

Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



Official Response, Analysis of Report & Benchmarking of Recommendations

February 15, 2021

Official Response, Commentary and Analysis of UK House of Lords Science and Technology Select Committee's 'Ageing: Science, Technology and Healthy Living' Report by Aging Analytics Agency

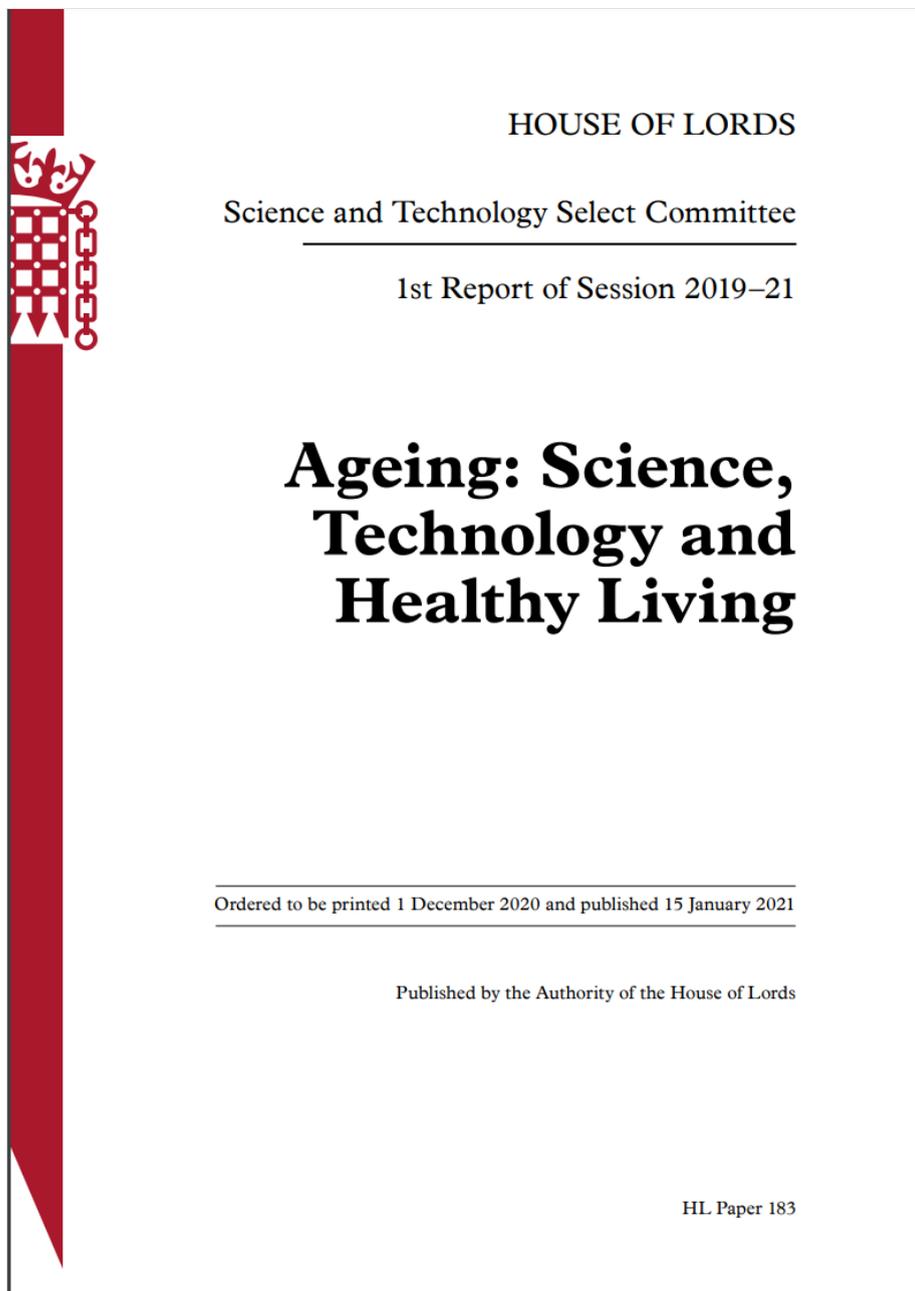




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Introduction

At the beginning of 2021, the House of Lords Science and Technology Select Committee released [Ageing: Science, Technology and Healthy Living](#), a document containing a number of concerns and criticisms of the UK Government's current management of the Aging Society Grand Challenge; a part of the industrial strategy laid out in 2017 by the Department of Business, Energy and Industrial Strategy (BEIS); and, in particular, the goal stated within the strategy literature and subsequently restated by government ministers of extending Health Longevity of UK residents by 5 years before 2035.

