging Analytics Agency foresees a future in which people alive today benefit from "low-hanging fruit" digital and biomedical technologies for facilitating longer, healthier working lives, which subsequently enable them to live to benefit from more advanced biotechnologies (such as those detailed below). The earlier biomedical innovations would consist of P4 medicine supported by data aggregated from advanced data infrastructures which include wearable devices. These would then give way to products of advanced geroscience such as effective geroprotector drugs, and eventually advanced rejuvenation biotechnologies. This progression would be financed by continuous investment in a continuously reinvigorated aging workforce, themselves equipped with access to advanced financial technologies ("fintech for the elderly"), operating via proposed novel financial systems. The overall vision is of a "longevity economy" powered by a longevity industry, run partly by and partly for the reinvigorated and rejuvenated eldery. In such a future, longevity becomes a source of economic dividends, and the tsunami is averted. This is a solution to the silver tsunami for which the components of a solution already exist. What remains is their optimal assemblage, which requires some government coordination. In order for the United Kingdom to play its role in this future at the present juncture, we make the following proposals:

Proposal to Create a Task Force to Establish a Minimum Required Budget and Blueprint for a National Longevity Development Strategy
Recommended List of Metrics for National Longevity Strategy
Establishment of Leading UK AI Centres for Longevity
Supporting Resources for Research and Development of Under-Represented Areas of Precision Medicine Including Advanced AI, Microbiome and Advanced Cosmetics
Establishment of Longevity Startup Accelerators
Establishment of London as International Longevity Financial Hub
Establishment of a Division for International Longevity Cooperation
Establishment of a Longevity Policy, Politics and Governance Conference Series During London Longevity Week
Establishing AI Centres for Lifetime Wellness (Financial Wellness, Continuing Education and Social Involvement)
Supporting the Development of Actionable, Implementable Panels of Ageing Biomarkers
Creating a Database of Relevant Partners and Counterparties for the Implementation of the UK National Healthy Ageing Industrial Strategy
Inputting Data, Analytics and Insights from Aging Analytics Agency's Upcoming "Comparative Analysis of Health-Adjusted Life Expectancy (HALE): Global Landscape Overview" Report
Proposal to Launch Task Force Focused on Initiatives to Reduce Psychological and Social Ageing
Proposal to Launch Task Force Focused on Roadmapping a Longer-term Strategy to Extend National Healthy Longevity Past 5 Years
Proposal to Establish Nation-Wide Network of Unmanned Preventive Diagnostics Booths
Upcoming Aging Analytics Agency Reports That Can Assist House of Lords in Future Longevity Projects
Proposal for Establishing a Division for the Identification of Sites for AI Centres for Longevity
Proposal for Establishing a Division for Cooperation Across Devolved Administrations
Proposal for Longevity Innovation Ecosystem Mapping for Regions Outside London
Proposal for Medical Education and Training Reforms: Prioritizing Prevention
Proposal for Responding to Recent Developments in the UK
Proposal for Establishing Financial Incentives for UK Insurance Companies and Pension Funds

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Introducing Aging Analytics Agency

Aging Analytics Agency is a leading provider of industry analytics on the topics of human longevity and what it terms the global "longevity industry". This it defines not merely as scientific research into aging and its diseases, but as a set of synergies between four sectors: geroscience research and development (including biomedical gerontology: the study of aging with a view to developing biomedical interventions, and rejuvenation biotechnology: the application of regenerative medicine to aging) P4 (personalized, precision, preventive, participatory) medicine, AgeTech (the emerging subset of the HealthTech sector that focuses on technology and innovation to improve the lives of older people), and longevity finance (consisting of a set of novel financial systems, specified at length in various of the company's documents). Every component of this industry is subject to analysis by Aging Analytics Agency as it evolves. AI, blockchain, digital health and their impact on the healthcare industry are also a major focus, and there has been a recent emphasises the role in government in integrating these technologies.

Our Vision

House of Lords Ageing: Science, Technology and Healthy Living Inquiry was correct to identify a global problem with economic and social consequences. This problem has two proximate consequences:

- A lack of productivity among the elderly working population.
- A lack of access to the basic resources necessary for a life of meaning and of dignity. Many others confront multiple barriers that prevent their full participation in society.

Here the committee has identified what is frequently referred to by financial publications globally as "the silver tsunami" or "grey tsunami" : the economic and social devastation soon to be inflicted by a global aging demographic.

Furthermore the committee is correct to identify the need for concerted government action as the next step.

Increased global longevity per se is a "problem of success", an inevitable consequence of sharp increases in sanitation, diet, health care, elderly care, and geriatric medicine, a set of changes which have occurred suddenly within the lifetimes of today's elderly.

We will not relinquish these gains, so what does the only logical alternative to the silver tsunami look like? In order to float rather than sink, Longevity must become an asset. And this means altering the nature of aging entirely, reducing the period of financially and socially inactive decrepitude at the end of life.

Specifically, it means utilizing technology to ensure that these longer lives are also healthy, productive, financially active lives, and creating a system of government frameworks and financial incentives to create and sustain this case of affairs.

Aging Analytics Agency foresees a future in which people alive today benefit from "low-hanging fruit" digital and biomedical technologies for facilitating longer, healthier working lives, which subsequently enable them to live to benefit from more advanced biotechnologies (such as those detailed below). The earlier biomedical innovations would consist of P4 medicine supported by data aggregated from advanced data infrastructures which include wearable devices. These would then give way to products of advanced geroscience such as effective geroprotector drugs, and eventually advanced rejuvenation biotechnologies. This progression would be financed by continuous investment in a continuously reinvigorated aging workforce, themselves equipped with access to advanced financial technologies ("fintech for the elderly"), operating via proposed novel financial systems (specified in detail in "*Advancing Financial Longevity Industry*").

The overall vision is of a "longevity economy" powered by a longevity industry, run partly by and partly for the reinvigorated and rejuvenated eldery. In such a future, longevity becomes a source of economic dividends, and the tsunami is averted.

This is a solution to the silver tsunami for which the components of a solution already exist. What remains is their optimal assemblage, which requires some government coordination.

Need for a national strategy

Government has two roles in moving the Longevity industry forward: national initiatives such as social care, financial reforms, and infrastructure for precision medicine ecosystems, and intergovernmental initiatives for marshaling key technologies, resources, and experts from nations around the world. Longevity development strategies are necessary on a national scale in order to enact these reforms, and necessary on an international scale to utilize the long term strengths of each individual state. Any government wishing to seize the Longevity Dividend must develop a national Longevity development strategy.

It is our position that the Longevity industry necessary to bring about [change in the previous section would necessarily be multi-faceted], consisting of Geroscience R&D (ranging from

geroprotector drugs to regenerative medicine technologies), P4 Medicine, AgeTech, and Novel Financial Systems.

Furthermore the role the financial industry has to play in the development of the global Longevity sphere is not to be underestimated.

It will be necessary for novel financial systems to be developed which monetize Healthy Longevity, and repeatedly reinvest in the technologically-reinvigorated working population, if they are to survive the silver tsunami. The opposing megatrends of aging population and advanced biomedicine are forcing the reform of business models for insurance companies, pension funds, banks, and investment firms, and opening up new opportunities around AgeTech, WealthTech, InsurTech and the rise of novel financial derivatives tied to the global Longevity Industry.

Aging Analytics Agency sees the United Kingdom, with its strong scientific base, its detailed industrial strategy which has 'aging society' as one of its central pillars, and its plans to integrate P4 medicine into its national healthcare system - as a potential international leader in Longevity governance.

Aging Analytics Agency's focus on government strategy

Aging Analytics Agency did not come to this conclusion lightly. Its recent major focus includes government development plans. The Agency is currently engaged with several government related organizations in their efforts to ensure that their strategic focus remains firmly on attaining synergy, and is keen to open dialogue with any Longevity-progressive governments in the formulation of their metrics for success. The Agency is also keen to engage in dialogue on the matter of cross-country and international coordination. And in early 2019, Eric Kihlstrom, former Director of the UK Government-led £98 Healthy Aging Industrial Strategy Challenge Fund, was appointed as the Agency's new Director.

The Agency has developed open-access and proprietary analytics on the topic of government-led National Longevity Development Plans. The focus is on specific social policy, healthcare, financial reforms, and socioeconomic factors that are most likely to enable governments to develop integrated Longevity industries and ecosystems to scale, and to help them reduce their national gap between life expectancy and Health-Adjusted Life Expectancy (HALE). The most recent report, National Longevity Development Plans: Global Overview 2019 was presented at the inaugural APPG for Longevity Advisory Board Meeting, and distributed at the APPG's official launch event.

Aging Analytics Agency's prioritization of Longevity policy and politics analytics coincides with an explosion of disconnected government initiatives around the world, each attempting

to address the demographic challenges of aging population in its own unique way, each of which is documented in the report. The Agency's strategy is to harness the rise of Longevity-focused political initiatives to maximum synergetic effect.

The initiatives documented in the report are currently uncoordinated across the globe. The Agency recommends coordinated development of national and international Longevity development plans to those nations ranking highest in terms of the strength, relevance, and proactivity of their current Longevity initiatives.

Later this year, the Agency intends to publish an in-depth follow up to its National Longevity Development Plans report which will analyze the specific social, healthcare, financial and socioeconomic factors contributing to the gap between life expectancy and HALE for 50 countries. We also plan to publish Longevity in UK Cross-Sector Comparative Analysis: Special Case Study that will utilize quantitative analytics to consider the most optimal, synergetic, and effective methods of increasing the UK's National Healthy Longevity.

Aging Analytic Agency's Parliamentary Involvement

On April 30th, 2019, Dmitry Kaminskiy (Founder of Aging Analytics Agency and Co-Founder and Head of International Development for Longevity International UK) and Eric Kihlstrom convened with parliamentarians, policy directors and researchers at the UK Houses of Parliament for the inaugural meeting of the All-Party Parliamentary Group (APPG) for Longevity to discuss key goals and strategic agenda for the coming year, where the government report was presented.

Aging Analytics Agency has already submitted a 100-page proposal to the APPG for Longevity that outlined its recommendations on how to optimize the formulation of the group's existing Blueprint and Framework, and to achieve maximum synergy and practical effects. Some of the major key points from that proposal included:

- The formation of a task force of experts to analyze and project the minimum estimated budget for the UK National Longevity Development Strategy in a realistic manner, considering that the practical threshold for the successful implementation of national Longevity industrial strategy in case of UK could not be less than £40 billion annually.
- Emphasis on international cooperation with other Longevity-progressive countries in the development of the Blueprint for a National Healthy Aging Industrial Strategy, seeking maximum synergy between the UK's Longevity strategy on the one hand and its AI Industrial Strategy on the other, given the substantial accelerative effect that AI brings to advanced biomedicine and practical applications (P4 Medicine)
- The creation of a database of relevant partners and counter parties to be involved in the implementation of the strategy

- Incorporating the use of maximally-relevant metrics for measuring Healthy Longevity, and specifically for measuring the effectiveness of its initiatives by examining their cost versus the practical effect they can achieve in terms of increasing national Healthy Longevity. In response to these concerns, Aging Analytics Agency has compiled a comprehensive list of metrics and parameters with specific weight factors. This can serve as an excellent foundation upon which relevant governmental bodies and authorities can structure the list of metrics it will be using to judge both where it stands in terms of its National Healthy Longevity currently, as well as to measure the real-world effectiveness of its Industrial Strategies for Healthy Longevity as they move forward and develop.
- The formation and development of multiple AI Centers for Longevity in key R&D, academic, industrial metropolitan centers throughout the UK, such as Birmingham, Liverpool and Edinburgh, modeled on the recent precedent of the multiple Centers for AI and Healthcare across the UK.
- The establishment of multiple Longevity Startup Accelerators in London and other major regional industry-academic hubs.
- The development of a task force and working group to structure and roadmap a UK Division for International Longevity Cooperation. This division would focus on the establishment of industrial and technological bridges between the UK and other Longevity-progressive regions such as Israel, Singapore, Switzerland and the USA, and would also focus on the establishment of intergovernmental initiatives that would leverage the key strengths of different nations in order to launch programs that yield synergistic, multiplicative effects, enabling the sharing of key technologies, resources and experts.
- An initiative for establishing embassies with UK ambassadors present in different Longevity-progressive regions to liaison with local government officials, startups, researchers and R&D hubs

Aging Analytics Agency would like to thank House of Lords Science and Technology Committee for their inquiry and the opportunity to present our strategy advice direct to Parliament.

Aging Analytics Agency's Strategic Advice

In light of House of Lords and Science and Technology Committee's call for evidence, we have assembled a document containing some key points and ideas, on behalf of Aging Analytics Agency and Biogerontology Research Foundation, regarding the roadmapping of

several relevant projects and initiatives for transforming the problem of an ageing population into an opportunity for Healthy Longevity and provide maximum benefit to all UK citizens.

The present document first summarises the key points of each separate proposal in an executive summary, and then gives a more comprehensive overview of each proposal in the corresponding section of the extended document. Generally speaking, the proposals set forth in this document collectively aim to sharpen the focus of government in addressing these recognised challenges in a number of key ways which include:

- Determining a realistic budget that can realistically attain the goals it has set out to achieve (while simultaneously decreasing overall spending on health care and social care by decreasing the economic burden of ageing population and increasing GDP by keeping citizens working for longer periods of time).
- Initiating the necessary projects required to make the UK both a world-leading Precision Medicine hub, as well as a Longevity Financial Hub, through the coordinated development of its Longevity and Longevity Finance Industries.
- Utilizing advancements in AI and data mining, analysis and management in order to optimize and strengthen both the health and the wealth of its citizens, giving them not only extra years of healthy life, but also the tools necessary to remain financially stable over them.
- Giving due consideration to methods of growing its Longevity economy to scale through prioritized support programs, accelerators, etc. for Longevity Startups and Longevity Investors

Overall, the sum of these proposals is intended to make it clear that in order to be successful in the goals it has set out to achieve, Parliament needs to be both bold and realistic, and willing to set out both timeframes and budgets for its Blueprint for a National Healthy Longevity Development Strategy that are commensurate to both the size of its goal, to the level of boldness needed to win the confidence of both the public and key strategic partners and other stakeholders, and to the level of importance that this goal represents in terms of a key national priority agenda item for the state - treating it of equal if not greater importance and required scale as the USA's Manhattan project or Apollo Space Program. The UK stands at a crossroads, with limited time to act within its current window of opportunity, and can either sink of swim against the tide of the oncoming Silver Tsunami depending upon how actively and proactively it allocates strategic resources to the issue of ageing population and the opportunity of Healthy Longevity.

Foreword to the Proposal

"The UK is very well positioned to become an international leader of Healthy Longevity, and was ranked #1 in this report's proprietary analysis for a number of reasons including its reputation as a BioTech R&D and Financial Hub, a strong history of industry-academia partnerships focusing on scientific and technological synergies, and its commitment of £300 million to its Ageing Population Industrial Grand Challenge. The nation has all necessary

compounds in place to leverage and channel its existing strengths into an efficient, Government-led campaign to make the promotion of Healthy Longevity and financial reform to neutralize the economic burden of an aging population a key priority of its national strategic agenda. " ~ Dmitry Kaminskiy, commenting on the conclusions of Aging Analytics Agency's analytical report National Longevity Development Plans: Global Overview 2019 (First Edition)

The Longevity Industry has reached a point where the politics surrounding the sector has become one of the most important factors on which its future depends. This naturally means that concerted efforts to analyse, optimise and synergise government-led Longevity development plans and related efforts is more important than ever before, and may very well determine the shape, rate and trajectory of the industry's further development in the years to come.

But what precisely **is** the role of government in moving Longevity forward?

- **National initiatives**: Government is responsible for driving forward the development of many facets of the Longevity industry ranging from social care to the financial reforms described in this series' previous article, and also in developing and supporting the missing technological synergies, such as the integration of big data and healthcare, that currently serve as roadblocks for further industry growth. As one such example, in Switzerland the heterogeneity of health data infrastructures has delayed the development of a nationwide personalised health ecosystem as compared to countries with more homogenous national health systems. But a government strategy could and should be developed for rectifying this, and government could also intensively develop its geroscience, precision medicine and FinTech to a state so advanced that it propels Switzerland into a central role in the internationally competitive Longevity business ecosystem, where it can rise to become a global leader in the specific field of Longevity finance.

- **International initiatives:** It is necessary for leading Longevity-progressive nations to establish intergovernmental initiatives that would leverage key strengths of different nations in order to launch programs that yield synergistic, multiplicative effects, enabling the sharing of key technologies, resources and experts.

Aging Analytics Agency has therefore been adapting its approach accordingly, beginning with recent enhancements to its executive management team, such as the appointment of Eric Kihlstrom, former Director of the UK Government-led £98 Healthy Ageing Industrial Strategy Challenge Fund, as its new Director.

The need for Eric Kihlstrom's strategic skill set in the digital transformation of industry reflects perfectly the immediate need for a major transformation of the Longevity industry at

its present juncture. Kihlstrom is a former Digital Transformation Strategy Director with 30+ years of delivering impactful innovation to multinational corporations as well as rapid growth start-ups. He helped to pioneer the disruption of the telecoms industry in the nineties and continues to deliver transformation via people-centred, analytics based innovation. He now works across industry, Government, 3rd sector and academia to unlock opportunities that come with demographic changes.

Aging Analytic Agency has always viewed the UK government's stated commitment to adding 5 extra years to UK national HALE as more than feasible, and well within the limits imposed by the current rate and state of scientific and technological innovation.

According to Aging Analytics Agency's industry analysis, the biomedical technologies and therapies necessary to meet this goal are already in place, and what is now needed is big data analytics to develop optimal panels of biomarkers of aging and to determine what preventive medicine technologies are effective.

Progress hereafter is less of a biotechnology problem (which requires us to wait on biotech breakthroughs), and more of a data mining, analysis and management problem. This, in turn, makes it a government problem to some extent, as only government-led initiatives would be capable of providing the necessary infrastructure for such a project on a national level.

An essential companion document to this proposal document is Aging Analytics Agency's 2019 report National Longevity Development Plans: Global Overview 2019 (First Edition).

That report documents and assesses government initiatives in the hope of offering governments some idea of the building blocks available for the construction of what could become the world's first Longevity National Development Plan.

It gives special mention to the UK and illustrates how far the UK is already ahead of the game in this regard, and why is therefore the potential cradle of the fourth industrial revolution.

The chapter titled Infographic Summary identifies the broad categories of a government initiative to be considered: such as the different orders of magnitude, ranging from small municipal programs to national industrial strategies; and the different areas of intervention, from the financial to the biomedical.

This chapter also visualizes a number of data relevant to each country's current challenges and opportunities relating to Healthy Longevity and Aging Population, ranging from healthcare expenditure and efficiency, gaps between their Health-Adjusted Life Expectancy

(HALE) and standard life expectancy, projected dates of insolvency for state-funded pensions systems and social security systems, etc.

The chapter titled Report Methodology describes in detail the methods for evaluating various initiatives and ultimately ranking countries according to how close they come to executing actionable developments with a practical impact on the aging population. As such, our analysis also includes the final ranking of twelve countries according to the strength and relevancy of their Government-led aging and Longevity-related projects and initiatives, as well as their likelihood of achieving tangible deliverables such as increases in Healthy Longevity, and decreases in the economic burdens posed by aging populations.

Ranking Countries on the Strength, Scope and Relevance of their Government Longevity-Related Projects and Initiatives

POSITION	COUNTRY	COUNTRY SCORE
1	United Kingdom	5.29
2	Netherlands	4.36
3	Singapore	4.15
4	South Korea	4.00
5	Israel	3.94
6	Switzerland	3.93
7	Hong Kong	3.41
8	Japan	3.10
9	USA	3.07
10	Spain	1.94
11	European Union	1.88
12	China	1.85

Aging Analytics Agency's ranking of the strength, relevance and proactiveness of various countries government-led Longevity-related projects and initiatives.

The present document first summarises the key points of each separate proposal in an executive summary, and then gives a more comprehensive overview of each proposal in the corresponding section of the extended document. Generally speaking, the proposals set forth in this document collectively aim to assist House of Lords in working toward a National Healthy Longevity Development Strategy in a number of key ways:

- Determining a realistic budget proportional to the boldness of House of Lords' overall strategy, and that can realistically attain the goals it has set out to achieve (while simultaneously decreasing overall spending on health care and social care by decreasing the economic burden of ageing population and increasing GDP by keeping citizens working for longer periods of time).
- Initiating the necessary projects required to make the UK both a world-leading Precision Medicine hub, as well as a Longevity Financial Hub, through the coordinated development of its Longevity and Longevity Finance Industries
- Utilizing advancements in AI and data mining, analysis and management in order to optimize and strengthen both the health and the wealth of its citizens, giving them not only extra years of healthy life, but also the tools necessary to remain financial stable over them.
- Giving due consideration to methods of growing its Longevity economy to scale through prioritized support programs, accelerators, etc. for Longevity startups and Longevity investors

Overall, the sum of these proposals is intended to make it clear that in order to be successful in the goals it has set out to achieve, House of Lords needs to be both bold and realistic, and willing to set out both timeframes and budgets for a blueprint for a National Healthy Longevity Development Strategy that are commensurate to both the size of its goal, to the level of boldness needed to win the confidence of both the public and key strategic partners and other stakeholders, and to the level of importance that this goal represents in terms of a key national priority agenda item for the state - treating it of equal if not greater importance and required scale as the USA's Manhattan project or Apollo Space Program. The UK stands at a crossroads, with limited time to act within its current window of opportunity, and can either sink of swim against the tide of the oncoming Silver Tsunami depending upon how actively and proactively it allocates strategic resources to the issue of ageing population and the opportunity of Healthy Longevity.

Contents

- We propose the formation of a task force to analyze and project the minimum estimated budget for the National Longevity Development Strategy in a realistic manner.
- We, for example, estimate that the absolute minimum for such a strategy, considering the scope necessary to add five extra years of healthy life to UK citizens, be no less than 200 billion GBP spread across five years.
- While this may seem like a large sum, in reality it is very realistic considering the amount of money that can be saved by those 5 extra healthy years, both by saved healthcare expenditure in end-of-life care, and simply in terms of GDP by keeping citizens active members of the work force, rather than dependents, for an extra five years.

- Thus, the mindset that this should be approached from is not as an overall increase in total healthcare and social care spending, but rather a temporary increase that, if successful, should decrease overall sending over several years by a much greater degree than it increases spending in the short term - i.e., smart spending.
- It should also be stressed that while this may seem like a large proposed budget, besides the points above, this issue (of increasing national HALE) is of the upmost importance as a major (if not *the* most important) national agenda item for the state considering the economic burden it will face due to ageing population in the coming years. The time to act is now, if the UK does not want to miss its window of opportunity in the same way as Japan. This is of commensurate, if not greater, importance than other notable national priority items that received extremely large amounts of government funding, like the USA's Manhattan Project (to develop the A-Bomb) and Apollo Project (to land the first man on the moon).

Recommended List of Metrics for National Longevity Strategy

- In order to formulate a relevant, tangible and actionable framework and blueprint for a National UK Industrial Strategy for Healthy Longevity, House of Lords needs to incorporate the use of maximally-relevant metrics for measuring Healthy Longevity, and specifically for measuring the effectiveness of its initiatives by examining the cost of its initiatives versus the practical effect they achieve in terms of increasing national Healthy Longevity.
- Aging Analytics Agency compiled a comprehensive list of metrics and parameters with specific weight factors in order to conduct its analysis of national Longevity development plans in various regions globally. This can serve as an excellent foundation upon which House of Lords can structure the list of metrics it will be using to judge both where it stands in terms of its National Healthy Longevity currently, as well as to measure the real-world effectiveness of its National UK Industrial Strategy for Healthy Longevity as it moves forward and develops.
- Aging Analytics Agency is in a strong position to deliver key strategic insights into the analytical basis used during the formulation of House of Lords' blueprint for a National UK Industrial Strategy for Healthy Longevity

Establishment of Leading UK AI Centres for Longevity

- We propose that House of Lords establish a task-force on the formation of several leading AI Centres for Longevity, which will apply the latest advances in AI, Precision Health, Preventive Medicine and Biomarkers of Aging to accelerate the development of technologies, procedures and services to increase the UK's National Healthy Longevity.
- King's College London would be the logical choice of location for the first AI Centre for Longevity, due to their unique combination of resources, departments and technologies for both AI and Longevity. This should be established in 2019 and further developed in 2020. We are currently in dialogue with King's College on this specific topic.
- Following the successful development of this first AI Centre for Longevity, House of Lords should seek to establish additional centres in key R&D, academic, industrial metropolitan

centres throughout the UK, such as Birmingham, Liverpool and Edinburgh. The precedent for such an initiative has already been made through the establishment of key Centres for AI and Healthcare across the UK, thereby providing a proof-of-concept for this proposal.

Supporting Resources for Research and Development of Under-Represented Areas of Precision Medicine Including Advanced AI, Microbiome and Advanced Cosmetics

- We propose that House of Lords convene a working group to focus on ways to support under-explored niches in Precision Medicine which have a high degree of actionability and ease-of-implementation, but which are comparatively underrepresented in the larger R&D landscape.
- These niches include personalised microbiome diagnostics and therapeutics, as well as the application of microbiome approaches and AI to advanced cosmetics (including most importantly restoring the microbiome of the skin to its youthful state as an approach to treating wrinkles, skin dryness and dandruff).

Establishment of Longevity Startup Accelerators

- We propose that House of Lords launch a number of task forces and working groups to roadmap the development of several key initiatives to boost the development of the UK's Longevity industry, including:
- A working group for establishing Longevity Startup Accelerators in London and other major regional industry-academic hubs.
- A working group on establishing an Association of Longevity Angel Investors and Early-Stage VC Firms.
- A working group to propose measures that the UK Government can take to provide enhanced and prioritized support for Longevity charities and non-profits in order to boost the development of its Longevity scientific and academic ecosystem.
- While these three initiatives should share a certain degree of dialogue and interaction, we propose that distinct, non-overlapping task-forces oversee their development due to the differing agendas of these three types of entity (Longevity startups, investors and non-profits, respectively), to maintain an appropriate degree of independence and objectivity, so that the specific aims and interests of all three types of entity can be met to their maximum individual benefit.

Establishment of London as International Longevity Financial Hub

- We propose the formation of a task-force to develop a plan to turn the UK into a world-leading Longevity Financial Hub.
- The financial industry faces the oncoming collision of two opposed mega-trends: the ageing population and the extension of healthy Longevity. Specific forms of pension system reform can help combat the economic burden of ageing population, while the extension of national Healthy Longevity can help relieve the costs of ageing population on healthcare systems while providing growth to the UK's national economy.

- The development of novel financial products and services (including novel financial derivatives) can help large UK financial institutions transform 1 billion people on retirement globally from a problem into an opportunity.
- Part of these development efforts could take the form of the establishment of a Longevity Stock Exchange in London, with the aim of making IPOs for UK-based Longevity companies and providing them with appropriate amounts of investment, to enable an accelerated pace of development for the entire UK Longevity ecosystem.
- The UK already has key strengths as an international financial, banking and FinTech hub. If the nation leverages these strengths to work in conjunction with developments in its Longevity Industry, it could become the #1 leader globally in the Longevity Financial Industry.

Establishment of a Division for International Longevity Cooperation

- We propose that House of Lords establish a specific task force and working group for creating a dedicated governmental Division for International Longevity Cooperation.
- This division would focus on the establishment of industrial and technological bridges between the UK and other Longevity-progressive regions such as Israel, Singapore, Switzerland and the USA.
- This division would also focus on the establishment of intergovernmental initiatives that would leverage key strengths of different nations in order to launch programs that yield synergetic, multiplicative effects, enabling the sharing of key technologies, resources and experts
- This initiative should also involve establishing embassies with UK ambassadors present in different Longevity-progressive regions with "name-brand recognition" in those areas to liaison with local government officials, startups, researchers and R&D hubs.

Establishing AI Centres for Lifetime Wellness (Financial Wellness, Continuing Education and Social Involvement)

- We propose that House of Lords convene a task-force to create a roadmap for the establishment of AI Centres for Lifetime Wellness.
- Whereas the proposed AI Centres for Longevity would focus on optimizing health into old age, these centres would focus on optimizing the wellness of elderly individuals in all aspects of life besides health.
- The specific scope of these areas of life would include financial wellness, continuing education, psychological wellbeing, and social involvement and activity.
- These centres would serve as R&D hubs that apply AI, machine learning, big data analysis and other predictive analytical techniques to the vast quantities of financial and behavioural data on UK citizens currently being generated, in order to create products and services that optimize elderly wellbeing, financial wellness, overall activity, neuroplasticity and social involvement.

Supporting the Development of Actionable, Implementable Panels of Ageing Biomarkers

- While the state of geroscience in the UK is quite advanced, there is a visible lag in the specific development of biomarkers for ageing.
- Additionally, there is an even greater lag between the theoretical and academic work being done on this topic, and its translation into real-world, practical implementation and "market arrival".
- The past few years have seen a lot of progress in the development of biomarkers of ageing that are not as precise as the current leading methods, but that are precise enough, and most importantly, extremely easy to implement in practice - in particular, those based on deep-learning and AI-driven analysis of routine blood tests, and of photographs.
- Therefore, the development of easily-implementable and non-expensive panels of biomarkers of ageing will have a much greater real-world effect than the development of extremely precise or comprehensive biomarkers of ageing that are extremely expensive or difficult to implement in practice, such as DNA methylation clocks.
- We propose that formulation of an actionable, easily-implementable panel of ageing biomarkers, and the convening of a task-force for increasing government support for groups working on the development of practical, and implementable panels of biomarkers of ageing (scientists, companies, non-profits, etc).

Creating a Database of Relevant Partners and Counterparties for the Implementation of the UK National Healthy Ageing Industrial Strategy

- We propose that House of Lords initiate the development of a comprehensive database of partners and relevant counterparties who can potentially serve as partners for the execution of the UK Healthy Ageing Industrial Strategy Challenge Fund
- This database should be structured according to the specific roles that each different type of partner would eventually assume, according to exactly how they would be useful and relevant for the strategy's execution in practice.
- The creation of this database should be heavily prioritized as an urgent item, given that it is the first step toward choosing and engaging with the entities that will assist in the actual execution of the strategy.

Inputting Data, Analytics and Insights from Aging Analytics Agency's Upcoming "Comparative Analysis of Health-Adjusted Life Expectancy (HALE): Global Landscape Overview" Report

- Aging Analytics Agency is currently producing a comprehensive report that identifies the most critical healthcare and socioeconomic factors that result in their good or bad HALE rankings for various countries globally.
- This report will provide crucial insights into what specific items should be prioritized for a given country to efficiently and economically increase its national HALE ranking.

- We recommend that House of Lords use the data, analytics and conclusions from this report as part of the structuring of its Blueprint and Framework for a UK Healthy Aging Industrial Strategy.

Proposal to Launch Task Force Focused on Initiatives to Reduce Psychological and Social Ageing

- While the majority of House of Lords' practical plans to add five healthy years to UK citizens focuses mainly on preventive medicine, this kind of approach will yield diminishing returns when applied to th elderly.
- However, there is another scope of initiatives that can add extra healthy years to those already aged - namely, those aiming to reduce psychological and social ageing, which denotes the phenomenon of declining health due to loneliness and withdrawal from society in the elderly.
- Thus, we propose that House of Lords convene a task force to brainstorm a framework for initiatives aiming to reduce loneliness and increase psychological well-being and active participation in society for the UK's elderly demographic.
- By using this two-pronged approach, House of Lords can tackle the problem of adding extra healthy years of life for UK citizens from opposite ends, adding years of life for those middle-aged through preventive medicine, and adding years of life for the already-aged by combating social and psychological ageing.

Proposal to Launch Task Force Focused on Roadmapping a Longer-term Strategy to Extend National Healthy Longevity Past 5 Years

- As mentioned previously, the goal of adding five extra years of Healthy Longevity for UK citizens is completely doable using existing preventive medicine technologies. It does not require intensive of radical biomedical innovation, but the optimization of existing, known and validated technologies, and emulation of best practices in preventive medicine from other countries, like Singapore, with the smallest gaps between life expectancy and HALE.
- However, the extent with which such existing, optimized best practices can add extra healthy years to the lives of UK citizens is limited, and there will be a time when they will begin yielding diminishing returns.
- Meanwhile, following the successful addition of 5 extra years of healthy life, the question will naturally arise as to how additional years of HALE will be added. This will require more intensive innovations in advanced biomedicine and precision, personalized and preventive medicine.
- Thus, we propose that House of Lords convene a task force to begin roadmapping longer-term strategies, and prioritized support and financing of key biomedical technologies that can be quantitatively predicted as necessary for the later-stage extension of HALE in the years and decades following the achievement of increasing national HALE by 5 years.

Proposal to Establish Nation-Wide Network of Unmanned Preventive Diagnostics Booths

- We propose that House of Lords launch a task force to roadmap the launch of a nation-wide network of unmanned, AI-assisted preventive diagnostics booths.
- This is already being implemented across the nation in China by the company Ping An Doctor.
- By simply emulating the approach already being taken elsewhere, the nation can enable near-continuous monitoring of fluctuations in citizen's measures of health in a very economic manner.
- These booths would feature simple diagnostic functionalities including visual recognition, and possible blood and urine analysis, and would ideally be connected to the cloud computing system of the NHS to allow for more advanced forms of analysis based on these rather simple preventive diagnostic methods described above.
- It is important to note that this would not require intensive or extensive biomedical innovation, and in this sense can be considered as a simple data management problem.

Upcoming Aging Analytics Agency Reports That Can Assist House of Lords in Future Longevity Projects

- Aging Analytics Agency is working on a number of upcoming analytical reports that can provide essential information necessary for House of Lords' future activities, as well as some of the specific proposals put forth in this document. These include:
- "National Longevity Development Plans Global Overview (Second Edition)", which will provide tangible insight into how House of Lords can structure a Framework and Blueprint for a National UK Industrial Strategy for Healthy Longevity.
- 'Advancing Financial Industry - Longevity / AgeTech / WealthTech", which looks at developments at the intersection of Longevity and the Financial Industry, and can provide valuable guidance for developing the UK as a leading Longevity Financial Hub.
- "Precision Medicine Clinics Global Landscape Overview: Most Advanced Clinics, Technologies and Methods" can provide key strategic guidance on the establishment of leading UK AI Centres for Longevity, and assist in the specific structuring of the clinics technologies and methods.
- Aging Analytics Agency's recent regional case studies, including "Longevity Industry in Israel Landscape Overview 2019", "Longevity Industry in Singapore Landscape Overview 2019", and its upcoming "Longevity Industry in Switzerland Landscape Overview 2019", which deliver comprehensive overviews of the Longevity Industry, academic and political landscapes of key Longevity-progressive nations, which can be used to develop a strategy for international cooperation and the formation of technological, scientific and political bridges between the UK and these regions.

Proposal for Establishing a Division for the Identification of Sites for AI Centres for Longevity

- House of Lords should establish a division with the following tasks:

- Enumerating the tasks involved in the procedural pipeline of a P4 clinic.
- Identifying the characteristics of an ideal site, regarding King's College as currently optimal.
- Assessing the resources , facilities and infrastructure of each site.

Proposal for Establishing a Division for Cooperation Across Devolved Administrations

- The home nations of the United Kingdom are irregularly devolved, vary in the following policy areas relevant to the implementation of a national longevity development plan.
- House of Lords should establish a division for cooperation across devolved administrations.
- Such a group should identify when in the course of the above proposals any such issues threaten to arise, and what alliances would need to be formed if they are to be overcome.

Proposal for Longevity Innovation Ecosystem Mapping for Regions Outside London

- There are regions of the UK which are facility-rich but are also economically depressed and cannot serve as major sites of Longevity industry innovation. They cannot for example serve as sites for AI Centres for Longevity, in their current state.
- A Longevity innovation ecosystem can be established in these areas, whereby resources are optimally assembled for the strategic purposes described in this document.
- In order to achieve the optimal strategic mobilisation of existing resources, an analysis is required. We could offer to create a snapshot of these regional economies, their sectors and subsectors, in 2019. We would do this by utilising the customary style of our previous reports, using infographics to illustrate data consolidated from public databases and diverse online sources.

Proposal for Medical Education and Training Reforms: Prioritizing Prevention

- P4 medicine has the potential to improve patient care, and provider performance, by helping clinicians make decisions based on vast quantities of data and patterns.
- But doctors and nurses will need to be properly re-trained. Doctors currently are not trained with the idea of prevention and maintenance of an optimal state of health in mind. They are only taught how to treat disease when it has already developed - in other words, sick care.
- Medical schools around the world are increasingly aware of this need and many institutions are beginning to develop courses to enhance physician understanding of genomics.
- Rapid technological change in the UK will require such retraining and rethinking of the roles of clinicians
- The following steps should be taken to support and encourage this culture shift in the United Kingdom: 1) Work to prepare the national education system, at a secondary

and tertiary level, for a P4 future, 2) advise fundamental reforms that prioritize preventive treatment in UK medical schools, 3) liaise with organisations such Health Education England (HEE), in order to prepare for retraining, as P4 precision medicine advances.

Proposal for Responding to Recent Developments in the UK

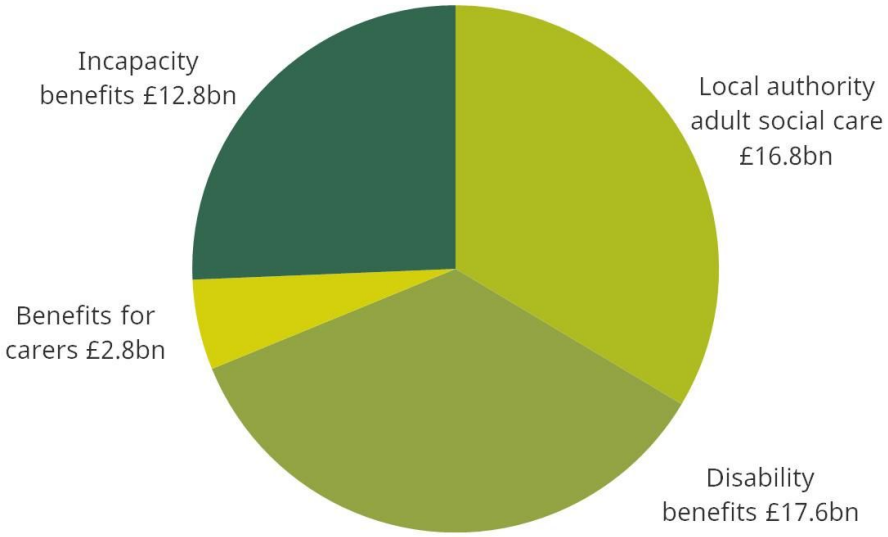
- Aging Analytics Agency recommends that House of Lords strategise for the most probable alterations to existing industrial strategy arising from political conditions. This strategy should begin with an assessment of the proposed industrial strategy of rival political parties to the government, in particular the Labour Party and Liberal Democrats, and an assessment of various possible future relationships with the EU.
- In the midst of Brexit, House of Lords should support advocacy groups such as the Royal Society in calling for an arrangement with the EU that: Keeps highly-skilled scientists working in the UK and ensures that international talented people still choose to come to the UK and contribute to our globally competitive science, keeps access to money and networks that support the UK to work with scientists around the world, maintains regulatory alignment that allows access to new medicines and technologies.

Proposal for Establishing Financial Incentives for UK Insurance Companies and Pension Funds

- Some countries with the lowest gap between HALE and unadjusted life expectancy, like Singapore, have a life insurance industry ecosystem where major life insurance providers give their clients a number of incentives for maintaining healthy lifestyles and meeting certain preventative health goals.
- The creation of an infrastructure and ecosystem that delivers financial incentives for remaining healthy (AKA, which delivers citizens wealth for retaining health) is a logical bottom-up solution for incentivizing populations to remain healthy for longer periods of time
- House of Lords should consider implementing a proposal to the UK government that offers financial incentives such as tax-breaks and subsidies to life insurance companies that provide similar financial incentives (e.g. discounted insurance premiums) for maintaining specific thresholds of preventive health and for meeting specific health goals, as part of their National Healthy Longevity Industrial Strategy.
- In coordination with this project, House of Lords should also convene a working group to roadmap the use of standardized panels of biomarkers of aging as the main tools for measuring the current state of health of life insurance clients, to be implemented in the next 2-3 years, where additional financial incentives are given to those clients willing to utilize such panels of biomarkers to validate their current state of preventive health in order to redeem discounted insurance premiums.

Proposal to Create a Task Force to Establish a Minimum Required Budget and Blueprint for a National Longevity Development Strategy

- We propose the formation of a task force to analyze and project the minimum estimated budget for the National Longevity Development Strategy in a realistic manner.
- We, for example, estimate that the absolute minimum for such a strategy, considering the scope necessary to add five extra years of healthy life to UK citizens, be no less than 200 billion GBP spread across five years.
- While this may seem like a large sum, in reality it is very realistic considering the amount of money that can be saved by those 5 extra healthy years, both by saved healthcare expenditure in end-of-life care, and simply in terms of GDP by keeping citizens active members of the work force, rather than dependents, for an extra five years.
- Thus, the mindset that this should be approached from is not as an overall increase in total healthcare and social care spending, but rather a temporary increase that, if successful, should decrease overall sending over several years by a much greater degree than it increases spending in the short term - i.e., smart spending.
- It should also be stressed that while this may seem like a large proposed budget, besides the points above, this issue (of increasing national HALE) is of the upmost importance as a major (if not *the* most important) national agenda item for the state considering the economic burden it will face due to ageing population in the coming years. The time to act is now, if the UK does not want to miss its window of opportunity in the same way as Japan. This is of commensurate, if not greater, importance than other notable national priority items that received extremely large amounts of government funding, like the USA's Manhattan Project (to develop the A-Bomb) and Apollo Project (to land the first man on the moon).



Source: Institute of Fiscal Studies

Just as House of Lords needs to be bold in its vision for the specific timelines of its blueprint and framework for a national UK Longevity development strategy, it also has to be reasonably and realistically bold in terms of its proposed funding levels for that strategy.

We, for instance, feel that, given the scope of treatment necessitated in order to raise the national HALE by 5 years (e.g., considering a population size of 67 million, intensive preventive medicine measures will need to be applied to at least 10 million people aged 40-60, along with measured to reduce psychological and social ageing for another 10 million citizens aged 60+), the total estimated budget should be no less than 200 billion GBP spread over 5 years. If a total budget any less than this is applied, it is bound to lead to no practical effects in terms of raising HALE.

Considering that the UK's total healthcare expenditure was 191 billion in 2016, plus tens of billions on social care (under which many of the measures aimed at reducing psychological and social ageing for the elderly demographic would fall under the scope of), while this may seem like an egregious amount of spending, when considered as a percentage of the total spending on health and social care, spread over five years, it should seem quite realistic.

And, in fact, the entire idea is not simply to increase total spending, but to spend this portion of the total health and social care budget in a highly optimized way in order to reduce the total healthcare spending over several years by substantially reducing the amount of spending toward ineffective end-of-life care and on ineffectively treating age-related diseases. Furthermore, the effective implementation of this strategy will also deliver positive economic benefits including an overall increase in GDP by keeping citizens actively working (and thus also paying taxes) for additional years, thereby both saving costs and increasing overall GDP simultaneously.

Furthermore, it should be stressed again that the extension of national Healthy Longevity is one of the most pressing issues for the state considering the looming economic risks posed by ageing population, and the incredible sum of money that the UK stands to lose in the face of the oncoming SIlver Tsunami. Furthermore, it is not only an issue of supreme national importance, but also an extremely pressing one, given that if the UK does not act to neutralize the effects of ageing population soon, it will lose its window of opportunity, in much the same way that Japan did by failing to act fast enough.

Meanwhile, in practice, there are a number of ways in which the total size of this budget could be left unchanged while reducing the total percentage being covered by the UK government itself. For instance, a large portion of the budget could potentially be covered through private investments by corporate partners, much in the same way as was done for the government's AI Industrial Strategy Grand Challenge Fund.

Recommended List of Metrics for National Longevity Strategy

There are a great many possible metrics which could be used to reliably measure global Healthy Longevity. The metrics presented here however, and expanded upon in Aging Analytics Agency's "National Industrial Strategy Development Plans Global Overview 2019" (First Edition), are specially selected for their relevance in assessing the tangible effects of government initiatives on the Healthy Longevity of each nation's population.

- In order to formulate a relevant, tangible and actionable framework and blueprint for a National UK Industrial Strategy for Healthy Longevity, House of Lords needs to incorporate the use of maximally-relevant metrics for measuring Healthy Longevity, and specifically for measuring the effectiveness of its initiatives by examining the cost of its initiatives versus the practical effect they achieve in terms of increasing national Healthy Longevity.
- Aging Analytics Agency compiled a comprehensive list of metrics and parameters with specific weight factors in order to conduct its analysis of national Longevity development plans in various regions globally. This can serve as an excellent foundation upon which House of Lords can structure the list of metrics it will be using to judge both where it stands in terms of its National Healthy Longevity currently, as well as to measure the real-world effectiveness of its National UK Industrial Strategy for Healthy Longevity as it moves forward and develops.
- Aging Analytics Agency is in a strong position to deliver key strategic insights into the analytical basis used during the formulation of House of Lords' blueprint for a National UK Industrial Strategy for Healthy Longevity

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

During the production of Aging Analytics Agency's "National Industrial Strategy Development Plans Global Overview 2019 (First Edition), we compiled a comprehensive list of metrics that were used to assess the relevance and effectiveness of various government-led Longevity initiatives. As part of the development of the Blueprint and Framework for a UK National Longevity Development Plan, we propose that House of Lords put special emphasis on a specific set of the most important metrics, listed below, as a means of measuring the practical effectiveness of the execution of that plan. Specifically, we recommend that they give highest emphasis to the following 9 metrics:

(CAGR = Compound Annual Growth Rate)

1. **Health expenditures per capita (current US$), CAGR (5 years)**
2. **HALE, CAGR (5 years)**
3. **Healthcare efficiency score, CAGR (5 years)**
4. **HALE CAGR (5 years) / Health expenditures per capita (current US$), CAGR (5 years)**
5. **Number of people 65+ employed CAGR (5 years) / Health expenditures per capita (current US$), CAGR (5 years)**
6. **Life expectancy CAGR (5 years) vs. Health expenditures per capita (current US$), CAGR (5 years)**
7. **HALE vs. life expectancy**
8. **Healthcare expenditures vs. Government spending**
9. **Budget of initiatives vs. healthcare expenditures**

In addition to these, we have compiled an extended list of metrics, indexes and ratios which should be taken into account when measuring the effectiveness of the execution of a National Longevity Development Plan, and in making adjustments on an ongoing basis in order to improve the effectiveness of its execution.

One point of note however: In the section entitled "Major Points and Issues to be Addressed in the Formulation of the Blueprint and Framework for a UK Healthy Ageing Industrial Strategy" we portray progress in the area of Longevity as more a data aggregation problem than a technological progress problem.

This point, however, only pertains to precision medicine as applied to young people. For those who have already aged, Healthy Longevity is influenced by much less well documented psychological factors, also known as "social aging". This is a combination of physical and psychological factors (many of which amount to the traditional notion of the "will to live", and the psychosomatic effects of retirement, loss of friends and loved ones, and withdrawal from active participation in society) which have diverse causes and diverse outcomes. There is also a notable link between psychological / social ageing and alcoholism, which is a particularly relevant issue for the UK.

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While initiatives aiming to reduce psychological and social ageing is not currently considered as a core part of Longevity agenda, but it should be, because it is a very significant issue. In fact, it can enable a combined approach whereby extra healthy years are added in the case of middle aged citizens through preventive medicine approaches, whereas extra healthy years are added in the case of elderly citizens through initiatives aiming to reduce psychological and social ageing by improving psychological wellness, increasing active participation in society, and reducing loneliness for those aged 60+.

There are already government initiatives around the world focused on improving the psychological health and wellness and boosting the "mental youth" of the elderly, which may play a role in allowing them to live long enough to enjoy the eventual fruits of accelerated progress in precision medicine.