Interspersed with these concerns were a total of 22 recommendations for the government on how to adjust and improve its strategy, which, the Committee argues, is not on the trajectory that is necessary to meet its 2035 target.

Aging Analytics Agency originally [provided evidence](#) for the House of Lords Science and Technology Select Committee's [Ageing: Science, Technology and Healthy Living](#) in 2019, during their initial call for inputs, in which we included our own set of recommendations:

Alphabetical list of witnesses

**	Academy of Medical Sciences (QQ 181–187)	INQ0078
	Action on Hearing Loss	INQ0013
**	Age UK (QQ 72–78)	INQ0077
	Agile Ageing Agency	INQ0052
	Aging Analytics Agency	INQ0043
	Alzheimers Research UK	INQ0092
	Professor Katherine Appleton	INQ0035
	ARCO (Associated Retirement Community Operators)	INQ0085
*	Association of British HealthTech Industries (ABHI) (QQ 159–169)	
*	Association of the British Pharmaceutical Industry (ABPI) (QQ 181–187)	
	Babraham Institute	INQ0070

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This is in accordance with our vested interest in Longevity Industry progress, which our analytics indicate has reached a point at which government coordination is a critical factor for continued progress.

Aging Analytics Agency has prioritised the proactive development and support of the international Longevity policy arena for the past several years through several coordinated activities. It serves as a supporting partner of the All-Party Parliamentary Group (APPG) for Longevity, a founding partner of the APPG's secretariat; Longevity International; and an Official Member of the United Nations NGO Committee on Ageing. The former interim director of the Ageing Society Grand Challenge, Eric Kihlstrom, served as our director from 2019 to 2020.



Over the past two years, Aging Analytics Agency has published several special analytical case studies focused on international Longevity Policy and Governance, detailing the industrial strategies of the world and how close each comes to meeting the challenge of increasing healthy life expectancy and transforming Health Longevity from an economic threat into an opportunity and potential future asset.

Aging Analytics Agency's first major Longevity Policy and Governance project was its case study, '[National Longevity Development Plans: Global Overview](#)', which was presented at an APPG for Longevity Strategic Advisory Board meeting in UK Parliament on 30th April 2019 and at the APPG's official launch event in UK Parliament on 7th May 2019.

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UK Secretary of Health & Social Care at the APPG for Longevity Launch

NATIONAL LONGEVITY DEVELOPMENT PLANS: GLOBAL OVERVIEW 2019 (First Edition)

Launch of the UK All-Party Parliamentary Group (APPG) for Longevity, House of Commons

Aging Analytics Agency Co-Founder Dmitry Kaminskiy and Strategic Director Eric Kihlstrom alongside The Secretariat with Rt Hon Damian Green MP (APPG Chair), The Lord Filkin CBE (Advisory Board Chair), Professor Andrew Scott (Advisory Board Member) and Rt Hon Matt Hancock MP, Secretary of State for Health and Social Care at the Launch of the APPG for Longevity, where Aging Analytics Agency's Global Longevity Governance Report was Premiered, distributed and discussed.

At that meeting, Aging Analytics Agency representatives argued that the UK Government needs to extend existing efforts and create a framework to change the deficit model of the 'Ageing Society' into an asset model around 'Longevity' and be bold in developing a national strategy to harness the 'Longevity Dividend' to benefit all people in society. Indeed, even in May 2019, a recognition of the UK's specific strengths and resources and potential leadership position was among the conclusions to come out of that project.

As our then-director Eric Kihlstrom stated in the report's press release, *"This report not only shows that the UK is an international leader of Government-led Longevity development initiatives but also highlights key next steps the nation can take to optimise its strategic execution of future initiatives. The UK has most of the required compounds in place to make the best possible assembly of resources to shift the nation's focus from the problem of ageing to the opportunity of Healthy Longevity and ignite the coordinated development of a world-leading intersectional Longevity, Advanced Biomedicine, Artificial Intelligence and Financial Industry Hub."*

This was a conclusion which Aging Analytics Agency had already reached during the production of its regional landscape overview of the UK Longevity Industry, the [first edition of which](#) was

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produced in Q3 2018, and the [second expanded \(1000+ page\) edition of which](#) was published in, profiling 260 Companies, 250 Investors, 50 Non-profits, 25 Research Centres and 55 UK Longevity Influencers and Thought-Leaders.

As Aging Analytics Agency Founder Dmitry Kaminskiy stated in that report's official press release, *"A new industry is more than just a collaboration between existing industries. It means a new direction, with new objectives and new metrics. This requires intelligent co-ordination. And in the British political tradition, this means a governing body equivalent to the UK's recently created Ministry for AI. Only when we begin to see Lords committees and government ministries explicitly concerned with Longevity, can we confidently claim there is a Longevity Industry decisively underway in the UK."*

Aging Analytics Agency followed up on this series of reports with another special analytical case study, '[Global Longevity Governance: 50 Countries Big Data Analysis of Longevity Progressiveness](#)', which uses multidimensional big data analytics (200 parameters applied to 50 countries, encompassing 10,000+ data points in total) for intelligible and fact-driven benchmarking of 50 nations in relation to levels of Healthy Longevity as measured by Health-Adjusted Life Expectancy (HALE); their current gaps between HALE and unadjusted life expectancy; their current levels of success in growing and maintaining National Healthy Longevity and dealing with the issue of ageing; and tangible policy recommendations on how to either maintain or improve their standing and optimise their National Healthy Longevity.



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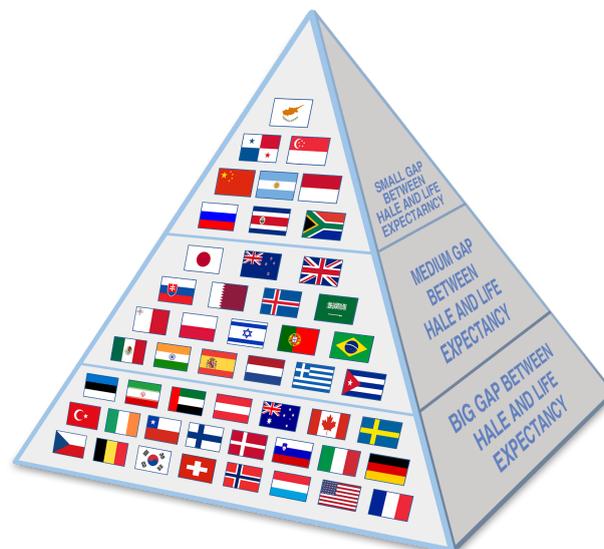
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By analysing the specific circumstances of Longevity outliers – nations with an unusually large or small gap between Health-Adjusted Life Expectancy and unadjusted life expectancy – the special case study can derive insights into the factors likely to either increase or decrease this gap.

The healthcare system in Singapore, for example, appears more geared towards raising up all its citizens than achieving excellence in a few high-profile areas. By contrast, the United States (which is the subject of another 2020 policy-focused analytical report by Aging Analytics Agency, "[Metabesity and Longevity: USA Special Case Study](#)", produced in partnership with 'Targeting Metabesity 2019', the USA's most popular Longevity Policy-oriented conference, held in Washington D.C each year) spends a disproportionate amount on healthcare and yet has the lowest levels of healthy life expectancy among high-income developed countries.

Singapore	United States
HALE: 76.2	HALE: 68.5
HALE GAP: 6.7	HALE GAP: 10.0
Life Expectancy: 82.9	Life Expectancy: 78.5
Healthcare Efficiency Rank: #2	Healthcare Efficiency Rank: #25
% GDP Healthcare Spending: 4.5%	% GDP Healthcare Spending: 18%

The United Kingdom was ranked 15th in Longevity Progressiveness in that special case study – not because it lacked either the resources or the political will to transform the challenge of an ageing population into the opportunity of optimised National Healthy Longevity, but because it had failed to leverage synergies efficiently between its existing strengths, learn from the best and worst-case examples abroad, manage its resources, and coordinate developments across policy, science, healthcare and industry in a truly effective manner.



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It is also notable that, in addition to its Healthy Ageing Industrial Strategy, the UK is also seeing a rise in local and municipal industrial strategies that place Longevity and Healthy Ageing at the forefront of their vision. One excellent example is the industrial strategy of the Greater Manchester Combined Authority.

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Specialist agency will profile Greater Manchester's healthy ageing assets



Business news
March 03 2021
Neil Hodgson



Write a comment



Dmitry Kaminskiy

Greater Manchester is seeking to exploit the growing 'grey economy'.

Highlighted as one of the UK's four grand challenges in the Government's Industrial Strategy, ageing populations across the world are driving demand for new technologies, products and services and the region is in a prime position to take advantage of this global change.



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MIDAS appoints specialist agency to profile Greater Manchester's healthy ageing assets

3 March 2021

Category: Life Science and Healthcare



Related sectors

Life Science and Healthcare

Highlighted as one of the UK's four grand challenges in the government's Industrial Strategy, ageing populations across the world are driving demand for new technologies, products and services and Greater Manchester is in a prime position to take advantage of this global change.

Already recognised as the UK's first age friendly region by the World Health Organisation, MIDAS - Greater Manchester's inward investment agency has appointed a specialist company, Aging Analytics Agency to characterise Greater Manchester's strengths to support a rapidly growing longevity industry.