The impact of government initiatives on the psychological wellbeing of the elderly therefore deserves to be among House of Lords' core panel of metrics, and already features heavily in "National Industrial Strategy Development Plans Global Overview 2019" (First Edition).

1. Absolute values

Metric	**Importance Factor**
Total number of initiatives	0.2
Number of initiatives that involve preventive medicine	0.4
Number of initiatives involve geroscience	0.4
Number of initiatives that involve AgeTech	0.1
How long ago a country began implementing relevant initiatives	0.15
Absolute amount of capital committed to projects and initiatives (US$)	0.5
How much absolute capital was committed to preventive medicine	0.3
How much absolute capital was committed to geroscience R&D	0.3
How much absolute capital was committed to AgeTech	0.1
Number of WHO age friendly cities and communities	0.05
Degree of govt industrialisation of longevity. Industrial Strategy, National Master Plan, Independent or Municipal Government Programs	0.1

Social Security Insolvency	-0.35
Population 60+ y.o.	0.025
Total # retired	-0.05
Early retirement age, Women	0.05
Early retirement age, Men	0.05
Normal retirement age, Women	0.05
Normal retirement age, Men	0.05
Both sexes life expectancy	0.1
Male life expectancy	0.05
Female life expectancy	0.05
Healthy life expectancy (HALE)	0.1

2. Indexes

Metric	**Importance Factor**
Healthcare efficiency Score	0.05
The Healthcare Access and Quality Index (HAQ)	0.05
Melbourne Mercer Global Pension Index, Overall Value Index	0.05
Melbourne Mercer Global Pension Index, Sustainability	0.05
Melbourne Mercer Global Pension Index, Adequacy	0.05
Melbourne Mercer Global Pension Index, Integrity	0.05
Inclusive Development Index Score	1

3. Ratios

Metric	**Importance Factor**
Population 60+ (% of total)	0.01

Health expenditure (% of GDP)	0.01
Health expenditure per capita current PPPs (US$)	0.01
DALY rate per 100 000 population	-0.01
Aged over 65 (% of total)	0.01
Age dependency ratio	-0.01
Retired people proportion (% of total)	-0.01
Employed 55–59 y.o., (% of total)	0.01
Employed 60–64 y.o., (% of total)	0.15
Employed 65-69 y.o., (% of total)	0.15
Employed 70-74 y.o., (% of total)	0.15
Employed 75+ y.o., (% of total)	0.15
Senior poverty ratio 66+ y.o.	-0.01
Budget of initiatives / healthcare expenditures	0.1
Budget of initiatives / GDP	0.1
Budget of initiatives / Inclusive Development Index Score	0.15
Budget of initiatives / Government spending	0.1
Healthcare expenditures / Government spending	0.05
Healthcare expenditures / GDP per capita	0.05
HALE / life expectancy	0.1

4. Growth rates

Metric	**Importance Factor**
Both sexes life expectancy, CAGR* (5 years)	0.01
Male life expectancy, CAGR (5 years)	0.01
Female life expectancy, CAGR (5 years)	0.01

HALE, CAGR (5 years)	0.1
GDP per capita, current prices, CAGR (5 years)	0.005
GDP per capita, PPP, CAGR (5 years)	0.005
GDP, current prices, CAGR (5 years)	0.005
Average growth of rate of people in the workforce	0.3
Rate of population aging (rate of increase 65+ y.o., 10 years)	0.01
Health expenditures per capita (current US$), CAGR (5 years)	0.01
Healthcare efficiency score, CAGR (5 years)	0.01
Number of people 65+ y.o. employed, CAGR (5 years)	0.1

*CAGR = (value in the most recent year / value 5 years before)^(⅕)-1, where 5 is the number of years between the start and finish values.

5. Growth rates of ratios

Metric	**Importance Factor**
Aged over 65, CAGR (5 years)	0.01
65+ y.o. population growth / population growth, CAGR (5 years)	0.05
Healthcare expenditures per capita, CAGR (5 years)	0.05
Healthcare expenditures per capita / Government spending, CAGR (5 years)	0.05
Healthcare expenditures / GDP per capita, CAGR (5 years)	0.05
HALE / life expectancy, CAGR (5 years)	0.05
Age dependency ratio, CAGR (5 years)	-0.01

6. Effectiveness ratios

Metric	**Importance Factor**
HALE CAGR (5 years) / Health expenditures per capita (current US$), CAGR (5 years)	0.2

Number of people 65+ employed CAGR (5 years) / Health expenditures per capita (current US$), CAGR (5 years)	0.2
Life expectancy CAGR (5 years) / Health expenditures per capita (current US$), CAGR (5 years)	0.2
Life expectancy CAGR (5 years) / GDP per capita, AAA, CAGR (5 years)	0.2

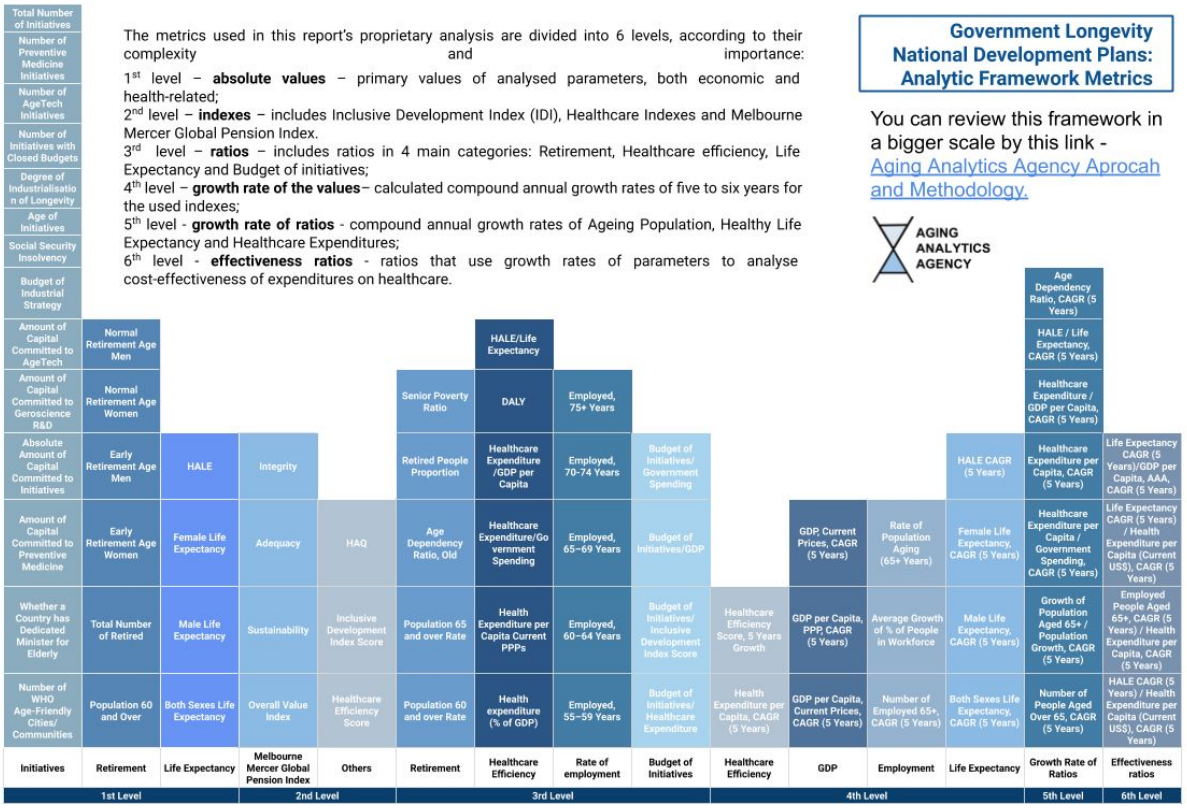
A more detailed explanation of the logic and methodology used during the composition of these metrics (and the aggregation of associated data) is given below.

Metric Values: Each metric`s absolute value is recalculated into the *Relative Score* within the range [0.0-1.0]. To be more specific, if a metric is numeric, the formula for *score* calculation is the absolute value of a country divided by the maximal absolute value among the countries. If a metric is qualitative (yes/no), a value "yes" equals to 1.0 and a value "no" equals to 0.0.

The qualitative metric "Degree of government industrialization of longevity" has 3 values according to the industrialization of Longevity in a country: *Industrial Strategies* (equals to 1.0); *National or metropolitan master plans* (equals to 0.5); *Independent or municipal government programs* (equals to 0.0).

Importance Factors: To normalise each metric in terms of significance among others the *Importance Factors* are applied. Each *Importance Factor* is in the range from -1.0 to 1.0, where 1.0 - the most favorable metric, -1.0 - the most detrimental metric and 0,0 - not an important metric at all (if the factor is negative, the higher positive magnitude of *Relative Score*, the worse for a country's score). The *Weighted Score* of a country for a particular metric is *Relative Score* multiplied by an *Importance Factor*.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry



The metrics used in this report's proprietary analysis are divided into 6 levels, according to their complexity and importance:

1st level – **absolute values** – primary values of analysed parameters, both economic and health-related;

2nd level – **indexes** – includes Inclusive Development Index (IDI), Healthcare Indexes and Melbourne Mercer Global Pension Index.

3rd level – **ratios** – includes ratios in 4 main categories: Retirement, Healthcare efficiency, Life Expectancy and Budget of initiatives;

4th level – **growth rate of the values**– calculated compound annual growth rates of five to six years for the used indexes;

5th level - **growth rate of ratios** - compound annual growth rates of Ageing Population, Healthy Life Expectancy and Healthcare Expenditures;

6th level - **effectiveness ratios** - ratios that use growth rates of parameters to analyse cost-effectiveness of expenditures on healthcare.

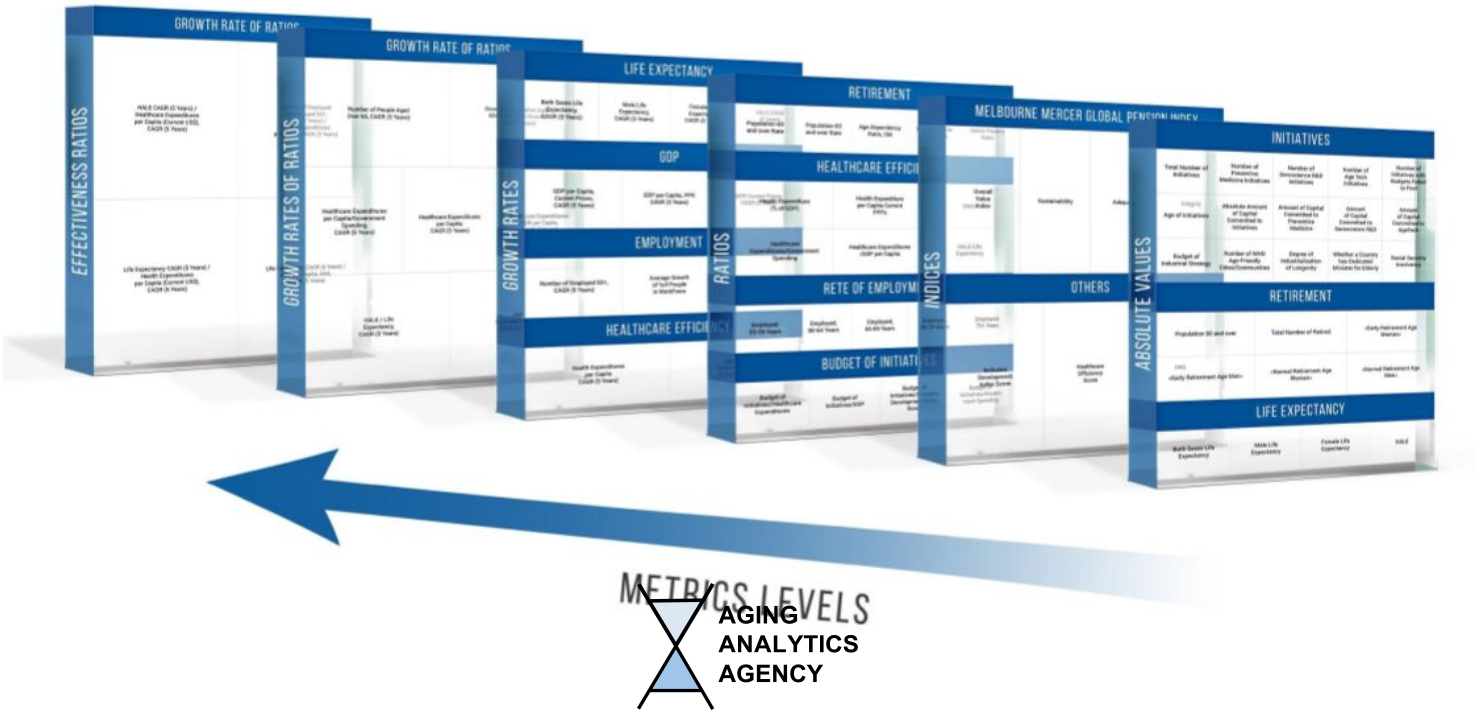
Government Longevity National Development Plans: Analytic Framework Metrics

You can review this framework in a bigger scale by this link - Aging Analytics Agency Aprocah and Methodology.

AGING ANALYTICS AGENCY

Establishment of Leading UK AI Centres for Longevity

Summary:



- We propose that House of Lords establish a task-force on the formation of several leading AI Centres for Longevity, which will apply the latest advances in AI, Precision Health, Preventive Medicine and Biomarkers of Aging to accelerate the development of technologies, procedures and services to increase the UK's National Healthy Longevity.
- King's College London would be the logical choice of location for the first AI Centre for Longevity, due to their unique combination of resources, departments and technologies for both AI and Longevity. This should be established in 2019 and further developed in 2020. We are currently in dialogue with King's College on this specific topic.
- Following the successful development of this first AI Centre for Longevity, House of Lords should seek to establish additional centres in key R&D, academic, industrial metropolitan centres throughout the UK, such as Birmingham, Liverpool and Edinburgh. The precedent for such an initiative has already been made through the establishment of key Centres for AI and Healthcare across the UK, thereby providing a proof-of-concept for this proposal.

We propose that House of Lords support the establishment of the first AI Centre for Longevity (Preventive Medicine and Biomarkers of Aging) at Kings College in 2019, along with its further development in 2020. It is an optimal location for this purpose because it has dedicated divisions and resources both for AI and for Longevity. Furthermore, being located in London, it is in an ideal physical location to engage in cross-sector and industry-academic collaboration.

We also recommend that House of Lords use this first centre as a case study to quantitatively assess the feasibility and practicality of using it as an example for the later establishment of four leading AI Centres for Longevity across the UK in key metropolitan, industrial and academic R&D hubs (such as Liverpool, Birmingham and Edinburgh), in much the same way that the UK has supported the development of 4 Centres for AI in Healthcare.

Currently, there are only 3 centres in the world actively trying to establish a leading AI Centre for Longevity. These include the US-based Buck Institute for Research on Aging, US-based Y Combinator, and the US-Hawaii AI Precision Health Institute, while only the latter has actually succeeded in establishing such a centre in practice. If the UK were to work toward the establishment of such centres in a proactive manner, the nation could leverage its existing resources, including its very well-developed AI industry and its reputation for extremely strong industry-academic-governmental cooperative initiatives, to become the #1 global hub for AI Centres for Longevity.

House of Lords should also take into consideration the possibility of using these existing Centres for AI in Healthcare as a basis and foundation for these three additional proposed AI Centres for Longevity, building upon their existing resources and accomplishments to more efficiently and economically develop these centres - but only in the event that such centres have existing assets and resources not only in AI, but also in the science of Longevity, which is what makes King's College an ideal hotspot for establishing the first such a centre (i.e., due to the constellation of both AI and Longevity expertise, divisions and resources).

By the beginning of July 2019, we will submit additional, more comprehensive materials on this specific matter on behalf of King's College, with whom we are currently in discussions on this prospect.

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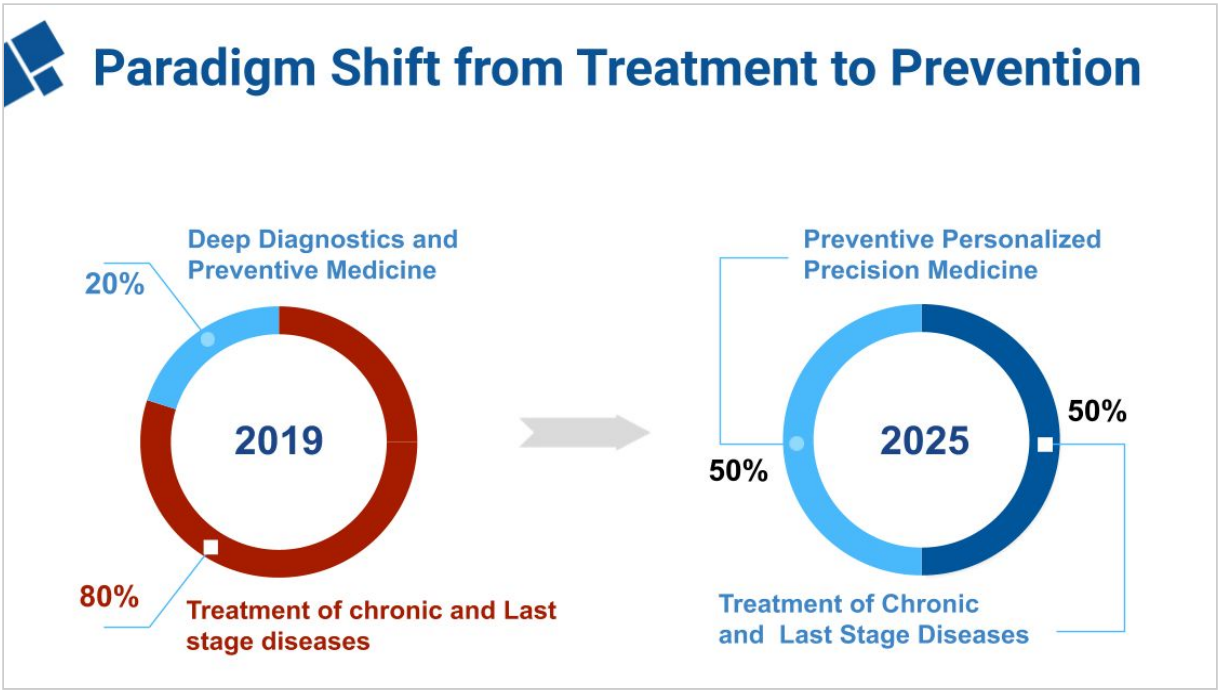


This would have strong emphasis on AI-driven personalized preventive diagnostics, prognostics and therapeutics. The main concept of precision medicine is providing health care which is individually tailored on the basis of a person's genes, lifestyle and environment.

With the advances in genetics, artificial intelligence and the growing availability of health data, present an opportunity to make precise personalized patient care a clinical reality.

The use of artificial intelligence in precision medicine is a revolutionary new approach to advancing health and wellness, knowledge, and data-driven health care delivery to maximize the quality of life for all over a lifetime.

Precision medicine with its DNA sequencing, high-tech diagnostic tests, and individually targeted therapies might be significantly less costly than conventional approaches.

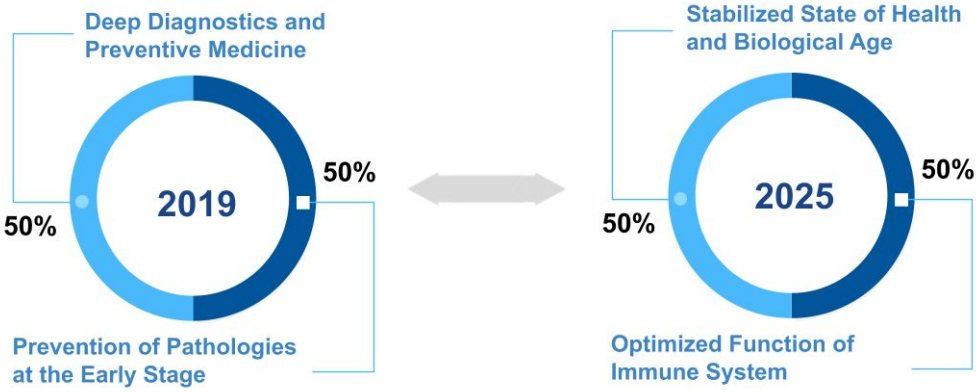
Aging Analytics Agency has done a great deal of analytic work on the role of AI in precision medicine, the role of precision medicine in Longevity, precision medicine clinical technologies and methods, and is currently working on the production of an analytical report profiling the 100 Leading Precision Medicine Clinics, titled **Precision Medicine Clinics Landscape Overview 2019: Most Advanced Clinics, Technologies and Methods**.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

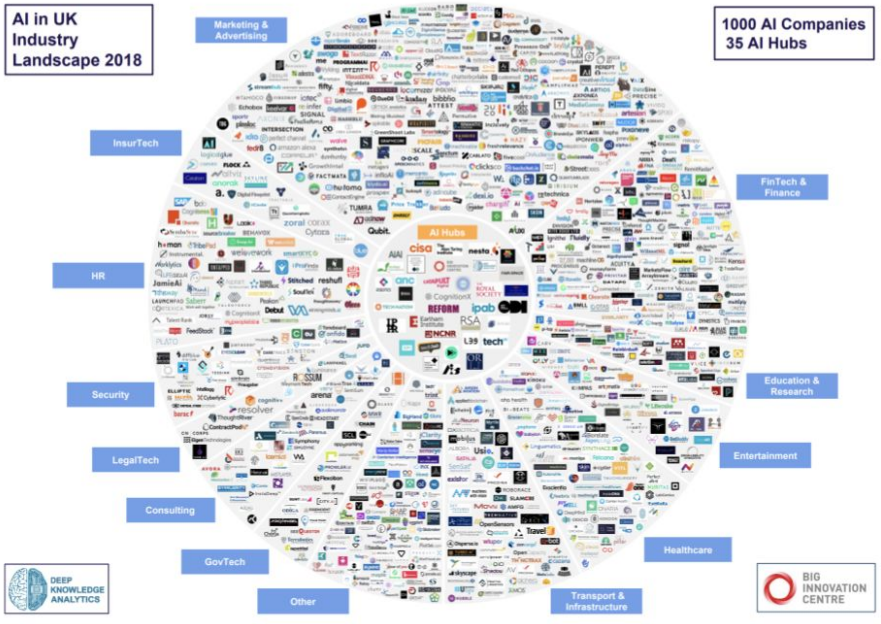
Based on this work, the company is in a strong position to offer strategic guidance on the exact formulation of leading precision health and preventive medicine methods and technologies.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

The New Frontier - from Precision Medicine to Precision Health



More than 1000 AI-Companies in the UK
More than 100 AI-Companies in Healthcare in the UK
No one AI-Company or R&D Centre focused on Longevity in the UK



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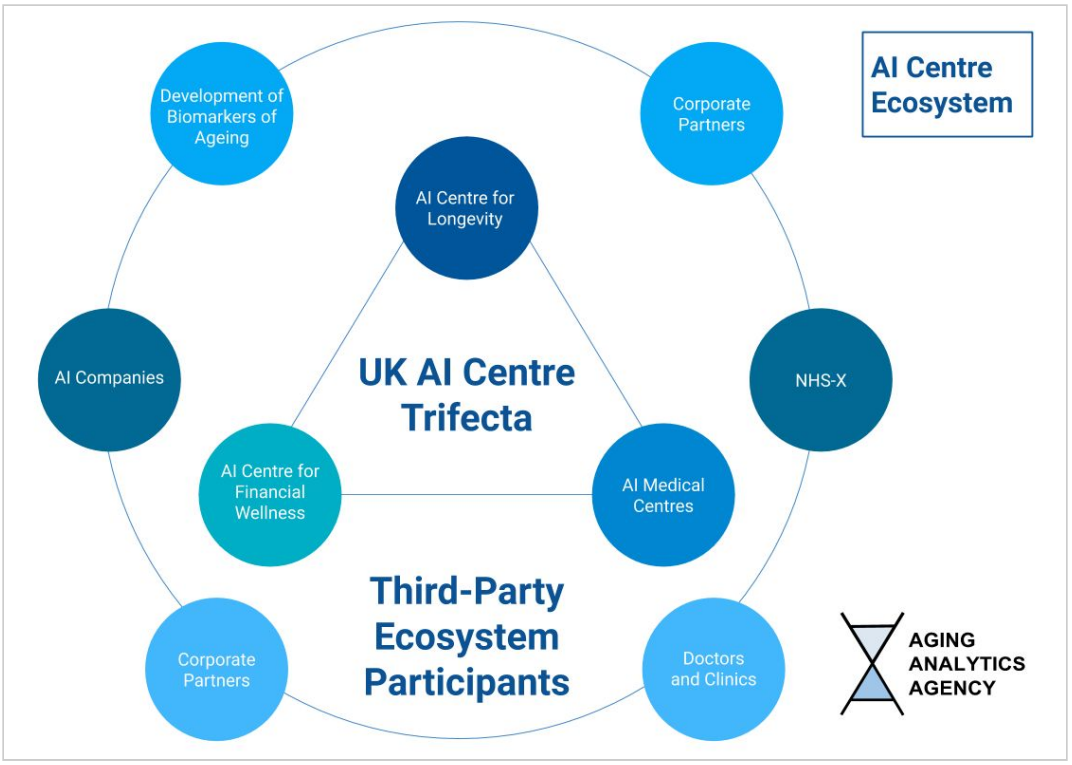