Aging Analytics Agency was recently appointed by MIDAS (Manchester Investment Development Agency Service), the inward investment arm of the Greater Manchester Combined Authority, to conduct an analytical survey and profiling of the municipality's healthy ageing assets (companies, investors, R&D Hubs, etc), to strengthen and help the local Manchester government to meet the goals set out in its Local Healthy Ageing Industrial Strategy. While Manchester is the first municipality that we are aware of to independently make the Healthy Longevity of their citizens a political priority, we are confident that that others will soon follow.



Tim Newns

Tim Newns, MIDAS chief executive, said: "With a growing population, Greater Manchester has put healthy ageing at the heart of its Local Industrial Strategy and is creating a city region test bed to trial close-to-market goods and services for older people.

"I have every confidence that the work undertaken by Aging Analytics Agency will further widen and cement our proposition as an international leader in this field and showcase Greater Manchester as the ideal environment to take advantage of this ever-growing market.

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There is a possibility that such local hubs may even make more progress on this front within their own borders than the UK Government by tapping into expert resources in order to profile and benchmark their local assets, refine their local strategies, and leverage the less cumbersome governmental bureaucratic structures and systems to execute their visions faster and more economical.

Therefore, the challenge and opportunity of optimising the UK Government's plan of action and execution of its own Healthy Ageing Industrial Strategy becomes all the more clear, pressing and important.

Longevity Policy and Governance, both domestically and internationally, remains a major strategic priority of Aging Analytics Agency, and our efforts in providing useful toolsets to help strategic decision makers obtain a clearer understanding of the present state, challenges and opportunities within their own regions will only increase as the issue of Longevity becomes increasingly recognized among national governments. Our most recent project in this regard is the [Longevity Policy and Governance Dashboard](#).

The dashboard uses Big Data analytics, AI, and deep learning algorithms for the profiling, comparative analysis, benchmarking, automated SWOT analysis and semi-automated practical recommendations for national and municipal Longevity Policy strategies and initiatives tuned to the specifics of individual territories, providing the necessary set of tools to enable national governments; individual economy, healthcare and industrial development industries; international policy organizations; and other responsible stakeholders to formulate and implement policies and

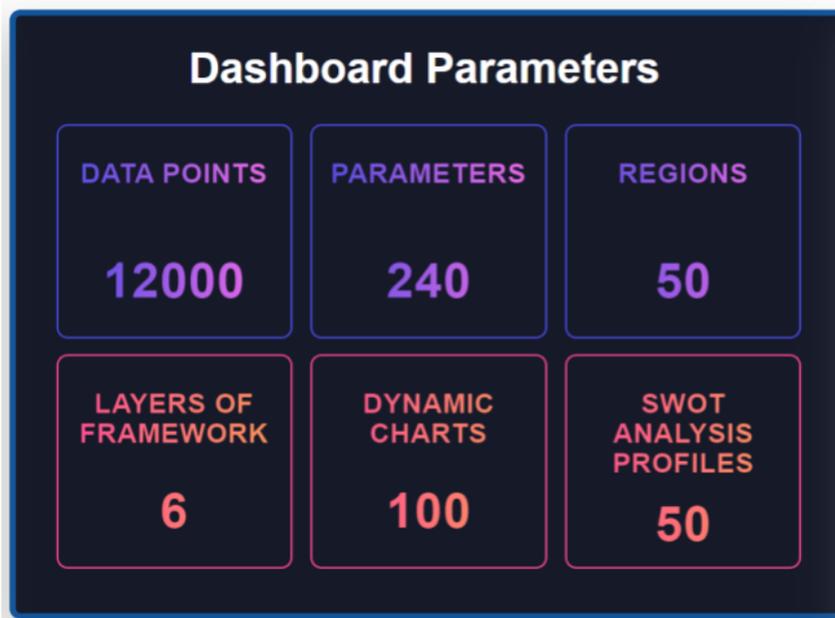
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development strategies capable of transforming the challenge of ageing into the opportunity of Healthy Longevity, for the mutual benefit of their citizens and their economy.

The analytical technologies and approaches applied in the dashboard were first developed and validated as part of Aging Analytics Agency's Longevity Industry dashboards, but have recently been re-tuned and applied to the arena of Longevity Policy, which is even more complex to model and make predictive forecasts for than the Longevity industry, since it involves interaction between not just technologies and industry players, but also national healthcare systems, financial systems, governmental policy and society, all at once.



- Reinforcement learning for comparative Longevity Policy analysis
- Longevity policy initiative and development plan benchmarking (ranking)
- Semi-automated SWOT analysis on region-specific Longevity governance and policy projects
- Semi-automated Practical recommendations to optimize Longevity policy and governance strategy

The dashboard alpha available at www.aginganalytics.com/longevity/governance-dashboard, with several more advanced features planned to be rolled out as part of the dashboard Beta, which is scheduled for release in Q2-Q3 2021, includes reinforcement learning for comparative Longevity Policy analysis; automated Longevity Policy initiative and development plan benchmarking (ranking); automated SWOT analysis on region-specific Longevity governance and policy projects; and semi-automated practical recommendations to optimize Longevity Policy and Governance strategy.

Moreover, as these Longevity Policy-focused projects have become increasingly developed and refined, both their strengths and advantages – as well as the insufficiently leveraged resources, potentials and opportunities at the UK's disposal – have become increasingly clear.

With these goals in mind, we now turn our attention to the House of Lords Select Committee's strategic review of the government's progress in this area, in order to offer our official response,

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analysis and commentary on the concerns and recommendations put forward in the report, and to perform a ranking and benchmarking of those recommendations according to their degree of importance within the context of the UK's current situation and technological, scientific, industrial and political specifics.

The Committee should be commended for holding the government to account on a matter of such crucial importance to the physical and economic health of humanity and for advancing the conversation begun in 2017 in a direction more aligned with what we would consider optimal.

This optimal direction for the future of the Aging Society Grand Challenge of the UK's Industrial Strategy is best understood if we first consider Aging Analytics Agency's long-term vision for the industrialisation of Longevity.

Since its establishment in 2013, Aging Analytics Agency has supported the vision of a global Longevity Industry.

The concept of a Longevity Industry first emerged informally among the community of supporters of advanced ageing biomedicine at the turn of the twenty-first century, before being formalised, developed and expanded in the literature of Deep Knowledge Group, and is increasingly recognised in financial publications and mainstream media as a reaction of global industry to the global ageing population or 'silver tsunami'.

In these later contexts, the Longevity Industry is discussed as a specific, largely propositional future industry whereby people alive today benefit from technologies (biomedical, digital, and financial) which facilitate longer, healthier working lives, enabling them to live to benefit from increasingly more advanced biomedicine.

This industrialisation of Longevity would be considered complete when, under such circumstances, Health Longevity (especially as measured by metrics such as HALE) can be regarded as an asset class in itself.

This would require, among many other things, a political program for increased Healthy Longevity in the UK, which would necessarily involve a combination of

- Biomedical research
- Innovations in preventive medicine and elderly care
- Financial reform of the NHS
- Pension fund reform
- A move towards a more prevention-based approach to healthcare.
- As an early first step, combining AgeTech and progressive social policies in a manner that keeps seniors functioning healthily for longer.

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We therefore commended the Department for Business, Energy and Industrial Strategy when in 2017 they made an explicit commitment to recognising the 'Ageing Society' as one of the four Grand Challenges of the nation's Industrial Strategy, and we responded with our own set of proposals to the APPG for Longevity, the [UK House of Lords Science and Technology Select Committee](#) and others.

This challenge, however, originally defined as "*Ageing populations will create new demands for technologies, products and services, including new care technologies, new housing models and innovative savings products for retirement*", had the following shortcomings:

- It was defined primarily as a strategy for coping with, rather than ameliorating, the ageing of society.
- The policy papers and official statements which defined the Grand Challenge fell short of explicitly acknowledging Health Longevity as a dividend in itself or as a metric for success in the implementation of this strategy.
- There was also no **explicit** commitment to healthy lifespan extension through biomedical means (as opposed to addressing diseases and infirmities separately). Official Government literature summarising the Aging Society Grand Challenge mentioned nothing about biomedicine or even preventive medicine.
- Much was made of coping with "new demands", but there was no mention of the potential economic dividends that may result from a healthy longeval population.
- Records of parliamentary discussions which placed these 'Grand Challenges' side-by-side reveal a lack of sufficiently comprehensive understanding of how progress in the 'AI and Data' Grand Challenge might accelerate progress in the 'Ageing Society' Grand Challenge. In fact, AI has a great many implications for the future of lifespan and healthspan, ranging from AI in AgeTech (e.g. smart homes, virtual assistants and chatbots) to AI in Biomedicine (e.g. AI-driven drug discovery for Longevity-focused drugs and therapies).

The UK can do better and needs to address not only the 'Ageing Society' Grand Challenge but also the 'Healthy Longevity' challenge from which it is inextricable.

We are therefore grateful to the House of Lords Select Committee for building significantly upon the initial "bare bones" of the 2017 challenge definition. For example, the whole of Chapter 3 of [Ageing: Science, Technology and Healthy Living](#), titled *The Science of Ageing*, enumerates in great detail various biomedical theories of ageing, and much is made throughout the rest of the report of the role of data-driven services, robotics and AI. We regard it as highly commendable and bold to bring these concepts directly into the political realm.