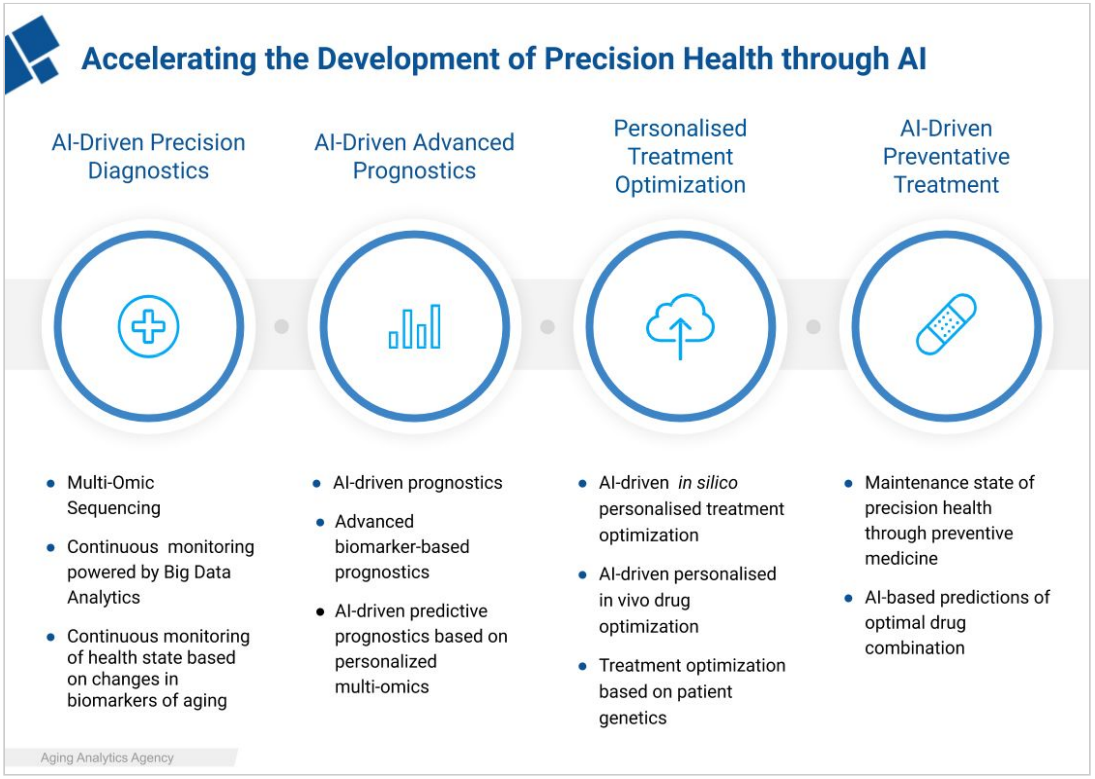

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Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

Supporting Resources for Research and Development of Under-Represented Areas of Precision Medicine Including Advanced AI, Microbiome and Advanced Cosmetics

- We propose that House of Lords convene a working group to focus on ways to support under-explored niches in Precision Medicine which have a high degree of actionability and ease-of-implementation, but which are comparatively underrepresented in the larger R&D landscape.
- These niches include personalised microbiome diagnostics and therapeutics, as well as the application of microbiome approaches and AI to advanced cosmetics (including most importantly restoring the microbiome of the skin to its youthful state as an approach to treating wrinkles, skin dryness and dandruff).

In addition to prioritizing resources toward the use of AI for Precision Health and prioritized support of developing actionable yet comprehensive enough panels of biomarkers of ageing, House of Lords should also focus on the supporting labs and startups focusing on R&D in other niches in which the levels of practical, real-world implementation are lagging behind advancements in science, including microbiome diagnostics and therapeutics, as well as recent advancements and innovations in advanced cosmetics in particular.

The microbiome has in recent years come to be viewed in scientific circles as a very clear, easily measurable indicator of bodily health. Meanwhile, microbiome therapeutics (including, for example, microbiota transplants) has also come to be recognized for its very high ratio of effectiveness vs. ease-of-implementation and low risk profile.

Similarly, whereas most areas of the cosmetics industry are still dominated by superficial, scientifically-unvalidated hype, there is an increasing amount of scientifically-validated approaches that are emerging. In particular, these include creams and injections based on patient-specific stem cell lines, and much more recently, the areas of (1) facial rejuvenation via restoration of the skin microbiome to its youthful state, and (2) the use of AI analytics to formulate personalized treatment regimes for wrinkled skin, dry skin and dandruff in particular.

One additional point of focus should be on the development of microbiome-based approaches to improving the efficacy of drug development and delivery, either by utilizing changes in the microbiome to enhance the absorption and deliver of oral drugs, or modifying the specific dosing of drugs in accordance with the personalized specifics of patients' microbiomes. One specific partner for this specific niche could be Atlas Biomed, a leading precision medicine clinic in London that has a strong focus on microbiome diagnostics and therapeutics.

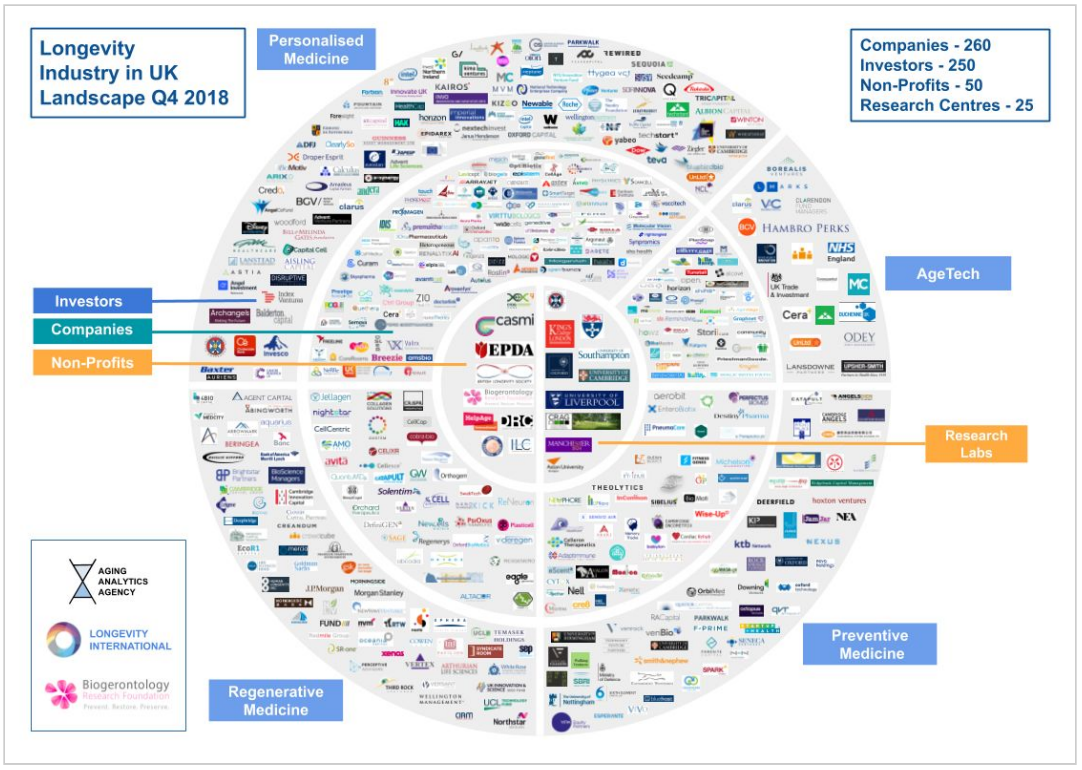
Establishment of Longevity Startup Accelerators

Summary:

- We propose that House of Lords launch a number of task forces and working groups to roadmap the development of several key initiatives to boost the development of the UK's Longevity industry, including:
- A working group for establishing Longevity Startup Accelerators in London and other major regional industry-academic hubs.
- A working group on establishing an Association of Longevity Angel Investors and Early-Stage VC Firms.
- A working group to propose measures that the UK Government can take to provide enhanced and prioritized support for Longevity charities and non-profits in order to boost the development of its Longevity scientific and academic ecosystem.
- While these three initiatives should share a certain degree of dialogue and interaction, we propose that distinct, non-overlapping task-forces oversee their development due to the differing agendas of these three types of entity (Longevity startups, investors and non-profits, respectively), to maintain an appropriate degree of independence and objectivity, so that the specific aims and interests of all three types of entity can be met to their maximum individual benefit.

We propose that House of Lords establish several related but distinct initiatives to support an increase in investments into UK Longevity startups, including the launch of a Longevity Startup Accelerator, and an initiative to support both new and existing Longevity-focused charities and non-profit organizations.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry



There are currently only a handful of Longevity startup accelerators active globally. One of them is Y Combinator's Longevity accelerator, based on California, which launched roughly 1

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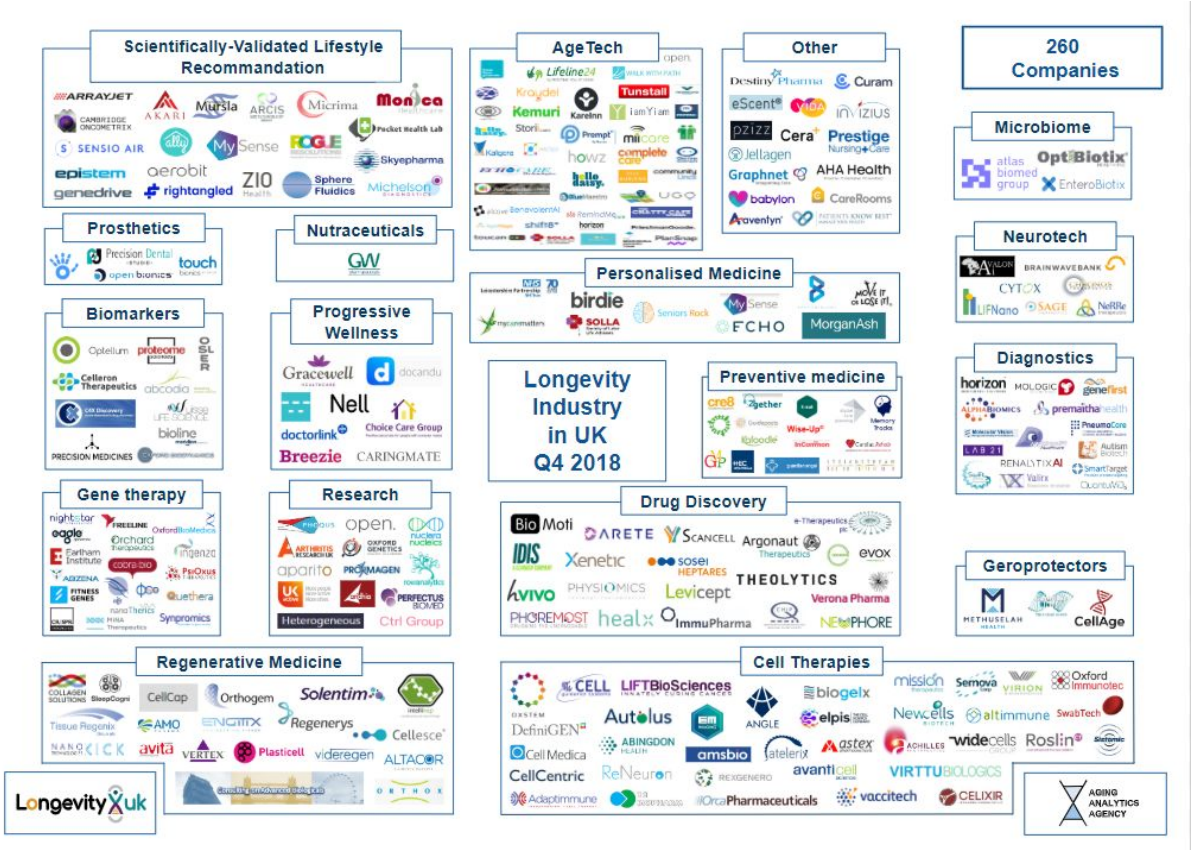
year ago and invested in 10 San Francisco-based Longevity startups. One other example is Aging 2.0, also based in California, which supports AgeTech startups (i.e. companies providing elderly care and support services, as well as companies developing products and services that use IT and digital technologies to increase quality of life for the elderly).



The only Longevity startup accelerator in the UK, and the most relevant example for House of Lords to use in considering the development of its own Longevity startups accelerator, is Innovation Warehouse's AgeTech and Longevity Hub, led by Ami Shpiro, Jeff McGeachie and Stephen Bloch, which focuses on supporting companies working on early stage diagnostics, preventive medicine and agetech.

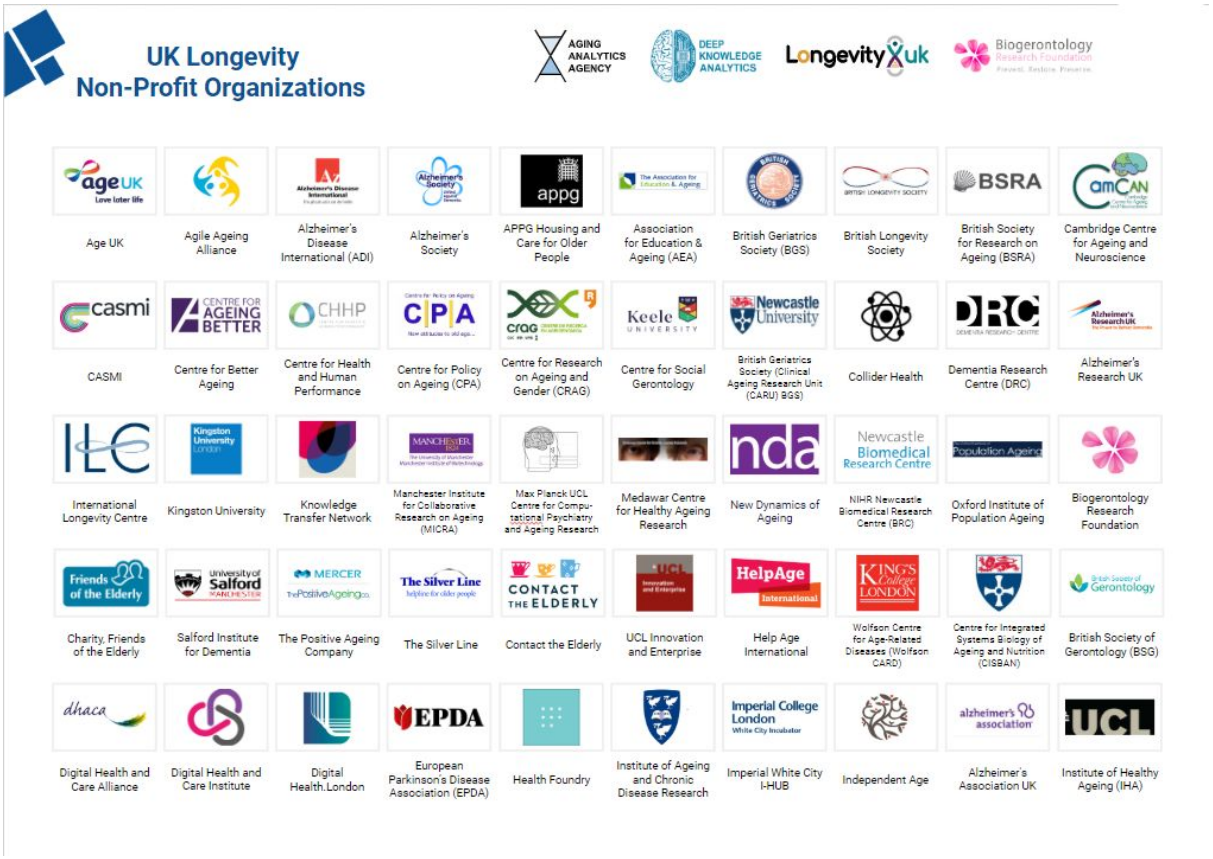
Therefore, we would propose the formation of a working group and task force to consider and roadmap the establishment of one or more Longevity Startup Accelerators. It would be logical to add both Ami Shpiro, Jeff McGeachie and Stephen Bloch as members of this task force, and to establish dialogue with potential collaborations and partners including Innovation Warehouse, and other like-minded organizations.

Furthermore, while there is currently only one Longevity-focused accelerator in the UK, the nation is home to many (likely more than 500) healthcare, preventive medicine and Longevity startups, which means that there may be room and use for 3-4 such accelerators, with the first

one being launched in London, and others being launched following the successful development of the first proof-of-concept accelerator in other optimal R&D, industry and academic hubs like Liverpool, Birmingham and Edinburgh.

In a similar vein, we propose that House of Lords launch a professional association of Longevity angel and early stage venture investors to support increased investments into the UK Longevity Industry and ecosystem.

Lastly, we propose that House of Lords launch a task force aiming to increase the level of both financial and non-financial support of UK Longevity-focusdd charities and non-profit organizations. As one example of such non-financial support is the launch of CogX to support the UK's AI industry and ecosystem (which featured a large number of the parliamentarians as speakers, including a keynote speech by healthcare secretary Matt Hancock). This was one non-financial form of support that returned great value to the UK AI ecosystem, and can be considered as one of the best examples of approaches that can be taken to support the non-profit side of the UK's Longevity ecosystem.



While a certain level of dialogue and intersection between these three initiatives would be optimal, we propose that the UK launch them as independent task forces, and structure them as distinct and independent organizations, due to the differing agendas of each type of entity.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

Establishment of London as International Longevity Financial Hub

Summary:

- We propose the formation of a task-force to develop a plan to turn the UK into a world-leading Longevity Financial Hub.
- The financial industry faces the oncoming collision of two opposed mega-trends: the ageing population and the extension of healthy Longevity. Specific forms of pension system reform can help combat the economic burden of ageing population, while the extension of national Healthy Longevity can help relieve the costs of ageing population on healthcare systems while providing growth to the UK's national economy.
- The development of novel financial products and services (including novel financial derivatives) can help large UK financial institutions transform 1 billion people on retirement globally from a problem into an opportunity.
- Part of these development efforts could take the form of the establishment of a Longevity Stock Exchange in London, with the aim of making IPOs for UK-based Longevity companies and providing them with appropriate amounts of investment, to enable an accelerated pace of development for the entire UK Longevity ecosystem.
- The UK already has key strengths as an international financial, banking and FinTech hub. If the nation leverages these strengths to work in conjunction with developments in its Longevity Industry, it could become the #1 leader globally in the Longevity Financial Industry.

We also propose the formation of a task force under the on the subject of industry development initiatives focused at the intersection of Longevity and the Financial industry, to develop the UK into a world-leading Longevity Financial Hub.

The popular media and scholarly publications such as The Economist use the term "Silver Tsunami" to describe the looming global demographic crisis. The crisis is economic in nature: consisting of the economic burdens of an ageing population that come with unexpected increases in lifespan without a concomitant increase in healthspan.

Aging Analytics Agency's research work, however, explains how this crisis can be converted into an opportunity. With investment in biotechnologies, healthspans could come to approach lifespans, further increasing lifespans. Data from longer lifespans could be used to provide greater precision in medicine, further increasing health spans. Or used as a basis for better AgeTech, which, when combined with the wisdom and resources of the elderly, could be used to improve general well being among their demographic, who might marshall resources toward improved biotechnologies, and so on.

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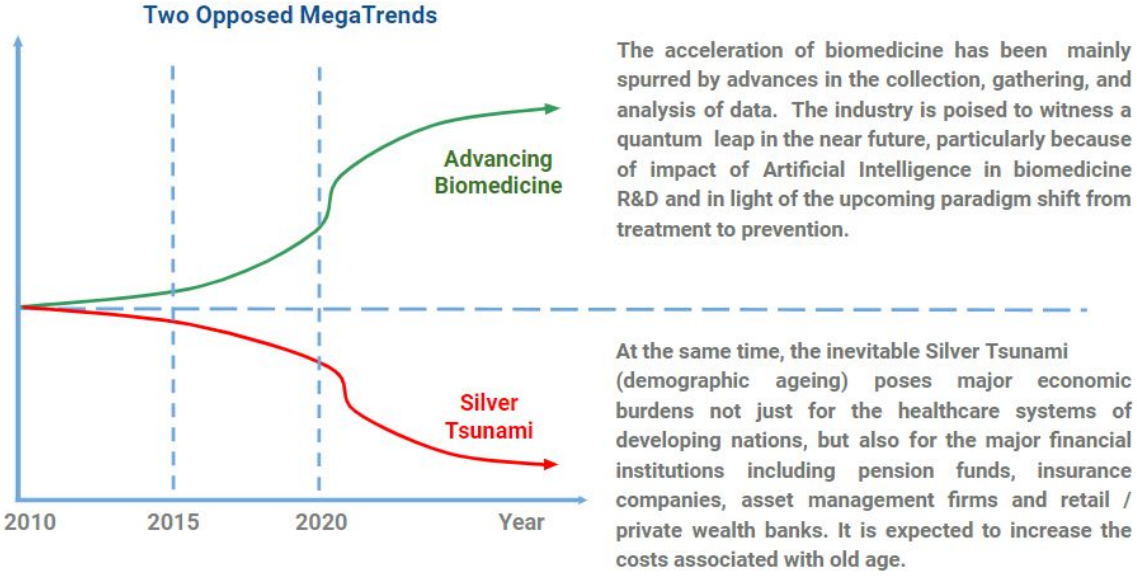
In other words, with the right synergies and technologies in place, Longevity produces economic dividends.

The technological synergies necessary to produce Longevity dividends have been outlined in previous chapters and reports.

This new global Longevity financial industry is a multi-trillion opportunity for progressive banks, asset management firms, pension funds and insurance companies. It is both extremely large, multidimensional and complex, but also possesses several very interesting features. Its scale is on the level of several tens of trillions of dollars, and yet it is marked by a distinct lack of innovation within the past 50 years, a resistance to embracing technological change, and to re-tuning business models in a manner that is relevant for the dynamic of scientific and technological progress.



But, we can already see fundamental changes taking place in the financial industry specifically due to innovations in Longevity, and we can expect to see a paradigm shift in their standard operating procedures, products, services and core business models directly in response to advances in Longevity not within the next several decades, but within the next 2-5 years. Aging Analytics Agency is currently working on a comprehensive proprietary report on this specific topic, titled **Advancing Financial Industry: Longevity, AgeTech, WealthTech**.