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Moreover, Aging Analytics Agency stands at the crossroads of all the relevant disciplines mentioned in the chapter, and indeed the rest of the document, occupying a pivotal position in the emerging Longevity Industry.

We are therefore well-situated to help simplify and prioritise these concepts so that they become permanent features of future political discussion, thus making the subject less opaque in the eyes of decision makers and giving politicians the language and conceptual framework necessary to discuss, envisage and develop a final vision for the future.

Aging Analytics Agency herein offers to the Committee two separate critiques of the Committee's recommendations on the government's progress in this area:

The first, Commentary on Key Recommendations and Concerns, provides Aging Analytics Agency's analysis and commentary on a select set of points from the Committee's document which are representative of the Committee's general approach and the direction in which the UK House of Lords Science and Technology Select Committee appear to be seeking to move government policy.

The second, Recommendation Benchmarking, deals with each recommendation individually, assigns each a score based on its merits, and rank orders them according to a classification framework designed to highlight what Aging Analytics Agency has concluded is the optimal strategy for maximising healthy lifespan in the shortest time frame possible.

The next section, **Keypoint Summary**, contains a summary of Aging Analytics Agency's key recommendations to the UK Government and associated departments (the Healthy Ageing Industrial Strategy Challenge Fund, UKRI, NIH, and others), prepared in response to the set of recommendations made in *Ageing: Science, Technology and Healthy Living* and organised according to key concerns (marked in italicised text) presented in that document. These recommendations are presented in full in the section **Commentary on Key Recommendations and Concerns**.

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Commentary and Analysis of Key Recommendations and Concerns in "Ageing: Science, Technology and Healthy Living"

The present section begins with a brief summary of Aging Analytics Agency's key recommendations to the UK Government and associated departments (the Healthy Ageing Industrial Strategy Challenge Fund, UKRI, NIH, and others), prepared in response to the set of recommendations made in *Ageing: Science, Technology and Healthy Living*, and organized according to key concerns (market in italicised text) present in the House of Lords' report.

This is presented under the heading "Keypoint Summary of Aging Analytics Agency Recommendations." Following this, an in-depth analysis and commentary on the full set of concerns and recommendations contained within *Ageing: Science, Technology and Healthy Living* is presented, point by point, according to the order in which they are raised in that report.

For each Committee recommendation or concern cited, Aging Analytics Agency supplements it with our own recommendations, framed in reference to each concern and recommendation present within the report. This is presented under the heading "Commentary and Analysis of Key Recommendations and Concerns in 'Ageing: Science, Technology and Healthy Living'."

Keypoint Summary of Aging Analytics Agency Recommendations

- **Re-evaluating concerns in light of the effect of Covid**
 - Public awareness
 - Concerns about lack of familiarity with telecare and telemedicine among the medical profession and general public no longer apply.
 - Covid has illustrated a link between health and wealth (health as new wealth, health as the most precious asset) in the minds of the public.
 - Political capital
 - Increased tolerance of extreme preventive measures at the public expense in order to prevent a "new normal" of repeated lockdowns.
 - Coordination and preparation for pandemic emergencies are now cardinal virtues (utmost priorities) in political discourse.

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- **Government objectives**

- The goal of adding five extra years of Health Longevity for UK citizens by 2035 is behind schedule.
 - The Government is unnecessarily behind schedule and can afford to be more ambitious.
 - The UK is a preventive medicine powerhouse and can achieve its objective through the optimisation of existing, known and validated technologies. Consider the example of Singapore.
 - Majority of short-term impact in extending Healthy Longevity will come from preventive medicine (early diagnosis and preventive treatment). The UK has substantial assets in preventive medicine, and these can be used to help meet UK goals. These should be used with a greater degree of cross-sector and cross-initiative synergy.
 - Assess and prioritise support and funding for market-ready solutions (behavioural and lifestyle interventions, preventive medicine diagnostics, prognostics and therapeutics, AgeTech, etc.) that can be supported, funded and implemented at scale (on a population level) today to match and meet the Government's short-term National Healthy Longevity goals.
 - Establish a specific UKRI-led task-force of industry experts to create a consensus framework for metrics used to periodically measure intermediary progress towards the 2035 goal. These should include the use of
 - (1) actionable and scalable biomarkers of ageing to **predictively** and periodically assess impact on National HALE, as well as financial incentives (e.g., tax breaks) to motivate the UK population to contribute their anonymized data for this purpose; and
 - (2) non-biomedical frameworks (such as self-reporting systems and anonymised data monitoring via smartphones) for non-biomedical aspects including social inclusivity, social isolation and loneliness, etc.
- Lack of strategic coordination and clarity
 - Solving the Aging Society Grand Challenge requires a breadth of coordination typical of an entire industrial strategy unto itself.