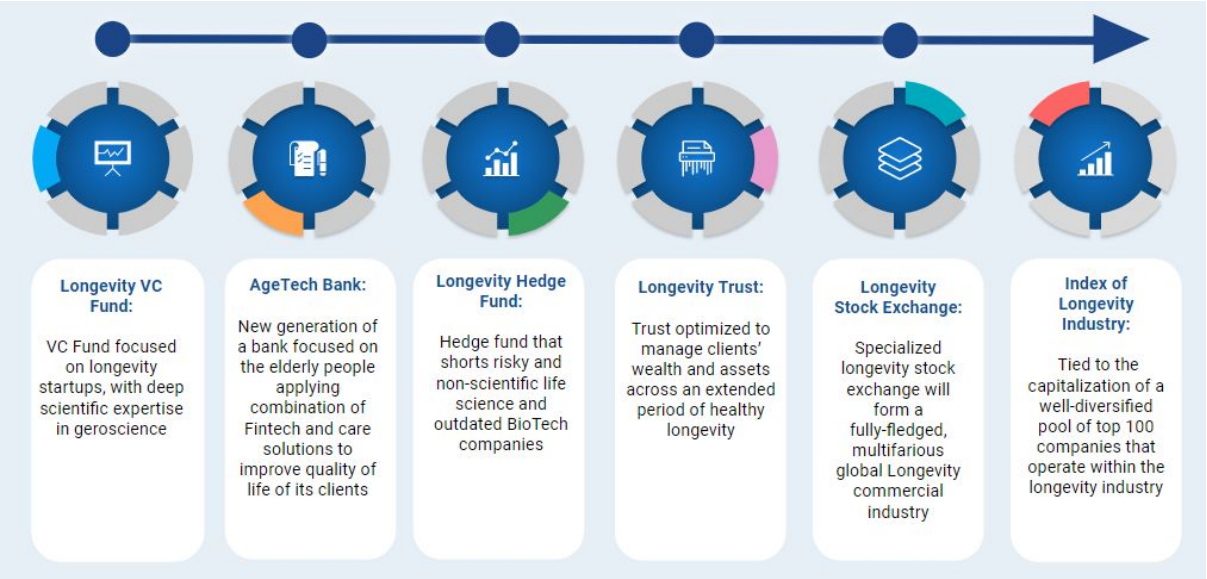
Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

With relevant sources of strategic consulting, the UK is in an extremely strong position to become a world-leading Longevity Financial Industry Hub, through the concentrated development of progressive financial reform and technologies, including Longevity-focused FinTech, InvestTech and GovTech projects, combined with novel Longevity-related financial instruments and advanced derivatives.

The UK is already known for being a leading FinTech, finance and progressive banking hub. This fact, combined with its focus on supporting the development of advanced technologies, and its flexible financial regulatory ecosystem, puts the region in a strong position to become a leader in the specific field of Longevity Finance. In 2019, Aging Analytics Agency made this area a core component of its proprietary analytics activities following the appointment of Eric Kihlstrom (former Director of the UK Government-led £98 million Healthy Ageing Industrial Strategy Challenge Fund) as its new Director.

One very specific action that House of Lords should consider is making a core component of this initiative is the formation of a Longevity Stock Exchange in London. A reasonable action plan might be for the UK government to buy off one of the smaller stock exchanges in London, and to repurpose it as a Longevity Stock Exchange, which will follow the example of London's AIM (Alternative Investment Market exchange) and Silicon Valley's new stock exchange focused on hi-tech startups (e.g, see "SEC approves new Silicon Valley stock exchange

backed by Marc Andreessen, other tech heavyweights").



Establishment of a Division for International Longevity Cooperation

Summary:

- We propose that House of Lords establish a specific task force and working group for creating a dedicated governmental Division for International Longevity Cooperation.
- This division would focus on the establishment of industrial and technological bridges between the UK and other Longevity-progressive regions such as Israel, Singapore, Switzerland and the USA.
- This division would also focus on the establishment of intergovernmental initiatives that would leverage key strengths of different nations in order to launch programs that yield synergetic, multiplicative effects, enabling the sharing of key technologies, resources and experts
- This initiative should also involve establishing embassies with UK ambassadors present in different Longevity-progressive regions with "name-brand recognition" in those areas to liaison with local government officials, startups, researchers and R&D hubs.

As demonstrated by Aging Analytic Agency's series of regional reports, and its recent National Longevity Development Plans Global Overview 2019, there is a great diversity of approaches between nations and regions to the global demographic crisis, as nations with vastly differing economies, political systems and scientific bases all converge upon the same problem.

Not only is the global longevity industry technologically very mixed - each country and region has developed and integrated each of the industry's constituent technologies to varying degrees, e.g. between the US, Singapore, and the UK, there is little to compare between the state of their industrial planning.

Therefore, in order to coordinate global efforts, we expect it will prove necessary to:

- Determine what are the equivalencies between various government departments and ministries. For example, not every government department entitled "Department of Industry", or something similar, has the same function internationally.
- Participate with the establishment of Longevity All-Party Parliamentary Groups (or their equivalents) in other countries, depending on the political system of each specific country under consideration.
- Normalize the measure of progress globally by applying the aforementioned metrics to the circumstances of each region.
- Minimise duplication of efforts.
- Ensure that each country is playing to its own specific strengths. Aging Analytics Agency can provide key guidance and insights on the specific areas of focus and expertise of each nation being considered.

In order to achieve this, we believe it will be necessary to establish a Division for International Longevity Cooperation. This division would be served by a set of ambassadors, one per major region (a 'region' here would represent large relevant industrial sphere of influence, usually a nation-state or large region such as California).

These ambassadors would need to have a great deal of insider knowledge, name recognition within the Longevity industry and its community of supporters, and also the resourcefulness to establish relations and cooperation with government officials, and their counterparts in other countries. Aging Analytics Agency has amassed large amounts of data on the Longevity industry's network of influencers and could assist with this selection process.

Thus the UK will be utilising its status as a soft superpower, and gaining additional the prestige of becoming a world leader in longevity strategy and policy.

We propose that the working group convened on this specific matter also prioritize the establishment of relevant cooperative initiatives with the most Longevity-progressive countries, and with the countries that have the lowest gap between Life Expectancy and Healthy Life Expectancy.

Establishment of AI Centres for Lifetime Wellness (Financial Wellness, Continuing Education and Social Involvement)

Summary

- We propose that House of Lords convene a task-force to create a roadmap for the establishment of AI Centres for Lifetime Wellness.
- Whereas the proposed AI Centres for Longevity would focus on optimizing health into old age, these centres would focus on optimizing the wellness of elderly individuals in all aspects of life besides health.
- The specific scope of these areas of life would include financial wellness, continuing education, psychological wellbeing, and social involvement and activity.
- These centres would serve as R&D hubs that apply AI, machine learning, big data analysis and other predictive analytical techniques to the vast quantities of financial and behavioural data on UK citizens currently being generated, in order to create products and services that optimize elderly wellbeing, financial wellness, overall activity, neuroplasticity and social involvement.

We recommend that House of Lords convene a task force to create a roadmap for the establishment of several AI Centres for Lifetime Wellness. Whereas the proposed AI Centres for Longevity described earlier in this document are clearly within the sector of health care and health tech, these centres would focus on the application of AI to the creation of methods and technologies to promote wellness in the elderly in all aspects of life besides health, ranging from financial wellness, continuing education, happiness, psychological wellbeing, neuroplasticity and active social involvement.

Considering the vast amount of data and information about citizens being collected by financial institutions, telecom companies, etc., there are a large number of options and avenues for how AI, machine learning, big data analysis and other predictive analytical systems could utilize that data to create personalized recommendations for how citizens 60 years and older can optimize their lifestyles and behaviours to achieve a high degree of wellness, stability and social involvement and activity.

The number of companies, researchers, projects and technologies active in this space (AgeTech, FinTech for the Elderly, Continuing Education, Brain Training, etc.) is very high, and rapidly growing. Therefore, the demand for practical and sophisticated AI-driven approaches for improving and optimizing the products and services in this space is very high. Thus, the establishment of dedicated centres focusing on providing companies active in this space with advanced AI-driven support and solutions would both serve to generate sizeable revenues by selling and licensing methods and technologies to these companies, and also

help optimize products and services aiming to improve the overall, lifetime wellness of elderly individuals in all aspects of life besides health.

Establishing a Roadmap for Increased Support of Elderly Entrepreneurship and Employment

Summary

- While the state of geroscience in the UK is quite advanced, there is a visible lag in the specific development of biomarkers for ageing.
- Additionally, there is an even greater lag between the theoretical and academic work being done on this topic, and its translation into real-world, practical implementation and "market arrival".
- The past few years have seen a lot of progress in the development of biomarkers of ageing that are not as precise as the current leading methods, but that are precise enough, and most importantly, extremely easy to implement in practice - in particular, those based on deep-learning and AI-driven analysis of routine blood tests, and of photographs.
- Therefore, the development of easily-implementable and non-expensive panels of biomarkers of ageing will have a much greater real-world effect than the development of extremely precise or comprehensive biomarkers of ageing that are extremely expensive or difficult to implement in practice, such as DNA methylation clocks.
- We propose that formulation of an actionable, easily-implementable panel of ageing biomarkers, and the convening of a task-force for increasing government support for groups working on the development of practical, and implementable panels of biomarkers of ageing (scientists, companies, non-profits, etc).

We propose that a working group be established to make a roadmap of ways for the UK to increase its levels of support for elderly entrepreneurs and employees, and to create clear incentives for working into one's old age. One possible practical avenue is the creation of a dedicated accelerator for elderly entrepreneurs, as well as the formulation of Government-led initiatives to support the growth of elderly entrepreneurs, such as tax exemptions and specific research and business development subsidies for companies led by entrepreneurs 50 years and older, and especially 60 years and older.

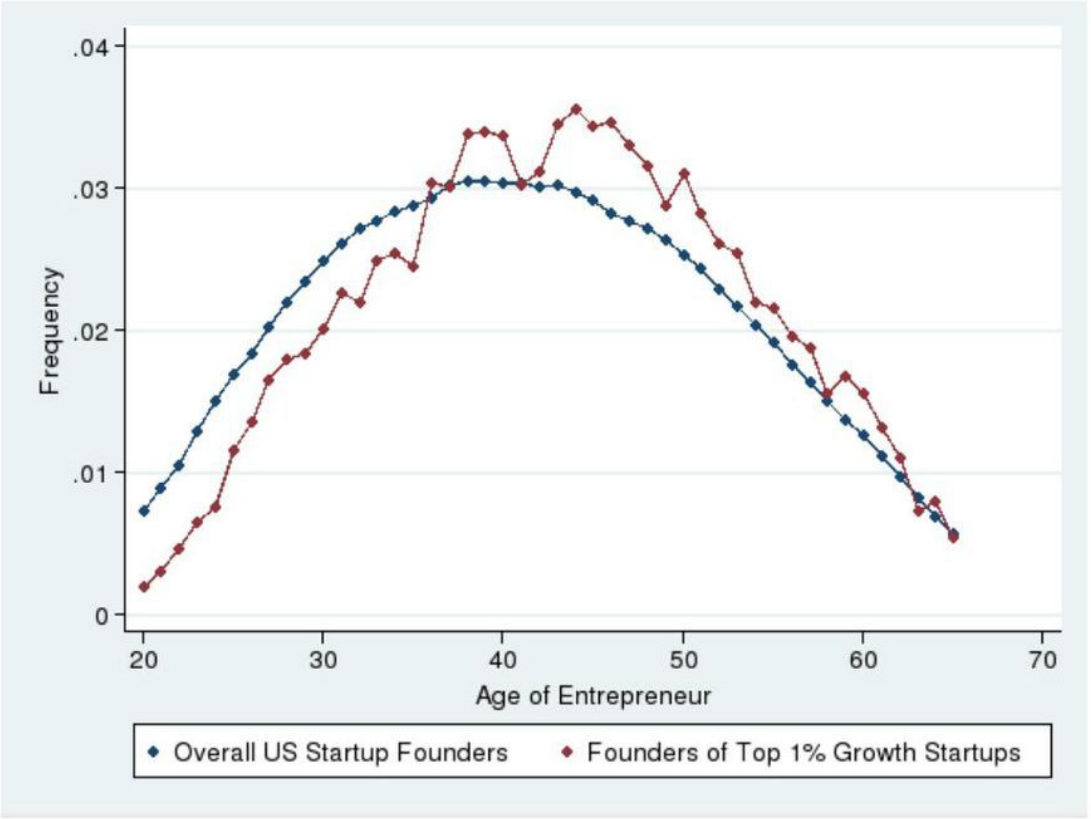
Other specific possibilities that should be considered include:

- Eliminating business taxes and employment taxes for people over 60+ years
- Offering tax breaks to businesses if the share of the elderly workers in a certain institution is higher than a certain value

- Tying in pension benefits to the educational, teaching and entrepreneurial activity, giving bonuses and benefits if older people are active and getting involved in certain activities.
- Offering grants for businesses creating technology solutions for the elderly.

This makes a lot of sense from many angles, especially considering the emerging trend of prioritized support of elderly entrepreneurs in other overseas regions; for example, whereas five years ago **in Silicon Valley in was very common to see a majority of young entrepreneurs in their 20s, now it is increasingly common to see a large portion of entrepreneurs that are 50 years and older**, and the age of this proportion also seems to be growing as well. This is a sign of a clear trend, and the UK should be proactive in becoming involved in the support of elderly entrepreneurs.

Founder Age Distribution:
All Startups and High Performance Startups



Support Development of Actionable, Implementable Panels of Biomarkers of Ageing

Summary

- While the state of geroscience in the UK is quite advanced, there is a visible lag in the specific development of biomarkers for ageing.
- Additionally, there is an even greater lag between the theoretical and academic work being done on this topic, and its translation into real-world, practical implementation and "market arrival".
- The past few years have seen a lot of progress in the development of biomarkers of ageing that are not as precise as the current leading methods, but that are precise enough, and most importantly, extremely easy to implement in practice - in particular, those based on deep-learning and AI-driven analysis of routine blood tests, and of photographs.
- Therefore, the development of easily-implementable and non-expensive panels of biomarkers of ageing will have a much greater real-world effect than the development of extremely precise or comprehensive biomarkers of ageing that are extremely expensive or difficult to implement in practice, such as DNA methylation clocks.
- We propose that House of Lords make the formulation of an actionable, easily-implementable panel of ageing biomarkers a priority.

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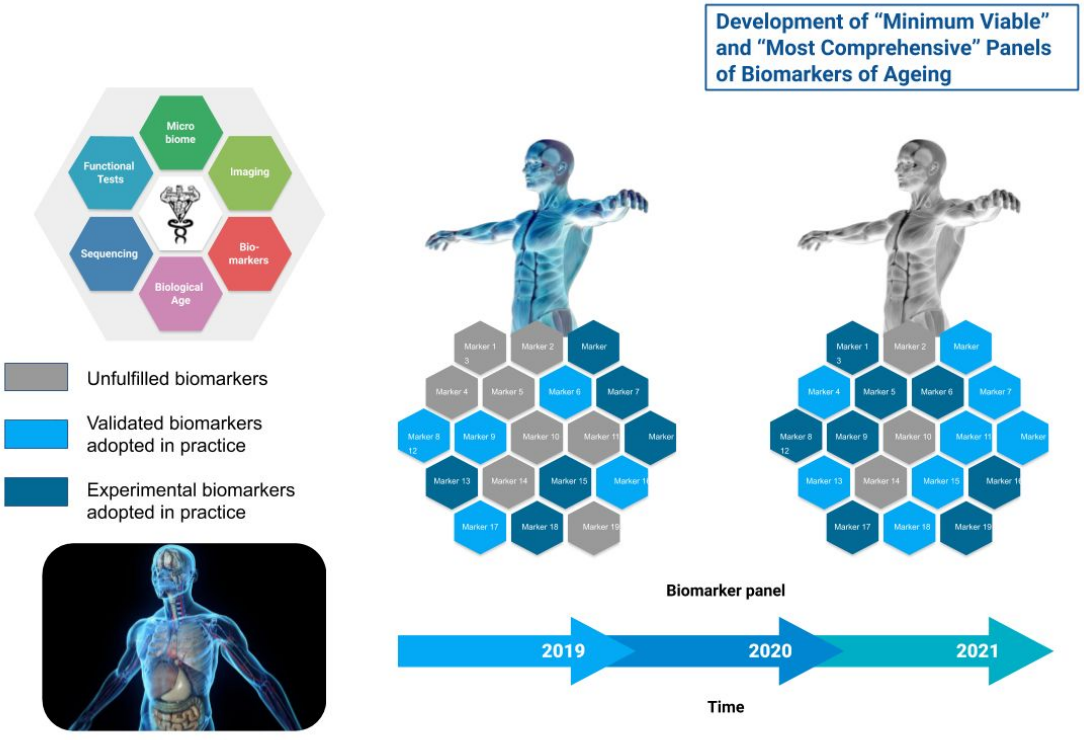
Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry



Biomarkers are a measurable indicator of some biological state or condition. Biomarkers are often measured and evaluated to examine normal biological processes, pathogenic processes, or pharmacologic responses to a therapeutic intervention. Biomarkers are used in many scientific fields.

Biomarkers of aging are biomarkers that could predict functional capacity at some later age better than will chronological age. Stated another way, biomarkers of aging would give the true "biological age", which may be different from the chronological age.

Validated biomarkers of aging would allow for testing interventions to extend lifespan, because changes in the biomarkers would be observable throughout the lifespan of the organism. Although maximum lifespan would be a means of validating biomarkers of aging, it would not be a practical means for long-lived species such as humans because longitudinal studies would take far too much time. Ideally, biomarkers of aging should assay the biological process of ageing and not a predisposition to disease, should cause a minimal amount of trauma to assay in the organism, and should be reproducibly measurable during a short interval compared to the lifespan of the organism.

Metrics for tangible progress are absolutely essential component of any government strategic agenda. Governments must be able to monitor and describe biomedical progress. It will be impossible to make concrete claims regarding global progress in biotechnology - and in preventive medicine in particular - without an agreed panel of biomarkers. In medicine, a

biomarker is a measurable indicator of the severity or presence of some disease state, and are capable of serving as a standard metric for industrial output in global Longevity Industry.

While the state of science, advanced biomedicine and the science of Longevity in particular are quite advanced in the UK, there is a clear paucity of practical developments in the specific realm of biomarkers of ageing, and in the development of panels of ageing biomarkers that can be used to assess differences in biological age vs. chronological age, and to measure the effects of lifestyle and therapeutic interventions on biological age.

This is a similar situation to the current state of AI for precision and preventive medicine, in which there is a lot of work going on in science and academia, but a visible lag in the practical real-world implementation of that science into practise.

Also, a very important factor to take into consideration is the degree of emphasis not just on the best biomarkers of ageing, a panel of biomarkers that has the highest ratio of comprehensiveness to actionability and implementability. A panel of less precise but highly implementable biomarkers of ageing is much better than an extremely precise and comprehensive panel of biomarkers of ageing that is too hard or expensive to translate easily into practical use.

Why is a minimum sufficient panel of biomarkers necessary?

It is important in technology never to let the perfect be the enemy of good, especially when the technology is of great humanitarian significance.

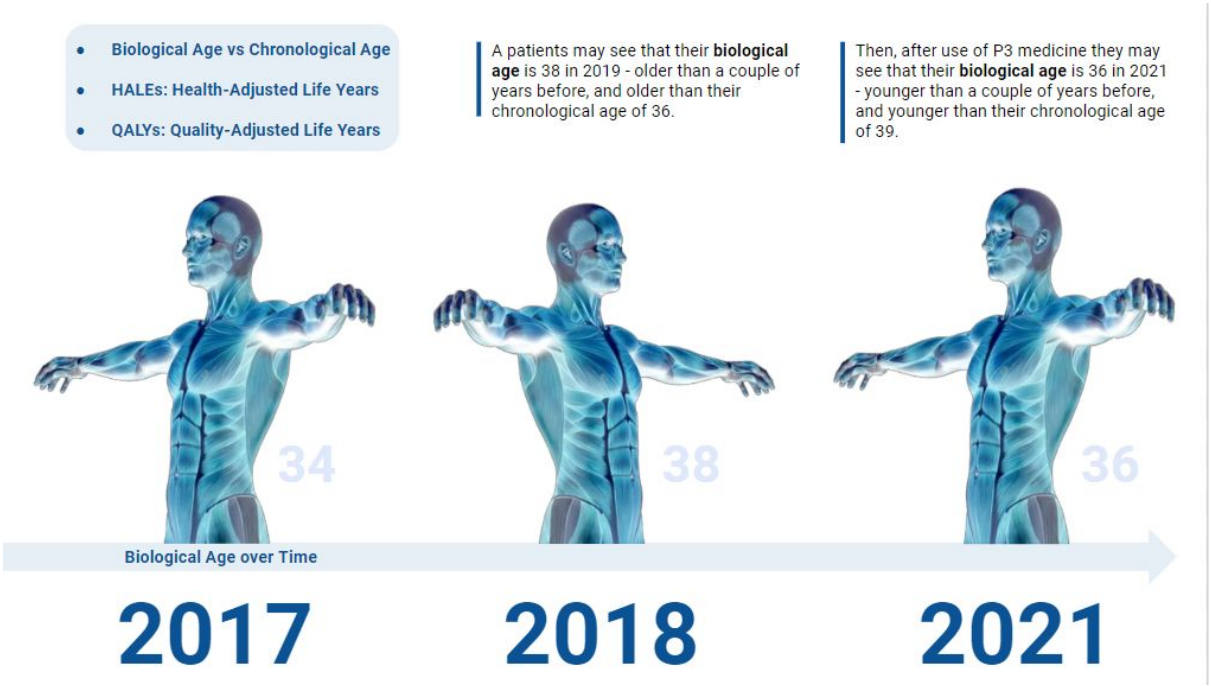
For example, in the early 2000s, enthusiastic proponents of the application of regenerative medicine to aging were urging governments, entrepreneurs and thought-leaders to make this a priority. They argued that technology was ahead of the science and the funding, and that while a great deal remains to be discovered about the mechanisms of aging, we already know enough to optimize the existing toolkit of regenerative medicine to address the damage of aging, which is already thoroughly researched. And thus out of this paradigm shift occurred from it arose the field of rejuvenation biotechnology.

Now once again, the technology is ahead of the science, the funding, and the political leadership. And, once again, a paradigm shift is due.

Presently the necessary biotechnologies for the implementation of P4 medicine technologies and therapies are already in place. What is needed now is big data analytics to develop optimal panels of biomarkers of ageing and to determine how to optimize their implementation.

But this is not a biotechnology problem, but a data mining, analysis and management problem. And moreover, in many countries, to various degrees, data mining, analysis and management problem is a question of political coordination.

As one example of recently discovered "minimum sufficient" biomarkers, there have been positive developments in the formulation of precise biomarkers of ageing that can be used to estimate biological age and mortality risk based on Deep Learning analysis of standard blood biomarkers, which is not as precise as the most precise available biomarkers of ageing (DNA Methylation clocks), but which are precise enough, and which can be implemented by any researcher, doctor and clinician that has access to routine blood tests.



Similarly, there have been biomarkers of ageing that are constructed using deep learning-based analysis of photographs in mice, which could quite easily be extended to humans. As one possibility, given the increasing resolution capabilities of smart-phones, the development of photographic biomarkers of ageing (e.g. of the face, or the eye) could be a very actionable area of research to focus on.

There is however a risk that governments and governmental or political strategic bodies may make one or both of the following errors:

- They might assume that missing bridge on the road to HALE-extending preventive medicine is still progress in biotech methods, rather than increased precision and personalization.

- They might assume that because the current scientific quest for ever more precise biomarkers is not slowing down, that we don't yet have a set of biomarkers precise and sufficiently actionable, in order to take immediate action.

As such government strategic bodies therefore risk limiting their strategic ambitions with regard to time frames.

Thus, we recommend that House of Lords make the development of both precise and actionable, implementable panels of ageing biomarkers one of their top priorities, and formulate a specific task-force for the formulation of a road-map that enables increased governmental support (both monetary and non-monetary) to scientists, non-profits and start-ups working on the development of both effective and practical panels of biomarkers of ageing.

Creating a Database of Relevant Partners and Counterparties for the Implementation of the UK National Healthy Ageing Industrial Strategy

Summary

- We propose that House of Lords initiate the development of a comprehensive database of partners and relevant counterparties who can potentially serve as partners for the execution of the UK Healthy Ageing Industrial Strategy Challenge Fund
- This database should be structured according to the specific roles that each different type of partner would eventually assume, according to exactly how they would be useful and relevant for the strategy's execution in practice.
- The creation of this database should be heavily prioritized as an urgent item, given that it is the first step toward choosing and engaging with the entities that will assist in the actual execution of the strategy.

We propose that House of Lords urgently dedicate resources to the construction of a database of potentially relevant partners for cooperation both on the formulation of the national healthy ageing industrial strategy, as well as for the practical implementation of the strategy over time.

The first step in this process is the formulation of a large database of potentially relevant partners and counterparties including government ministries, departments and agencies, laboratories, BioTech hubs and other R&D hubs, AgeTech hubs, and relevant start-ups, corporations, NGOs and non-profits.

An early and proactive approach to the creation of this database is essential to the formulation of a maximally relevant and effective list of partners and institutional collaborators, and this process should be launched as early as possible to achieve the best possible effects in practice.

Once the full database is created, parliamentarians and researchers can offer their input in terms of which institutions and entities within the full database should be shortlisted for engagement, and ultimately who among them should be formally approached for participation in various components of the UK Healthy Aging Industrial Strategy execution plan.

Inputting Data, Analytics and Insights from Aging Analytics Agency's Upcoming "Comparative Analysis of Health-Adjusted Life Expectancy (HALE): Global Landscape Overview" Report

Summary

- Aging Analytics Agency is currently producing a comprehensive report that identifies the most critical healthcare and socioeconomic factors that result in their good or bad HALE rankings for various countries globally.
- This report will provide crucial insights into what specific items should be prioritized for a given country to efficiently and economically increase its national HALE ranking.
- We recommend that House of Lords use the data, analytics and conclusions from this report as part of the structuring of its Blueprint and Framework for a UK Healthy Aging Industrial Strategy.

"Comparative Analysis of Health-Adjusted Life Expectancy (HALE): Global Landscape Overview" is an upcoming report scheduled for release in September 2019 by Aging Analytics Agency which not only delivers an updated and deeper analysis of the HALE-related analyses presented in its previous "National Longevity Development Plans: Global Overview (First Edition)", but which also extends the analysis to unprecedented levels by conducting big data analysis using tens of thousands of total data points in order to identify the specific metrics and parameters that have the greatest impact on various countries HALE, as well as on other indicators of Healthy Longevity including the gap between HALE and life expectancy, HALE CAGR (the speed of velocity of HALE increase over time), the ratio of healthcare spending and healthcare efficiency scores to HALE and HALE CAGR, etc.

Health-Adjusted Life Expectancy Countries Analysis

	HALE/life expectancy ratios 2016	HALE/life expectancy ratios 2000	HALE 2016, years	HALE 2000, years	CAGR HALE	CAGR HALE/Life expectancy ratio
Singapore	91.92%	89.02%	76.20	71.30	0.44%	0.08%
China	89.92%	90.83%	68.70	64.80	0.39%	0.00%
Japan	88.84%	89.18%	74.80	72.50	0.21%	-0.03%
Spain	88.81%	88.92%	73.80	70.60	0.30%	-0.01%
Israel	88.58%	89.02%	72.90	69.70	0.30%	-0.03%
Netherlands	88.36%	88.49%	72.10	69.20	0.27%	-0.01%
UK	88.33%	88.58%	71.90	69.00	0.27%	-0.02%
South Korea	88.27%	89.25%	73.00	68.10	0.46%	-0.07%
Switzerland	88.24%	87.84%	73.50	70.10	0.32%	0.03%
USA	87.26%	87.65%	68.50	67.40	0.11%	-0.03%
EU	87.16%	89.77%	70.60	69.30	0.12%	-0.20%

Source: GHO Life expectancy and HALE

Firstly, the report will build a predictive model of HALE by starting with the known HALE values of specific countries. Based on this, a host of relevant metrics and parameters with specific weight factors will be constructed, and the specific parameters and weight values will be varied until the predictive model outputs HALE values and rankings that match the real-world values of the countries analyzed, essentially reverse-engineering the specific causes of good and bad HALE (and associated values) via statistical techniques and big data analysis.

Secondly, by applying random variations to specific metrics and parameters and analyzing the resulting increase and decrease in the model's output HALE values, the report's analysis will enable the identification of the parameters that bear the greatest amount of importance for the model's output, and therefore the specific healthcare and socioeconomic factors that determine the HALE of the countries being analyzed.

Thus, this report will offer key strategic insights into the specific factors and parameters most responsible for the real-world HALE values of a given country, and therefore the most economic and effective ways in which an increase in the national UK HALE can be achieved. We recommend that House of Lords utilize the findings of this report extensively during the formulation and structuring of their Blueprint and Framework for the UK Healthy Ageing Industrial Strategy

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

Health-Adjusted Life Expectancy vs. Life Expectancy

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Source: GHO Life expectancy and HALE

Health-Adjusted Life Expectancy Countries Analysis

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Asian countries are on top of all the rankings. Singapore is the leader in a number of key metrics, i.e. Singapore has the smallest gap between HALE and life expectancy both in 2000 and 2016, and the country has the biggest annual growth in this metric. Japan has lost the leading position in HALE ranking to Singapore, but it's South Korea that has gained the most position in HALE rankings and has the biggest HALE growth rate.

	Ranking HALE/life expectancy ratios 2016	Ranking HALE/life expectancy ratios 2000	HALE ranking 2016	HALE ranking 2000	CAGR HALE ranking	CAGR HALE/Life expectancy ratio ranking
Singapore	1	1	1	2	2	1
China	2	2	10	11	3	3
Japan	3	5	2	1	9	7
Spain	4	7	3	3	6	4
Israel	5	6	6	5	5	9
Netherlands	6	9	7	7	8	5
UK	7	8	8	8	7	6
South Korea	8	4	5	9	1	10
Switzerland	9	10	4	4	4	2
USA	10	11	11	11	11	8
EU	11	3	9	6	10	11

Source: GHO Life expectancy and HALE

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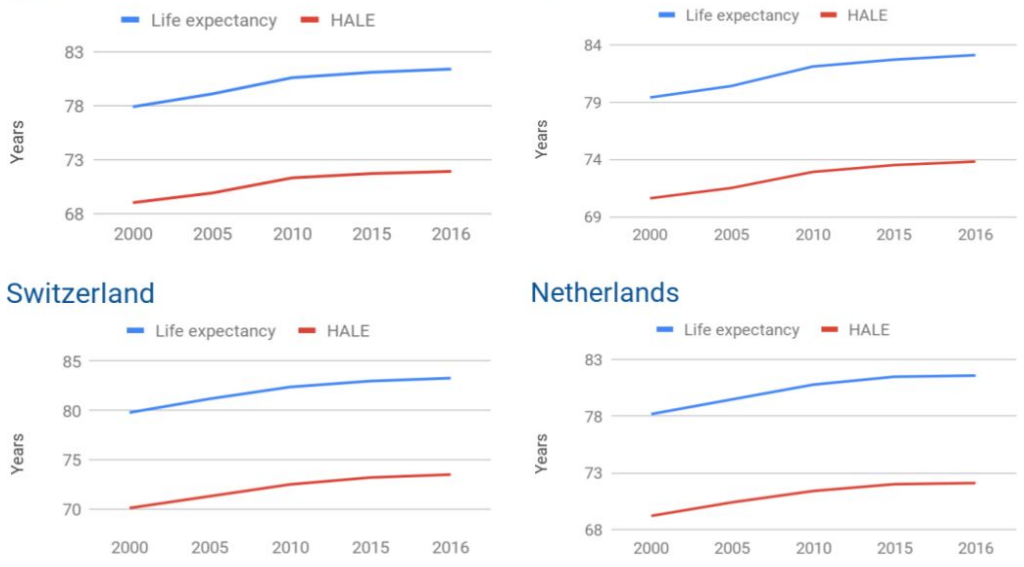
Health-Adjusted Life Expectancy vs. Life Expectancy UK, Spain, Switzerland and Netherlands (2000-2016)

25



Source: GHO Life expectancy and HALE

Age Dependency Ratio and Early Retirement Age

35

Source: Age dependency ratio - Data

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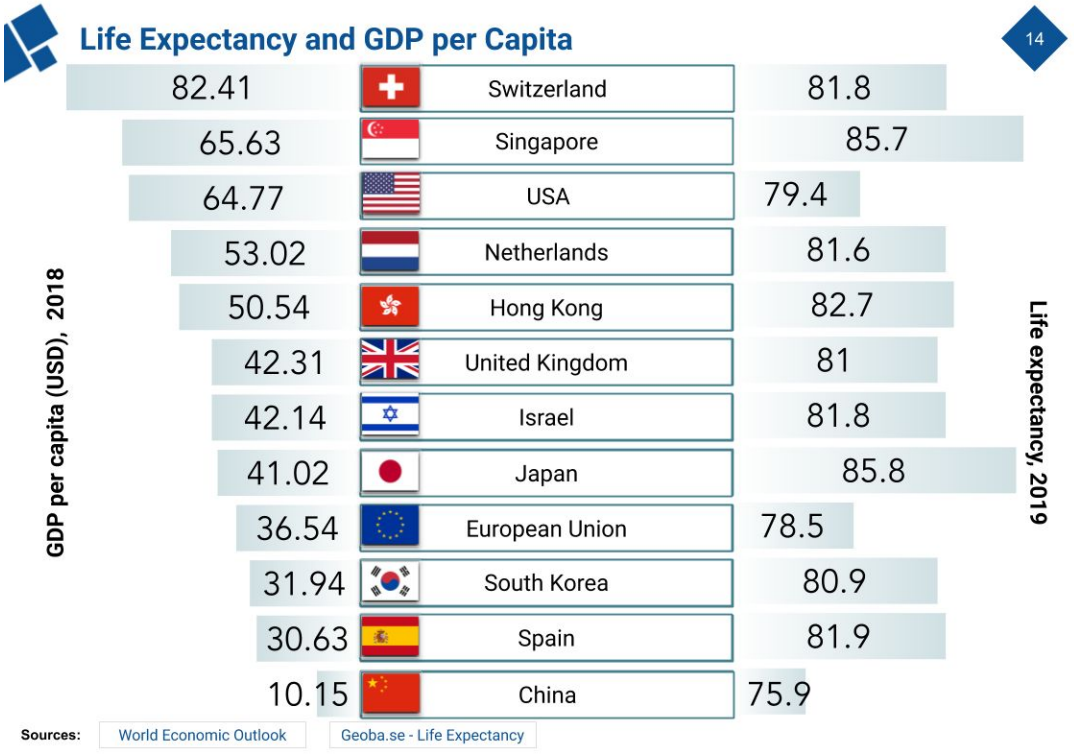
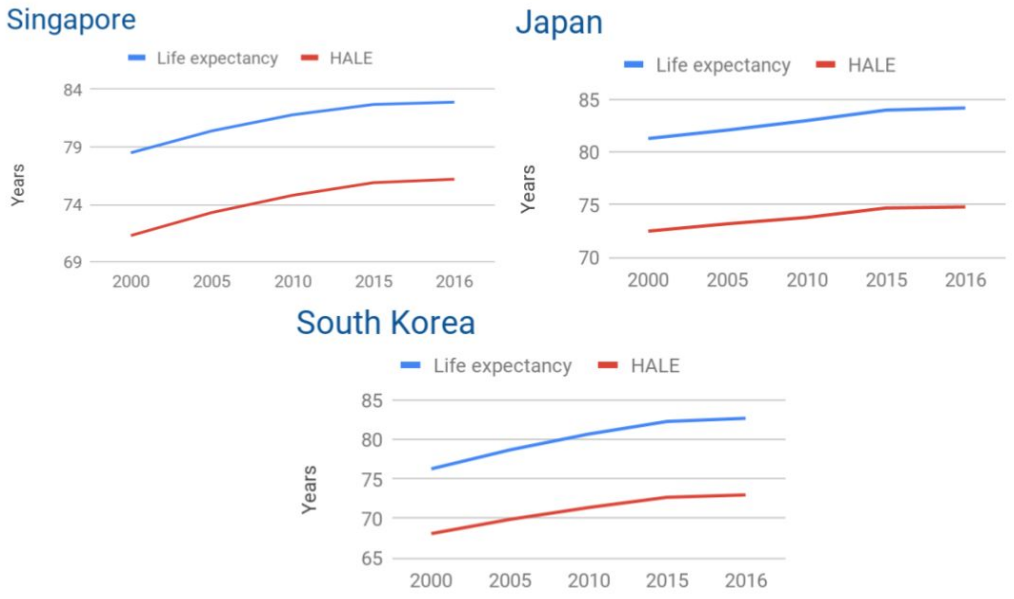

Life Expectancy and GDP per Capita
14
GDP per capita (USD), 2018
Life expectancy, 2019
82.41 Switzerland 81.8
65.63 Singapore 85.7
64.77 USA 79.4
53.02 Netherlands 81.6
50.54 Hong Kong 82.7
42.31 United Kingdom 81
42.14 Israel 81.8
41.02 Japan 85.8
36.54 European Union 78.5
31.94 South Korea 80.9
30.63 Spain 81.9
10.15 China 75.9
Sources: World Economic Outlook Geoba.se - Life Expectancy

Health-Adjusted Life Expectancy vs. Life Expectancy Singapore, Japan, and South Korea (2000-2016)

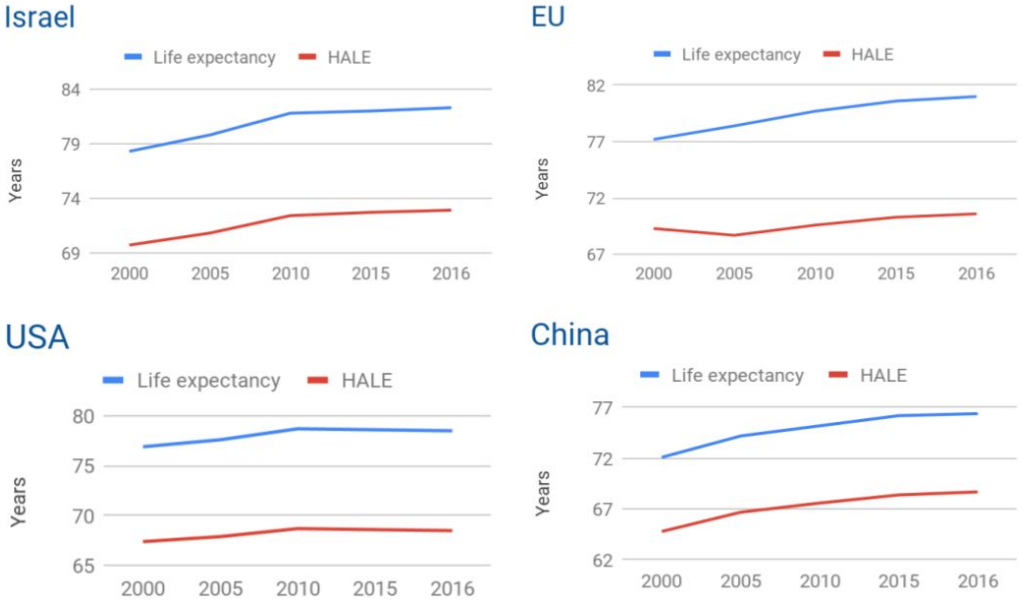
26



Source: GHO Life expectancy and HALE

Health-Adjusted Life Expectancy vs. Life Expectancy Israel, EU, USA and China (2000-2016)

24



Sources: GHO Life expectancy and HALE | Life expectancy - WB Data

Proposal to Launch Task Force Focused on Initiatives to Reduce Psychological and Social Ageing

- While the majority of House of Lords' practical plans to add five healthy years to UK citizens focuses mainly on preventive medicine, this kind of approach will yield diminishing returns when applied to th elderly.
- However, there is another scope of initiatives that can add extra healthy years to those already aged - namely, those aiming to reduce psychological and social ageing, which denotes the phenomenon of declining health due to loneliness and withdrawal from society in the elderly.
- Thus, we propose that House of Lords convene a task force to brainstorm a framework for initiatives aiming to reduce loneliness and increase psychological well-being and active participation in society for the UK's elderly demographic.
- By using this two-pronged approach, House of Lords can tackle the problem of adding extra healthy years of life for UK citizens from opposite ends, adding years of life for those middle-aged through preventive medicine, and adding years of life for the already-aged by combating social and psychological ageing.

While the majority of possible proposals for adding five extra healthy years of life for UK citizens falls under the scope of preventive medicine approaches, we propose that House of Lords convene a task force and working group to brainstorm initiatives to reduce psychological and social ageing among the UK's 60+ demographic.

While efforts focused on preventive medicine can add extra healthy years to those either young of middle-aged, such approaches will yield diminishing returns when applied to those who are already 60 years or older. While these efforts should still be applied to the UK's elderly demographic of course, it will not result in a tangible increase in the nation's HALE.

There is, however, a scope of initiatives that can potentially add years of healthy life to those who are already 60+ or older, and one that does not rely on extreme, intensive or expensive technological and biomedical innovation -- namely, projects aiming to reduce psychological and social ageing among the elderly.

The fact that withdrawal from society, loneliness and the loss of loved ones can accelerate the decline of health in the elderly. This is a combination of physical and psychological factors (many of which amount to the traditional notion of the "will to live", and the psychosomatic effects of retirement, loss of friends and loved ones, and withdrawal from active participation in society) which have diverse causes and diverse outcomes. There is also a notable link between psychological/social ageing and alcoholism, which is a particularly relevant issue for the UK.

While initiatives aiming to reduce psychological and social ageing is not currently considered as a core part of Longevity agenda, but it should be, because it is a very significant issue. In fact, it can enable a combined approach whereby extra healthy years are added in the case of middle aged citizens through preventive medicine approaches, whereas extra healthy years are added in the case of elderly citizens through initiatives aiming to reduce psychological and social ageing by improving psychological wellness, increasing active participation in society, and reducing loneliness for those aged 60+.

Proposal to Launch Task Force Focused on Roadmapping a Longer-term Strategy to Extend National Healthy Longevity Past 5 Years

- As mentioned previously, the goal of adding five extra years of Healthy Longevity for UK citizens is completely doable using existing preventive medicine technologies. It does not require intensive of radical biomedical innovation, but the optimization of existing, known and validated technologies, and emulation of best practices in

preventive medicine from other countries, like Singapore, with the smallest gaps between life expectancy and HALE.

- However, the extent with which such existing, optimized best practices can add extra healthy years to the lives of UK citizens is limited, and there will be a time when they will begin yielding diminishing returns.
- Meanwhile, following the successful addition of 5 extra years of healthy life, the question will naturally arise as to how additional years of HALE will be added. This will require more intensive innovations in advanced biomedicine and precision, personalized and preventive medicine.
- Thus, we propose that House of Lords convene a task force to begin roadmapping longer-term strategies, and prioritized support and financing of key biomedical technologies that can be quantitatively predicted as necessary for the later-stage extension of HALE in the years and decades following the achievement of increasing national HALE by 5 years.

As we have stated earlier in this document, the challenge of adding five extra year of healthy life to UK citizens does not necessitate any radical innovations in biomedicine, but simply the optimization of existing, known and proven best-practices and technologies in preventive medicine to the middle aged, combined with initiatives aiming to reduce psychological and social ageing in the elderly. This alone will be more than enough to add 5 years of HALE for the nation.

However, following the attainment of that goal, both the public as well as other stakeholders will naturally ask what plans are in place to extend HALE beyond 5 years. And to achieve this will require not just optimization of existing methods, but prioritized development of cutting-edge preventive medicine technologies and methods.

Such efforts will take a number of years, and in order to effectively execute their testing, validation and clinical translation, efforts should begin being made now in terms of prioritized development and funding for key biomedical technologies that can be quantitatively forecast to be required for the more comprehensive extension of Healthy Longevity.

Thus, we propose that House of Lords convene a task force to roadmap this issue, and create a structure and framework that determines what technologies are expected to deliver the most practical benefits, and how their prioritized support by the UK government should actually be planned and implemented in practice.

Proposal to Establish Nation-Wide Network of Unmanned Preventive Diagnostics Booths

Summary:

- We propose that House of Lords launch a task force to roadmap the launch of a nation-wide network of unmanned, AI-assisted preventive diagnostics booths.
- This is already being implemented across the nation in China by the company Ping An Doctor.
- By simply emulating the approach already being taken elsewhere, the nation can enable near-continuous monitoring of fluctuations in citizen's measures of health in a very economic manner.
- These booths would feature simple diagnostic functionalities including visual recognition, and possible blood and urine analysis, and would ideally be connected to the cloud computing system of the NHS to allow for more advanced forms of analysis based on these rather simple preventive diagnostic methods described above.
- It is important to note that this would not require intensive or extensive biomedical innovation, and in this sense can be considered as a simple data management problem.

We propose that House of Lords convene a task force to roadmap the creation of a nation-wide network of unmanned preventive diagnostics booths across the UK.

This has already been launched in China by the company Ping AN Doctor, which plans to install 300,000 such unmanned booths in populated public spaces, wherein each booth will cover 5,000 citizens.

Considering that the UK has a population of 67 million citizens, we propose that the UK model the scope of these booths after the example of China, which would translate to 13,500 such booths, if we assume a single booth to cover 5,000 citizens.

It is important to note that this project should not necessitate any novel R&D, but just an emulation of the existing efforts being made in China.

These booths would not aim to offer deep or broad preventive care, or the deepest levels of preventive diagnostics and prognostics available, but would include simple preventive diagnostics (including visual recognition, and possible blood and urine analysis) capable of enabling regular monitoring of changes in conditions and results, and should be in locations that make it convenient for citizens to have check-ups at these booths 1 time per month.

These booths should be connected via the NHS cloud computing system to provide deeper, AI-enabled analysis based on the simple diagnostic tools and methods described above. They should also be integrated with user's digital devices (including mobile phones and wearables).

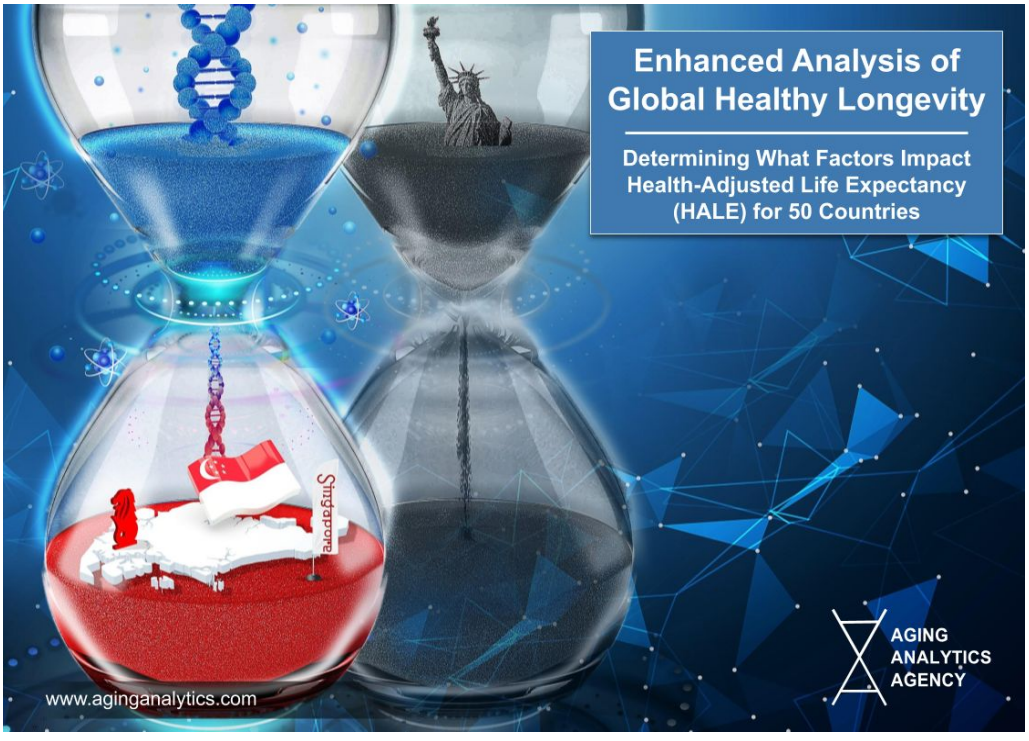
This is another example of an initiative that is not complex, and does not require intensive efforts at innovation, but rather the simple optimization and application of existing technologies.

It can be considered to be for the most part a data aggregation and management issue, rather than project requiring any kind of medical innovation whatsoever.