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- On paper the industrial strategy is configured with synergies in mind, but the Government must take the obvious steps in applying this form of strategic thinking to the Ageing Society.
 - E.g. One of the universal stumbling blocks described in the document is a lack of market readiness across the board. But the “artificial intelligence and data economy,” an entire pillar of the UK Industrial Strategy, is not brought to bear on this problem. Government needs to seek synergy between these two Grand Challenges, not treat them as industry silos in isolation.
 - Consider the comprehensive list of metrics mentioned in Aging Analytics Agency’s “National Industrial Strategy Development Plans Global Overview 2019 (First Edition).” We compiled those that were used to assess the relevance and effectiveness of various government-led Longevity initiatives.
- Biomarkers
 - Aging Analytics Agency maintains that biomarkers are essential to all sectors of the Longevity Industry.
 - Though “there is no single biomarker that can be used to assess how ‘well’ a person is ageing,” we can and should promote the widespread use of a comprehensive panel of biomarkers.
 - Get a fundamentally clear consensus understanding of what a useful and relevant set of “biomarkers of aging and Longevity” would actually be, and give priority to any funding commitments or specific initiatives for determining this.
 - We should work to eliminate wasteful strategic thinking on the subject of biomarkers. It is important to think hard about the biomarkers we need and why.
 - Convene a task force of industry experts to create a consensus framework of actionable biomarkers that can be implemented at scale with a preference for accuracy, availability and actionability.
 - Use these biomarkers to assess progress towards the 2035 year goal.
 - Prioritise support and funding of groups and companies making such biomarkers.

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- Try to integrate the use of biomarkers in the UK drug evaluation and approval system.
 - Create financial incentives (e.g., subsidies or tax breaks) for insurance companies to utilise them in offering discounts to their clients for maintaining Health Longevity.
 - Provide incentives (e.g., tax breaks) for people to allow their anonymised data to be collected for the purpose of measuring progress towards this goal.
 - Commission (via expert consultation) a specific network of labs and companies to develop an official biomarker panel, using existing Centres for AI in Healthcare.
- **Accelerating the rate of clinical translation**
 - Incentives:
 - Create incentives for groups (companies, labs, etc.) that can demonstrate human efficacy in some form, whereby funding and support is provided in a tiered manner, with the largest levels of support going to groups that can demonstrate market readiness.
 - Enabling fast-track approval for companies that are working on drug repurposing (i.e., applying drugs and therapies whose safety has already been demonstrated for other clinical indications for ageing and age-related disease).
 - Enabling fast-tracking of drugs and therapies that can demonstrate efficacy, and considering case-by-case approval of drugs based on an evaluation of safety alone, as opposed to safety and efficacy.
 - Task force
 - Creating a specific task-force involving experts and industry stakeholders from both industry and academia, to roadmap and validate safe and effective approaches for human validation prior to the stage of clinical trials.
 - A number of sensible approaches exist, including:
 - Biomarkers of human Longevity
 - In silico human modeling
 - In vitro tests using human cells and tissues

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- Human-animal chimeras (e.g., human-mouse chimeras) for safety, toxicity and efficacy testing. This approach is already common in immuno-oncology research, and a wide array of validated approaches can be applied for testing of ageing-focused interventions.
- In vivo administration of sub-therapeutic doses using microfluidic chips (i.e., in vitro “skin-on-a-chip” testing).
 - Once this consensus framework is achieved, an action plan to incorporate these methods of drug and therapy evaluation into the UK’s existing medical regulatory system and infrastructure should be developed.
 - Financial incentives to promote the use of these methods of testing among UK companies should be deployed in order to make them standard practice.
- **Other recommendations**
 - Prioritising governmental funding and support for the field of AI for Biomarkers
 - Prioritising governmental funding for the “AI for Longevity” sector in particular
 - Creating financial incentives to support development of the UK Longevity Industry (Australian-style dollar-for-dollar fund matching programs, like-for-like tax breaks, etc.

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Commentary and Analysis of Key Recommendations and Concerns in "Ageing: Science, Technology and Healthy Living"

In this section we supplement the Committee's various recommendations and concerns, in the order in which they are raised, with our own recommendations and comments on the same points of concern.