Upcoming Aging Analytics Agency Reports That Can Assist House of Lords in Future Longevity Projects

Aging Analytics Agency is working on a number of upcoming analytical reports that can provide essential information necessary for House of Lords' upcoming activities, as well as some of the specific proposals put forth in this document. These include:

"Enhanced Analysis of Global Healthy Longevity: Determining What Factors Impact Health-Adjusted Life Expectancy (HALE) in 50 Countries", a follow-up to Aging Analytics Agency's previous "National Longevity Development Plans Global Overview (First Edition)" analytical report, which will provide tangible insight into how House of Lords should structure a framework and blueprint for a National UK Industrial Strategy for Healthy Longevity.



'Advancing Financial Industry - Longevity / AgeTech / WealthTech", which looks at developments at the intersection of Longevity and the Financial Industry, and can provide valuable guidance for developing the UK as a leading Longevity Financial Hub.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

"Precision Medicine Clinics Global Landscape Overview: Most Advanced Clinics, Technologies and Methods" can provide key strategic guidance on the establishment of leading UK AI Centres for Longevity, and assist in the specific structuring of the clinics technologies and methods.

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Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

"USA Longevity Policy, Politics and Governance" can provide valuable insights into the strengths and weaknesses of the USA's efforts on combating ageing population and boosting its national Healthy Longevity, showing the UK what practices were successful and should be considered to adopt, and which policy initiatives should be avoided.

Aging Analytics Agency's recent regional case studies, including "Longevity Industry in Israel Landscape Overview 2019", "Longevity Industry in Singapore Landscape Overview 2019", and its upcoming "Longevity Industry in Switzerland Landscape Overview 2019", which deliver comprehensive overviews of the Longevity Industry, academic and political landscapes of key Longveity-progressive nations, which can be used to form a strategy for international cooperation and the formation of technological, scientific and political bridges between the UK and these regions.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

Aging Analytics Agency has planned a series of upcoming reports which will arm House of Lords with the knowledge it needs to bootstrap the Longevity industry globally.

In advancing the agenda of international cooperation between governments, it will be necessary for House of Lords to stay informed about the state of government initiatives around the world. Aging Analytics Agency will therefore be releasing a new updated edition of our recent report National Longevity Development Plans Global Overview 2019, expected to be published this month (September 2019).

The first edition of the report found that the United Kingdom comes out in the #1 position according to its proprietary comparative analysis, suggesting that the nation is in position to become a leader in Healthy Longevity, and in a position to deliver tangible benefits to its citizens through the prioritization of Healthy Longevity as a key component of it's national strategic agenda, such as increases in its nationwide Health-Adjusted Life Expectancy (HALE) and a reduction in the economic burden posed by its Ageing Population.

Toward the end of 2019 it will be necessary to revisit this data, in order that House of Lords has the most up-to-date information at its fingertips, especially when going forward with any of the other proposals described here.

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House of Lords must be able to monitor and describe biomedical progress. It will be impossible to make concrete claims regarding global progress in biotechnology - and in preventive medicine in particular - without an agreed panel of biomarkers. In medicine, a biomarker is a measurable indicator of the severity or presence of some disease state, and are capable of serving as a standard metric for industrial output in global Longevity Industry.

Aging Analytics Agency is planning to release a report outlining a recommendation for a panel of biomarkers of use to all relevant counterparties (in particular the AI Centre for Longevity).

We expect that an early test of these biomarkers' efficacy for industry purposes will be their adoption by longevity accelerators for use in assessing startups, by measuring their early incremental progress.

Another report will be a list of the most progressive advanced biomedicine and precision medicine clinics. It will contain examples of the best practical cases and examples of those best use-cases, and at the same time evaluate which UK clinics currently serve as the best precision clinics in the UK, and how it compares to other countries such as Germany, Switzerland, US, Singapore and so on. By October, we hope and expect to have had some fruitful discussions regarding the future shape for a Longevity national development plan for the UK. Aging Analytics Agency will be able to support this plan with a list of players - relevant states, ministries, government departments, and government organizations - whose cooperation we would need to seek, and whose participation we would seek for our advisory boards, committees, working groups, and so on in the foreseeable future.

This information will be published in the next edition of our Longevity In in the UK. In July 2018, Aging Analytics Agency published an analytical report titled "Longevity Industry in UK Landscape Overview 2018." This regional case study documented the factors that make the UK well-suited as a global Longevity industry hub, and provided insight on how to foster that potential. To reach its conclusion, the report profiled hundreds of relevant companies and investors, provided an overview of major UK Longevity nonprofits and research labs, and identified major industry trends. The report then utilised comprehensive infographics to distill industry data and conclusions into easily understandable summaries, and offered guidance on how various stakeholders and government officials could work to strengthen the industry and assist the UK to reach its full potential as a global Longevity Industry hub. The October edition of the report will have this data fully revised and updated.

Establishing a Division for the Identification of Sites for AI Centres for Longevity

Summary:

- House of Lords should establish a division with the following tasks:
- Enumerating the tasks involved in the procedural pipeline of a P4 clinic.
- Identifying the characteristics of an ideal site, regarding King's College as currently optimal.
- Assessing the resources , facilities and infrastructure of each site.

We have already proposed that House of Lords form a task-force and working group on the formation of several leading AI Centres for Longevity, which will apply the latest advances in AI, Precision Health, Preventive Medicine and Biomarkers of Aging to accelerate the development of technologies, methods and services to increase the UK's National Healthy Longevity.

We have chosen King's College London as the location for the first AI centre for longevity, due to their unique combination of resources, departments and technologies in both AI and in Longevity. This should be established in 2019 and further developed in 2020.

We are currently in dialogue with King's College on this specific topic, and will deliver a more specific proposal to House of Lords on this matter in the coming weeks.

Following the successful development of this first AI Centre for Longevity, House of Lords should roadmap the establishment of additional centres in key R&D, academic, industrial metropolitan centres throughout the UK, such as Birmingham, Liverpool and Edinburgh.

The precedent for such an initiative has already been made through the establishment of key Centres for AI and Healthcare across the UK, thereby providing a proof-of-concept for this proposal.

In late 2018 the UK Government announced that five medical technology centres will be established, which will be dedicated to using artificial intelligence (AI) to accelerate disease diagnosis. The centres are to be based at existing universities and NHS hospitals in London, Oxford, Coventry, Glasgow and Leeds, including the London Medical Imaging and Artificial Intelligence Centre for Value-Based Healthcare. The centres are opening over the course of this year (2019).

House of Lords should likewise establish a division with the following tasks:

- Enumerating the tasks involved in the procedural pipeline of a P4 clinic.

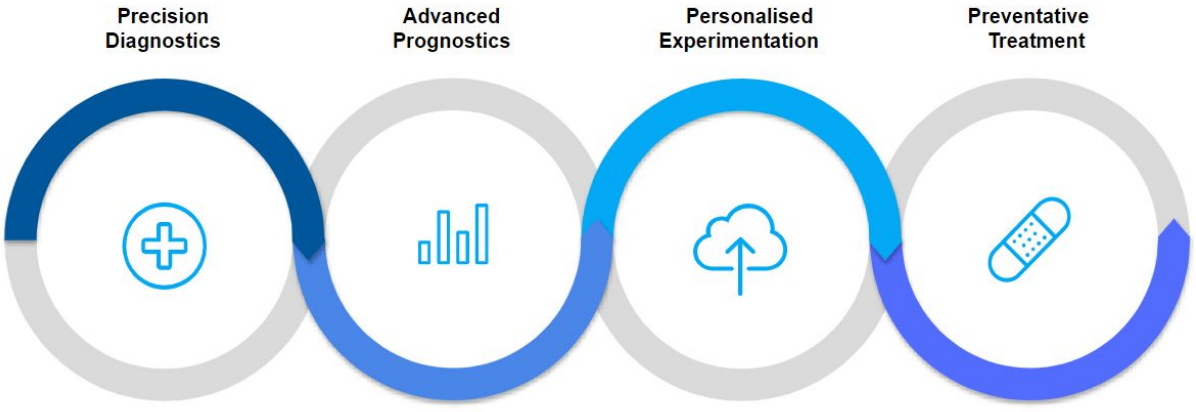
- Identifying the characteristics of an ideal site, regarding King's College as currently optimal.
- Assessing the resources , facilities and infrastructure of each site.

The locations should have the resources, departments and technologies necessary to combine geroscience, integrative health, digital medicine, precision medicine and 'personalised clinical trials' to deal with the causes of ageing.

The procedural pipeline of P4 medicine clinic begins with advanced diagnostics and the building of digital avatars, digital clones created using mathematical models to process assembled parameters from different types of diagnostics - blood, tissue samples, genetics, urine, etc.

Empowered by AI algorithms, doctors should be able to calculate the most probable scenarios for detected pathologies and estimate timeframes, as well as produce a list of recommended interventions. After creating the list of possible interventions, the process of personalized experimentation can start, using a supersystem of high-frequency (close to real time) personalized experimentation and in silico modelling (AI-based calculation and prediction of the possible outcomes of applying an exact geroprotector cocktail), and finally concluding by comparing in vitro results with in silico results. The most promising results will be checked in vitro (organoids from a specific member of the clinic, and then installed in mice, like "tumographs in mice for cancer").

So these would be tested in silico, then tested in transplanted organoids, then validated in the third stage using the skin of the specific person (this constitutes the next stage of bio-environment specificity that will be very close to the actual in vivo environment). Cells extracted from tissues should be stored in bioreactor to be used in other experiments (extraction could be done once a month from different tissues, e.g. 100 tissues once, and then have them expanded in vitro using bioreactors).



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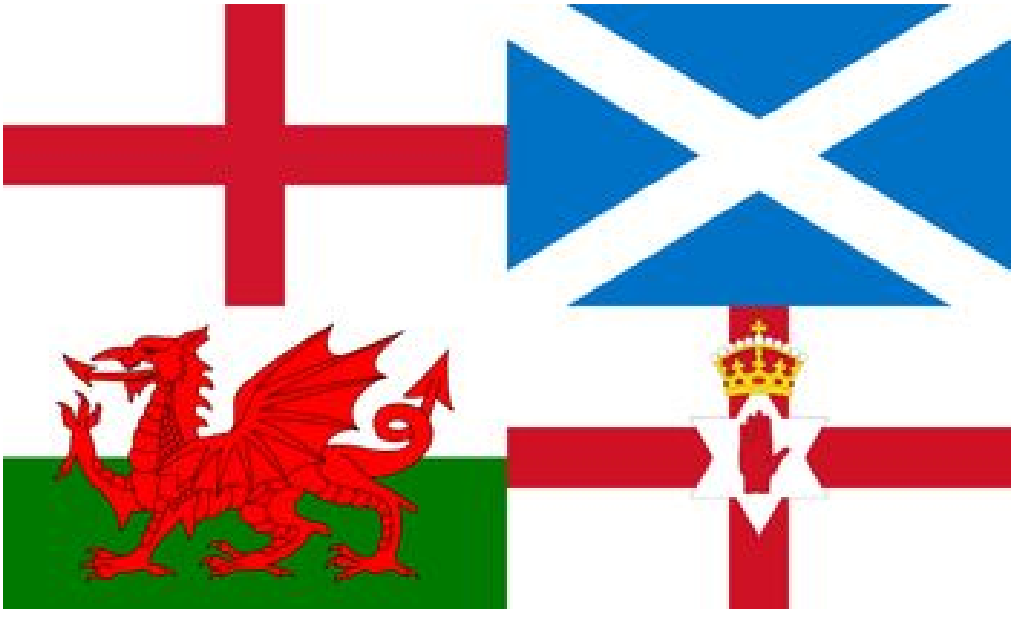
Proposal for Establishing a Division for Cooperation Across Devolved Administrations

Summary:

- The home nations of the United Kingdom are irregularly devolved, vary in the following policy areas relevant to the implementation of a national longevity development plan.
- House of Lords should establish a division for cooperation across devolved administrations.
- Such a group should identify when in the course of the above proposals any such issues threaten to arise, and what alliances would need to be formed if they are to be overcome.

The home nations of the United Kingdom are irregularly devolved, and it remains to be discovered, in the course of following through on these proposals, the extent to which it will be necessary for the UK House of Lords to harmonise its efforts with parliamentarians in the devolved administrations (the Northern Irish Executive, the Welsh Government, and Scottish Government).



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In particular the home nations of the UK vary in the following policy areas relevant to the implementation of a national longevity development plan.

- Education and training devolution, which has consequences for preparing the workforce for a P4 future.

- NHS governance (although budgets are largely decentralised). Since devolution in 1998, the UK has had four increasingly distinct health systems, in England, Northern Ireland, Scotland and Wales. From a similar starting point, there has been a considerable distancing of the four health systems from each other in policies, priorities and organization. England differs from the three devolved jurisdictions in a number of ways. Not only is it a far larger political system and NHS, its politics also include a much stronger Conservative party with a weaker attachment to public services including the NHS, and it has a long-standing set of assertive advocates for the introduction of more management and competition into the NHS. The standing of the NHS is not as solid in England as it is elsewhere, and as a result even pro-NHS politicians are constantly seeking ways to make it show its usefulness through high customer satisfaction.

- Social care devolution is even more complex. E.g. all the councils in Greater Manchester will have direct control of, or influence over, the entire budget currently spent on 2.8m people of which £6 billion is spent on the NHS and social care. Health and social care devolution is part of the wider plan to devolve a range of powers for significant areas such as transport, planning and housing to Greater Manchester.

- Welfare payments (e.g. the Scottish Government can use part of its block grant to top up existing welfare arrangements, e.g. additional winter fuel allowances for the elderly to account for the colder climate etc etc)

- Public health has seen many of the same focuses and limitations in all four jurisdictions, probably reflecting shared socioeconomic circumstances and problems such as income inequality. There was some devolved initiative in the movement to ban smoking in public places, there were a variety of experiments in addressing social determinants of health in Scotland and Wales, and now the Scottish Government is trying to institute minimum alcohol pricing (since the UK declined to devolve the power to establish a separate Scottish excise tax power on alcohol).

Scotland	Wales	Northern Ireland
Agriculture, Crown Estate, forestry and fishing	Agriculture, forestry and fishing	Agriculture
Education and training	Education	Education
Environment	Environment	Environment and planning
Health and social work	Health and social welfare	Health and social services
Housing	Housing	Enterprise, trade and investment
Justice, policing and courts*	Local government	Local government
Local government	Fire and rescue services	Justice and policing
Fire service	Economic development	Control over air passenger duty and corporation tax (from 2017)
Economic development and tourism	Highways and transport	Transport
Internal transport	Control over stamp duty and landfill tax	Pensions and child support
The ability to change and top up benefits such as Universal Credit, Tax Credits and Child Benefit	Welsh language	Culture and sport
Limited power over local taxes, the basic rate of tax and landfill tax		
Right to receive half of the VAT raised in Scotland		

House of Lords should establish a division for cooperation across devolved administrations. Many of the proposals contained in this document run into jurisdictional issues, and may involve multiple layers of government, each governed with conflicting priorities. As such a group should be set up to identify when in the course of the above proposals any such issues threaten to arise, and what alliances would need to be formed if they are to be overcome.

Proposal for Longevity Innovation Ecosystem Mapping for Regions Outside London

Summary:

- There are regions of the UK which are facility-rich but are also economically depressed and cannot serve as major sites of Longevity industry innovation. They cannot for example serve as sites for AI Centres for Longevity, in their current state.

- A Longevity innovation ecosystem can be established in these areas, whereby resources are optimally assembled for the strategic purposes described in this document.
- In order to achieve the optimal strategic mobilisation of existing resources, an analysis is required. We could offer to create a snapshot of these regional economies, their sectors and subsectors, in 2019. We would do this by utilising the customary style of our previous reports, using infographics to illustrate data consolidated from public databases and diverse online sources.

The sites and facilities necessary for developing the above Longevity industry development proposals already exist across all nations and regions of the United Kingdom. But they cannot serve as major sites of innovation unless assembled together into an innovation ecosystem.

An innovation ecosystem is the sum of the technologies, sectors, supply chains and investor relationships that are necessary for innovation in any given industry. Innovation ecosystem mapping is a key stage in economic policy making, and in the development of business strategy at a national and regional level. It involves covering the interactions between businesses (small or large), investors, government, research hubs and innovators, and tracking the flow of technology, talent, resources, investments and trade.

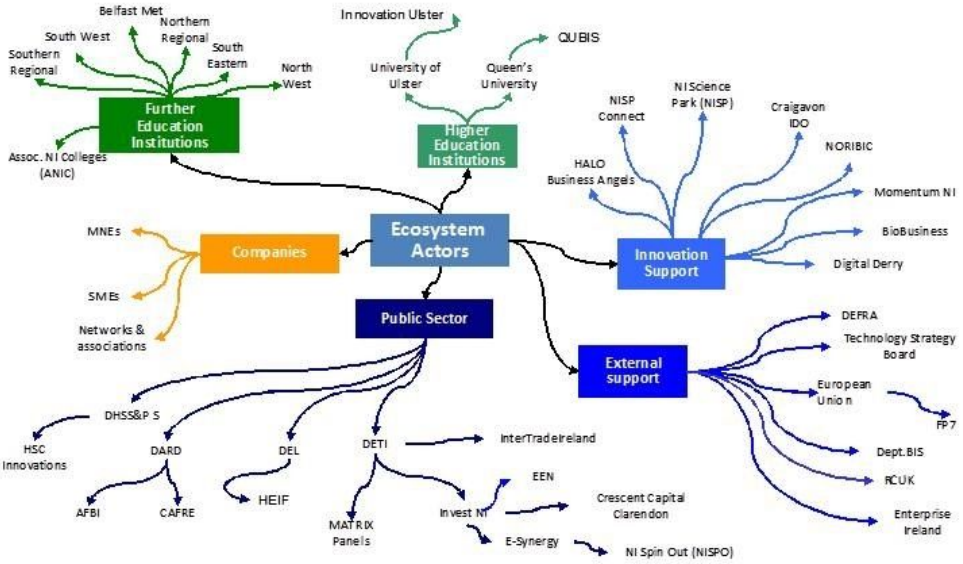
We would recommend the creation of a 21st century data infrastructure for connecting and optimising Scotland, Wales and Northern Ireland's Longevity innovation economies, with those of Greater London and the "Northern Powerhouse".

We would offer to create a snapshot of these regional economies, their sectors and subsectors, in 2019. We would do this by utilising the customary style of our previous reports, using infographics to illustrate data consolidated from public databases and diverse online sources.

Using this format would examine each sector and sub-sector individually, assess the state of innovation in each, and develop an "opportunity map" of each, identifying which avenues of progress remain to be explored, which are dead ends, and what are the 'roadblocks' to be cleared. This map will also identify which sectors are hotspots of innovation and which are inert and in need of stimulus.

We will further contextualize this data by comparing the equivalent data between the devolved administrations (Scotland, Northern Ireland, and perhaps London), which, having similar sizes, populations, and degrees of autonomy, and find themselves in direct competition with each other commercially.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry



An example of a section of an innovation ecosystem in Northern Ireland

Proposal for Medical Education and Training Reforms: Prioritising Prevention

Summary:

- P4 medicine has the potential to improve patient care, and provider performance, by helping clinicians make decisions based on vast quantities of data and patterns.
- But doctors and nurses will need to be properly re-trained. Doctors currently are not trained with the idea of prevention and maintenance of an optimal state of health in mind. They are only taught how to treat disease when it has already developed - in other words, sick care.
- Medical schools around the world are increasingly aware of this need and many institutions are beginning to develop courses to enhance physician understanding of genomics.
- Rapid technological change in the UK will require such retraining and rethinking of the roles of clinicians
- The following steps should be taken to support and encourage this culture shift in the United Kingdom: 1) Work to prepare the national education system, at a secondary and tertiary level, for a P4 future, 2) advise fundamental reforms that prioritize preventive treatment in UK medical schools, 3) liaise with organisations such Health Education England (HEE), in order to prepare for retraining, as P4 precision medicine advances.

Written Evidence on Behalf of Aging Analytics Agency to House of Lords Science and Technology Committee's "Aging: Science, Technology and Healthy Living" Inquiry

Artificial intelligence is poised to transform healthcare, and in some areas, is already doing so, and that means doctors and clinicians will need to get to grips with automation, machine learning, advanced algorithms and predictive analytics.

P4 medicine has the potential to improve patient care, and provider performance, by helping clinicians make decisions based on vast quantities of data and patterns. Automated tools are simplifying tasks and allowing doctors to focus more on the clinical side of things.

But doctors and nurses will need to be properly re-trained. Doctors currently are not trained with the idea of prevention and maintenance of an optimal state of health in mind. They are only taught how to treat disease when it has already developed - in other words, sick care. As the paradigm shift from treatment to prevention occurs, fundamental reforms in how medical professionals are trained needs to occur as well. Their already-important skill sets need to be expanded if the technology is to be leveraged properly. That is a challenge, and it requires a culture shift in United Kingdom medical training.

Medical schools around the world are increasingly aware of this need and many institutions are beginning to develop courses to enhance physician understanding of genomics. E.g. In the USA, the University of Utah Health established the four-year Certificate in Personalized Health Care in 2012 to help the next generation of doctors develop the skills needed to practice medicine in the era of genomics. The program offers medical students hands-on genomics experience, including:

- communicating about direct-to-consumer genetic tests results and limitations;
- interpreting results of genomics-based medical tests;
- understanding the role of genetic counselors;
- understanding how drugs interact with a person's specific genetic make-up;
- familiarity with bioinformatics tools to interpret genomic data;
- evaluating patient risk for disease based on genomic information; and
- applying genomic technologies in an ethical, legal, and socially appropriate way.

Rapid technological change in the UK will require similar retraining and rethinking of the roles of clinicians, according to a technology review of the United Kingdom's National Health Service (NHS). In an interim report called *Preparing the health care workforce to deliver the digital future*, Dr. Eric Topol, executive vice-president of the Scripps Research Institute, has stated that while it is difficult to predict the future, we do know artificial intelligence, digital medicine and genomics will have an enormous impact on improving efficiency and precision in health care.

These changes will also transform what it means to be a clinician. Future generations of clinicians will need training in digital literacy and patient engagement to refocus their roles on uniquely human aspects of care. Some health staff will likely need in-depth training to make

this shift, while others will probably only need to know general principles. Technological change and the need to manage increasing amounts of patient data may also give rise to new professional groups, such as clinical data scientists, medical software engineers and digital medicine scientists.

The following steps should be taken to support and encourage this culture shift in the United Kingdom:

- **Liaise with education ministers in England, Scotland, Wales and Northern Ireland** and advise them to prepare these education systems for a P4 future, to assess whether the current education system is sufficiently focused in its medical training, and doctors do not know how to prevent and maintain optimal state of health, disease treatment.

- **Advise the government of necessary reforms that prioritize preventive treatment in UK medical schools** in proportion with the increasing market-readiness of preventive and precision medicine technologies and techniques

- **Liaise with organisations such Health Education England (HEE)** in order to prepare for retraining, as P4 precision medicine advances.

Proposal for Responding to Recent Developments in the UK

Summary:

- Aging Analytics Agency recommends that House of Lords strategise for the most probable alterations to existing industrial strategy arising from political conditions. This strategy should begin with an assessment of the proposed industrial strategy of rival political parties to the government, in particular the Labour Party and Liberal Democrats, and an assessment of various possible future relationships with the EU.
- In the midst of Brexit, House of Lords should support advocacy groups such as the Royal Society in calling for an arrangement with the EU that: Keeps highly-skilled scientists working in the UK and ensures that international talented people still choose to come to the UK and contribute to our globally competitive science, keeps access to money and networks that support the UK to work with scientists around the world, maintains regulatory alignment that allows access to new medicines and technologies.

Possible General Election

Recent developments in political alignment have created the possibility of a general election later in 2019, with a range of possible consequences that have implications for various steps in the above proposal:

- A radical alteration in parliamentary composition.

- A change of government, with the most likely alternative government being Labour-led, with **implications for industrial strategy** (a change in conservative leadership is possible but unlikely to produce significant change in this regard).

- A fragmentation of the British home nations in response to recent political upheavals (Scotland and Northern Ireland in particular). This has implications for the plan **AI Centres for Longevity across Britain's major metropolitan centres**.

- A range of possible relationships with the European Union.

Aging Analytics Agency therefore recommends that House of Lords strategise for the most probable alterations to existing industrial strategy arising from political conditions. This strategy should begin with:

- An assessment of the proposed industrial strategy of rival political parties to the government, in particular the Labour Party and Liberal Democrats.
- An assessment of various possible future relationships with the EU

Brexit

On 18 November 2016, the House of Commons Science and Technology Committee published a report in which it recommended that the Department for Exiting the European Union appoint a departmental Chief Scientific Adviser to 'help ensure that the impact on science and research of various models for Brexit, and the opportunities these provide, is understood and prioritised within the Department'. The Committee also recommended raising the UK's commitment to research to 3% of GDP, the target fixed by the European Union in the Lisbon Strategy in 2000 and reiterated in Europe 2020, 'to demonstrate a determination not only to negotiating a post-Brexit relationship with the EU that is good for science but also to secure opportunities for science collaboration with markets beyond Europe'.

The Committee has pointed out the Swiss experience in particular as a cautionary tale. When the Swiss voted to curtail free movement of people, the EU revoked access to science funding and collaboration, undermining the country's science sector.

House of Lords should therefore use the current period to join the Committee and other advocacy groups such as the Royal Society in calling for an arrangement with the EU that:

- Keeps highly-skilled scientists working in the UK and ensures that international talented people still choose to come to the UK and contribute to our globally competitive science.

- Keeps access to money and networks that support the UK to work with scientists around the world.

- Maintains regulatory alignment that allows access to new medicines and technologies.

Proposal for Establishing Financial Incentives for UK Insurance Companies and Pension Funds

Summary:

- Some countries with the lowest gap between HALE and unadjusted life expectancy, like Singapore, have a life insurance industry ecosystem where major life insurance providers give their clients a number of incentives for maintaining healthy lifestyles and meeting certain preventative health goals.
- The creation of an infrastructure and ecosystem that delivers financial incentives for remaining healthy (AKA, which delivers citizens wealth for retaining health) is a logical bottom-up solution for incentivizing populations to remain healthy for longer periods of time
- House of Lords should consider implementing a proposal to the UK government that offers financial incentives such as tax-breaks and subsidies to life insurance companies that provide similar financial incentives (e.g. discounted insurance premiums) for maintaining specific thresholds of preventive health and for meeting specific health goals, as part of their National Healthy Longevity Industrial Strategy.
- In coordination with this project, House of Lords should also convene a working group to roadmap the use of standardized panels of biomarkers of aging as the main tools for measuring the current state of health of life insurance clients, to be implemented in the next 2-3 years, where additional financial incentives are given to those clients willing to utilize such panels of biomarkers to validate their current state of preventive health in order to redeem discounted insurance premiums.

Precedents here include:

- **AIA Vitality**, a science-backed wellness programme that works to make a difference to a person's health by adding up the benefits of every healthy choice, however small, so they can live a healthy life that's rewarding also. To join AIA Vitality and start enjoying improved health and wellbeing, plus all the savings and rewards, a person must be

covered with an eligible health or life insurance policy through AIA Australia or one of their partners.

- **Vitality** has led the way with its incentive-led schemes now called Vitality Health and Vitality Life (formerly known as PruHealth and PruProtect). When customers sign up to a private medical insurance or life insurance policy – either as an individual or through a workplace scheme – they have to fill out a health review online. They then earn points for healthy behaviour.
- **Aviva** is another insurer that encourages its customers to make healthy lifestyle choices. Customers who take out a Healthier Solutions private medical insurance policy get access to discounts on their premium if they live healthily. They can do this by registering for MyHealthCounts, a free online tool designed to help customers understand their current state of health, and the lifestyle choices that impact upon it. After signing up, customers have to complete an online health questionnaire. Based on this information, the insurer will then calculate their 'Q score', which shows how healthy they are compared to 100 people of the same age, race and gender. MyHealthCounts will then recommend a 12-week health programme to help you improve their health. This can range from increasing physical activity to quitting smoking. It will also include personalised advice and suggestions on how you can become healthier. By improving Q score - and ultimately health, people can receive a discount of up to 15% on their renewal premium.
- Bupa's **Bupa Boost** also offers a range of online health tools and calculators to help people to keep fit and well. Customers can already get access to Bupa's online knee clinic. It has been used by more than 88,000 people since it launched last year. At the same time, Bupa Boost has been designed to help businesses create a proactive healthy culture, and to improve the health and well-being of their workforces. It provides direct phone-based access to a specialist team of nurses and dieticians to help customers suffering from heart conditions. The aim is to encourage people to improve their diet and lifestyle, helping to minimise future health risks.

Conclusions

House of Lords is to be commended for seeking to address the demographic challenge. There is no reason why we should not live up to previous generations' determination and commitment to developing technologies that would have been considered downright miraculous only two decades earlier, such as the lunar travel or the atomic bomb. Those two technologies emerged from a ballistics industry which had recently been brought rapidly to maturity during wartime. We ought to be making the same commitment during peacetime in pursuit of the most precious asset of all: added years of healthy productive life.

- **The lack of government initiative is the latest impasse in the advancement of the Longevity industry**, Aging Analytics Agency has therefore made it its latest special focus. This is reflected in its recent output, such as National Longevity Development Plans: Global Overview 2019 (First Edition), and the appointment of Eric Kihlstrom as Director, with his strategic skill set in the digital transformation of industry reflecting the immediate needs of the Longevity industry at its present juncture. Kihlstrom is a former Digital Transformation Strategy Director with 30+ years of delivering impactful innovation to multinational corporations as well as rapid growth start-ups.
- **The work of government in advancing the Longevity industry consists of national and international initiatives.** The most important possible national initiative possible at the present moment is the integration of big data and healthcare, the lack of which is a current roadblock for further industry growth. The most important possible international initiative at the present moment is leadership: Longevity progressive nations (*a concept described in* Aging Analytics Agency's 2018 document *Longevity Industry Landscape Overview Vol II: The Business of Longevity*) should establish intergovernmental initiatives that will leverage key strengths of different nations in order to launch programs that yield synergistic, multiplicative effects, enabling the sharing of key technologies, resources and experts.
- Aging Analytics Agency has herein proposed the first steps that the United Kingdom must take in order to fulfill the role of a Longevity-progressive country, nationally and internationally. In the latter regard in particular, as argued in *Longevity Industry Landscape Overview Vol II: The Business of Longevity*, the United Kingdom is poised to take on a leadership role.
- **The biomedical technologies and therapies necessary to meet the goal of 5 extra years to the UK's national HALE by 2035 are already in place**, and what is now needed is big data analytics to develop optimal panels of biomarkers of aging and to determine what preventive medicine technologies are effective. Progress hereafter is less of a biotechnology problem (which requires us to wait on biotech breakthroughs), and more of a data mining, analysis and management problem. This, in turn, makes it a government problem to some extent, as only government-led initiatives would be

capable of providing the necessary infrastructure for such a project on a national level. This bring us to the topic of **national initiatives**.

- **House of Lords should establish a task force to estimate the minimum required budget for the National Longevity Development Strategy.** At the very least this budget would be no less than 200 billion GBP spread across five years. This is just 40 billion a year, just 10.4% of the combined annual expenditure on health spending (145 billion) and social protection spending (240 billion). is of the utmost importance as a major (if not the most important) national agenda item for the state considering the economic burden it will face due to ageing population in the coming years. This may seem large, but the silver tsunami is an ineluctable priority, and if the UK does not act now it will miss its window of opportunity and suffer the same fate as Japan. **But** there are ways of covering this cost while still lowering or maintaining government expenditure. For instance, a large portion of the budget could potentially be covered through private investments by corporate partners, much in the same way as was done for the government's AI Industrial Strategy Grand Challenge Fund.
- **The *National Strategy for 5 More Years of Healthy Life Expectancy by 2035* document does not give sufficient emphasis to the necessary role of AI and big data, or the necessary role of international cooperation.** AI can be harnessed as an exponentially-accelerative technology for almost all areas of biomedical, financial and social innovation proposed as part of the plan. And actual progress could be accelerated by leveraging the specific strengths and resources of other countries, and by learning from the proven best-case examples already implemented elsewhere. In addition to international cooperation, we also recommend cooperation between government ministries, departments and agencies, laboratories, BioTech hubs and other R&D hubs, AgeTech hubs, and relevant start-ups, corporations, NGOs and non-profits. The first step in this process is the formulation of a large database of potentially relevant partners and counterparties.
- **House of Lords needs to incorporate the use of maximally-relevant metrics for measuring Healthy Longevity**, in order to formulate a relevant, tangible and actionable Framework and Blueprint for a National UK Industrial Strategy for Healthy Longevity, and specifically for measuring the effectiveness of its initiatives by examining the cost of its initiatives versus the practical effect they achieve in terms of increasing national Healthy Longevity. Aging Analytics Agency compiled a comprehensive list of metrics and parameters with specific weight factors to conduct its analysis of National Longevity Development Plans in various regions globally, and can provide key strategic insights into the analytical basis used during the formulation of the Framework and Blueprint for a National UK Industrial Strategy for Healthy Longevity.
- **The impact of government initiatives on the psychological wellbeing of the elderly therefore deserves to be among the core panel of metrics**, and already

features heavily in *National Industrial Strategy Development Plans Global Overview 2019 (First Edition)*.

- **House of Lords should form a task-force and working group on the formation of several leading AI Centres for Longevity**. These would apply the latest advances in AI, Precision Health, Preventive Medicine and Biomarkers of Aging to accelerate the development of technologies, methods and services to increase the UK's National Healthy Longevity. Currently there are only 3 centres in the world actively seeking to fulfill this role: the US-based Buck Institute for Research on Aging, US-based Y Combinator, and the US-Hawaii AI Precision Health Institute. King's College London should be used as the site of the first AI centre for longevity (due to its location and unique combination of facilities). This should be established in 2019 and further developed in 2020, whereupon it should serve as a precedent for AI centres for Longevity across the UK's metropolitan centres.
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- **House of Lords should convene a working group to focus on ways to support under-represented niches in Precision Medicine** (such as personalised microbiome diagnostics and therapeutics) that have a high degree of actionability and ease-of-implementation, but that are comparatively underrepresented in the larger R&D landscape. One additional point of focus should be on the development of microbiome-based approaches to improving the efficacy of drug development and delivery.
- **House of Lords should launch a Longevity Startup Accelerator**. There are currently only a handful of Longevity startup accelerators active globally. The most relevant example for House of Lords to use in considering the development of its own Longevity startups accelerator, is Innovation Warehouse's AgeTech and Longevity Hub.
- **House of Lords should launch a professional association of Longevity angel and early stage venture investors** to support increased investments into the UK Longevity Industry and ecosystem.
- **House of Lords should launch a task force** aiming to increase the level of both financial and non-financial support of UK Longevity-focused charities and non-profit organizations.
- The latter three initiatives are related, but we recommend them being launched by independent task forces and structured as structure them as distinct and independent organizations, due to the differing agendas of each type of entity.
- **House of Lords should form a task-force to develop a plan to turn the UK into a world-leading Longevity Financial Hub**. This should seek to convert the looming demographic crisis into an opportunity. With relevant sources of strategic consulting, the UK is in an extremely strong position to become a world-leading Longevity Financial Industry Hub, through the concentrated development of progressive financial reform and technologies, including Longevity-focused FinTech, InvestTech and

GovTech projects, combined with novel Longevity-related financial instruments and advanced derivatives. And with the right financial synergies and technologies in place, Longevity produces economic dividends.

- **House of Lords should establish a specific task force and working group for creating a dedicated governmental Division for International Longevity Cooperation**. This brings us to the above-mentioned topic of **international initiatives.** This should build industrial and technological bridges between the UK and other Longevity-progressive regions such as Israel, Singapore, Switzerland and the USA. It will do this by identifying equivalencies between various government departments and ministries, liaising with Longevity APPGs (or their equivalents) in other countries, normalize the measure of progress globally by applying the aforementioned metrics to the circumstances of each region, thereby minimising replication of efforts and ensure that each country is playing to its own specific strengths. Aging Analytics Agency can provide crucial guidance here. Furthermore, In order to conduct this, we believe it will be necessary to appoint a set of "ambassadors", one per major world region.
- **House of Lords should convene a task-force to create a roadmap for the establishment of AI Centres for Lifetime Wellness.** The establishment of dedicated centres focusing on providing companies active in this space with advanced AI-driven support and solutions would both serve to generate sizeable revenues by selling and licensing methods and technologies to these companies, and also help optimize products and services aiming to improve the overall, lifetime wellness of elderly individuals in all aspects of life besides health.
- **House of Lords should establish a task force to create a roadmap for ways that the UK government can support elderly entrepreneurship and employment**. It should consider the creation of a dedicated accelerator for elderly entrepreneurs, the formulation of Government-led initiatives such as tax breaks and incentives to support the growth of elderly entrepreneurs, eliminating business taxes and employment taxes for people over 60+ years, and offering grants for businesses creating technology solutions for the elderly.
- **House of Lords should support the development of an Actionable, Implementable Panels of Biomarkers of Ageing.** The Scientific Advisory Board should make this one of their top priorities. This means a panel of biomarkers that has the highest ratio of comprehensiveness to actionability and implementability. A panel of less precise but highly implementable biomarkers of ageing is much better than an extremely precise and comprehensive panel of biomarkers of ageing that is too hard or expensive to translate easily into practical use.
- **House of Lords** initiate the development of a comprehensive database of partners and relevant counterparties (government ministries, departments and agencies, laboratories, BioTech hubs and other R&D hubs, AgeTech hubs, and relevant start-ups, corporations, NGOs and non-profits) who can potentially serve as partners for the execution of the UK Healthy Ageing Industrial Strategy Challenge Fund

- **House of Lords should use the data, analytics and conclusions from Aging Analytics Agency's 2019 report** *Comparative Analysis of Health-Adjusted Life Expectancy (HALE): Global Landscape Overview* as part of the structuring of its Blueprint and Framework for a UK Healthy Aging Industrial Strategy.
- **House of Lords should launch a task force focused on roadmapping a longer-term strategy to extend national healthy Longevity past 5 years** to begin roadmapping longer-term strategies, and prioritized support and financing of key biomedical technologies that can be quantitatively predicted as necessary for the later-stage extension of HALE in the years and decades following the achievement of increasing national HALE by 5 years. This would not necessitate any radical innovations in biomedicine, but simply the optimization of existing, known and proven best-practices and technologies in preventive medicine.
- **House of Lords should launch a task force to roadmap the launch of a nation-wide network of unmanned, AI-assisted preventive diagnostics booths.** This is not complex, and does not require intensive efforts at innovation, but rather the simple optimization and application of existing technologies. It can be considered to be for the most part a data aggregation and management issue.
- **House of Lords should establish a Division for the Identification of Sites for AI Centres for Longevity.** It should enumerate the tasks involved in the procedural pipeline of a P4 clinic, identify the characteristics of an ideal site, regarding King's College as currently optimal, and assess the resources , facilities and infrastructure of each possible site.
- **House of Lords should establish a division for cooperation across devolved administrations.** Many of the proposals contained in this document run into jurisdictional issues, and may involve multiple layers of government, each governed with conflicting priorities. As such a group should be set up to identify when in the course of the above proposals any such issues threaten to arise, and how they can be overcome.
- **House of Lords should consider allowing Aging Analytics Agency to assist with innovation ecosystem mapping for regions outside London.** The agenda described herein calls upon the full resources and facilities across the whole of the United Kingdom and yet many of them are situated in economically depressed areas or areas which do not function as technology hubs. This situation can be improved, but it calls for the creation of creation a 21st century data infrastructure for connecting and optimising Scotland, Wales and Northern Ireland's Longevity innovation economies, as well those of Greater London and the "Northern Powerhouse".
- **House of Lords should work to prepare the national education system, at a secondary and tertiary level, for a P4 future,** advise fundamental reforms that prioritize preventive treatment in UK medical schools, and liaise with organisations such Health Education England (HEE) in order to ensure rapid retraining as precision,

personalisation and preventiveness of medicine increase.

- **House of Lords should remain alert and responsive to recent and impending political and constitutional developments in the UK**, such as a change of government in the autumn, and constitutional ramifications of Brexit. In particular it should examine the proposed industrial strategies of the major parties, Labour and the Liberal Democrats especially.

Whereas this agenda may seem bold, the state of maturity of biotechnology, and the likely exponential rate of progress in precision medicine, and the extent to which further progress is largely a question of improving methods of data aggregation, analysis and management make all of this entirely feasible.

There is no reason why we should not live up to previous generations' determination and commitment to developing technologies that would have been considered downright miraculous only two decades earlier, such as the lunar travel or the atomic bomb.

Those two technologies emerged from a ballistics industry which had recently been brought rapidly to maturity during wartime. We ought to be making the same commitment during peacetime in pursuit of the most precious asset of all: added years of healthy productive life.

Glossary of Key Concepts and Terms Referenced in the Text

HALE (Health-Adjusted Life-Expectancy)

HALE, a specific measure of healthy Longevity, is an indispensable metric for Aging Analytics Agency. Today's increased global Longevity is a "problem of success", an inevitable consequence of sharp increases in sanitation, diet, health care, elderly care, and geriatric medicine, a set of changes which have occurred suddenly within the lifetimes of today's elderly.

But this increased Longevity is not a consequence of decreased aging; this life extension is not accompanied by a commensurate extension in health. As a result, increased global Longevity is producing a global aging demographic, an impending crisis frequently referred to as the "silver tsunami". In order to float rather than sink, Longevity must become an asset. And this means altering the nature of aging entirely, reducing the period of financially and socially inactive decrepitude at the end of life.

Specifically, it means utilizing technology to ensure that these longer lives are also healthy, productive, financially active lives, and creating a system of government frameworks and financial incentives to create and sustain this case of affairs.

The most important technical metric for this task is HALE (health-adjusted life-expectancy). It belongs to a set of metrics known as HALYs (health-adjusted life-year). It includes HALE, a measure of population health that takes into account mortality and morbidity, Quality-adjusted life years (QALYs) and disability-adjusted life years (DALYs), the latter being types of HALY whose original purposes were at variance.

Uses of the HALE include:

- Research on healthy ageing encompasses: the biological processes contributing to ageing per se; the socio-economic and environmental exposures across life which modulate ageing and the risk of age-related frailty, disability and disease; and the development of interventions which may modulate the ageing trajectory. Such research needs measures of health span which, in addition to chronological age, can characterise and quantify important functions which are subject to decline at faster, or slower, rates during individual human ageing. Furthermore, it is impossible to determine whether biotechnologies for aging have been successful if we cannot tell how advanced the aging process is in any given individual.
- The role of government strategy is of immediate importance in advancing the Longevity industry from its present point, and governments must be able to monitor and describe biomedical progress. Metrics for tangible progress are absolutely essential component of any government strategic agenda. It will be impossible to make concrete claims regarding global progress in biotechnology - and in preventive medicine in particular - without an agreed set of metrics
- HALE serves as a crucial metric type in many Aging Analytics Agency reports and publications, most notably National Longevity Development Plans: Global Overview 2019 (First Edition).

Aging Analytics Agency has conducted in-depth analysis of this question and compiled its findings in their volume: " Enhanced Analysis of Global Healthy Longevity: Determining What Factors Impact Health-Adjusted Life Expectancy (HALE) for 50 Countries. "Some key preliminary findings include:

- Low GDP per capita correlates with low HALE and LE and vice versa higher wealth of the country corresponds to higher HALE
- For countries with lower level of GDP per capita increase in healthcare expenditures correlates with increase in HALE. But for countries with high level of wealth increase in healthcare spendings does not lead to growth of HALE because higher spendings are caused by high medical prices.
- Countries with high level of urbanisation have high HALE as more people have better access for medical treatment and appropriate infrastructure.
- Countries with stable economic conditions have higher HALE. In contrast, economic instability affects negatively on the level of life and HALE.
- High level of disease corresponds to decrease in health and decrease in HALE.

- Developing countries have higher birth and fertility rate which corresponds to lower HALE. Developed countries have lower birth and death rate and higher HALE and LE.
- Advances in medicine and medical technology have had a major impact on increased longevity. Development of antibiotics and immunizations, as well as improvements in imaging, surgery, cardiac care and organ transplants all have helped push the average life expectancy higher.
- Obesity leads to increase in gap between HALE and LE.
- Women live longer than men, on average. They are diagnosed disease later than men.
- There appears to be a link between genetic factors and mortality rates. The leading causes of death include heart disease, cancer, chronic lower respiratory disease, accidents, stroke or cerebrovascular disease, alzheimer's disease, diabetes, influenza and pneumonia.
- As socio-economic status decreases, so does life expectancy, according to the IFA. Among other things, socio-economic status can affect a person's ability to access adequate medical care and their participation in healthier lifestyle habits like exercising more, smoking less and maintaining a healthy weight.
- Improved infrastructure correlates with better health and higher HALE
- Historically, lifestyle factors that affect mortality include an unhealthy diet, inadequate exercise, tobacco use, excessive use of alcohol, risky behaviors, food safety.

AgeTech

AgeTech is an emerging subset of the HealthTech sector that focuses on technology and innovation to improve the lives of older people. The industry encompasses all products and services that enable the elderly to remain, functional members of society, capable of executing the day-to-day activities. These most typically consist of IT-related products and services, such as smartphones, tablets and computers optimized for ease-of-use for those aged 60 and over, or novel banking interfaces and services that enable the elderly to conduct their daily banking with less difficulty, and which protect them from financial fraud.

AgeTech companies consist of both startups and established consumer-focused institutions and technology companies. These companies are innovating to replace or enhance existing solutions and technologies and gain improved competitive advantage. Age technology has been used to improve aspects of insurance, domiciliary care, residential and nursing homes and health care. The services may originate from various independent service providers or the interconnection of devices and services, through the Internet of Things.

Over the next few years, AgeTech will likely be featured as complementary functions within a single product or service. The financial industry is likely to see the emergence of what can be referred to as AgeTech banks, a novel type of institution focused on simplifying banking for people over 60. What is certain is that the senior demographic is multiplying and are

increasingly receptive to using familiar technology. AgeTech will continue to rapidly expand to improve longevity, promote independent living and deliver peace of mind. AgeTech industry is expanding in a synergetic and coordinated manner with both Longevity and WealthTech. Longevity enables AgeTech, AgeTech merges with WealthTech, WealthTech supports Longevity. This makes their ongoing emergence and growth almost inevitable.

AgeTech and WealthTech

WealthTech is one of the subsections of FinTech. It refers to the usage of cutting-edge technologies such as artificial intelligence and Big Data, to provide an alternative to traditional wealth management firms. WealthTech companies are advancing the investment and wealth management profession and offer various solutions and platforms ranging from full-service brokerage alternatives, automated and semi-automated robo-advisors, to self-service investment platforms, asset class-specific marketplaces, and investing tools for both individual investors and advisors.

The WealthTech industry comprises any product or service (again, almost invariably IT-based) that either simplifies or enhances the creation and maintenance of wealth - from savings to investment - for all ages of society.Over the next few years, we can expect to see the WealthTech industry become more old-age-oriented, offering an increasing number of products and services to those aged over 60 as the proportion of citizens in retirement continues to grow. Most asset management sectors incorporate artificial intelligence into their research & development. In wealth management, decisions form a crucial part.

Artificial intelligence could thus help managers make effective decisions for their clients by automatically research troves of data in collaboration with quantum computing and providing the best results each time. Considering the changes that WealthTech has introduced to the financial sector up to this point, we can certainly look forward to innovations. Wealth management firms and financial institutions are thus in the process of developing an environment that is conducive towards the development of self-services for their clients.

WealthTech has transformed the way advisors and consumers approach wealth management. It has brought new challenges, but also new opportunities to the market. For WealthTech startups, this means coming up with fresh ideas to apply technology while focusing on data security, predictive analytics, and more. For financial advisors, it involves providing value that goes beyond the capability of algorithms. We can expect to see the creation of novel investment strategies targeting elderly individuals. Software automation and the use of innovative technologies in wealth management will in a great way help advisers with useful audibility and increase traceability, thus provide reductions in liabilities. In tandem, we can anticipate seeing the rise of novel investment strategies emerge for various kinds of institutional investors interested in becoming active in the growing longevity financial industry, from small venture funds up to national sovereign funds.