- **Concern: Evidence was submitted to the Committee prior to the pandemic.** Aging Analytics Agency's position is that the public's experience of the pandemic has made many of the Committee's proposals more politically viable than they would have been a year ago, because it has clarified the link between health and wealth (in this case economic stability) in the minds of the public; familiarised the public and medical community with new technologies such as telecare and telemedicine; and created an urgent desire for preventive measures, even if they come at great public expense.
- **Concern: The goal of adding five extra years of Health Longevity for UK citizens by 2035 is behind schedule.** Aging Analytics Agency's position is that the government is *even* more unnecessarily behind schedule than the Committee may suppose, and can afford to be more ambitious. The UK, with its network of AI Centres for Health and its commitment to digital health, is a preventive medicine powerhouse, and the Government's goal can be achieved using existing preventive medicine technologies, the optimisation of existing, known and validated technologies, and the emulation of best practices in preventive medicine from other countries like Singapore with the smallest gaps between life expectancy and HALE. Aging Analytics Agency can advise, having documented examples of such countries.
- **Concern: It has proven difficult to identify reliable markers for ageing in general, rather than individual diseases.** Aging Analytics Agency's position is that there is a lot of scope to reduce wasted efforts in this area, and recommends a more discerning approach to biomarkers. Think hard about the biomarkers we need and why. There should be a bias toward easily-implementable and non-expensive panels of biomarkers of ageing that will have a much greater real-world effect than the development of extremely precise or comprehensive ones, such as DNA methylation clocks, which are too expensive or difficult to implement in practice. Aging Analytics Agency recommends that the UK Government develop a consensus on which biomarker panels must be favoured according to three qualities: accuracy, availability and actionability, and then take pre-existing centres that have existing assets and resources not only for AI, but also for geroscience, and convert them into a network of labs to support the development of such biomarker panels.

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- **Concern: UK Research and Innovation and the National Institute for Health Research should commit to working more closely to ensure rapid translation of ageing research into clinical benefit.** Aging Analytics Agency recommends that the government create incentives for groups (companies, labs, etc.) that can demonstrate human efficacy in some form. A number of fast-track approaches exist, including the use of Biomarkers of Longevity; in silico human modeling; in vitro tests using human cells and tissues; human-animal chimeras (e.g., human-mouse chimeras) for safety; toxicity and efficacy testing; and in vitro application of subtherapeutic doses using microfluidic chips ("ship-on-skin" technology). A specific task-force should be created, involving experts and industry stakeholders from both industry and academia, to roadmap and validate safe and effective approaches for human validation prior to the stage of clinical trials.
- **Concern: It is very difficult to get funding in the UK for ageing research, to the extent that people are sending in grant applications for US funding work on ageing processes identified here in the UK.** Aging Analytics Agency's position is that there is a lot of scope to redress this balance. Aging Analytics Agency recommends adopting the Australian policy of matching motor neuron disease research dollar for dollar but for aging research.
- **Concerns about the division of public health responsibilities and its effect on efforts to develop public health advice, including for healthy ageing.** Aging Analytics Agency recommends seeking means for greater levels of *coordination* among municipalities rather than seeking to solve the problem through recentralisation. A one-solution-fits-the-whole-nation approach may not be a good idea, given variations in factors such as population density and the fact that some municipalities such as Manchester have what amounts to their own partial, localised ageing industrial strategies. Also the nature of the Ageing Society grand challenge necessitates close coordination across the four Home Nations, as Industrial Strategy applies in its entirety only to England while the population it is concerned with circulates freely throughout the British Isles.
- **Concern: Two million people in the UK aged over 75 live alone and could be at risk of loneliness. We heard about the use of technology to reduce social isolation and loneliness by enabling older people to connect with friends and family on social media or communication platforms.** Aging Analytics Agency's position is that there are many such specific UK issues and challenges of national importance that we believe AgeTech has the potential to substantially impact include alleviating the economic burden of the nation's ageing population; protection and treatment of COVID-19 in the elderly; social isolation, loneliness and mental health problems; increased economic activity and participation among the 60+ demographic; and much-needed reforms to the management of care homes and social care among the nation's elderly. We would refer the Committee to Aging Analytics Agency's AgeTech Analytics Platform.

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- **Concern: Devices such as trackers may be necessary to assist with “self-monitoring.”** We have extensively documented the mHealth industry and this is one area where the UK would appear to be a bigger player than the US. Aging Analytics Agency recommends the UK government should do everything possible to develop its mHealth sector with a specific emphasis on tracking and monitoring.
- **Concern: How we are going to capture and evaluate the impacts of measures taken that we think are so important to the mission?** UKRI needs to create a specific task-force of industry experts to create a consensus framework for metrics used to periodically measure intermediary progress towards their 2035 goal. These should include the use of (1) actionable and scalable biomarkers of ageing to **predictively** assess impact on National HALE periodically, as well as financial incentives (e.g., tax breaks) to motivate the UK population to contribute their anonymized data for this purpose, and (2) non-biomedical frameworks (such as self-reporting systems and anonymized data monitoring via smartphones) for non-biomedical aspects including social inclusivity, social isolation and loneliness, etc.
- **Concern: There is not a coordinated, cross-government strategy for achieving the mission; this may be related to the lack of clarity over responsibility for the mission.** Aging Analytics Agency's position is that solving the Aging Society Grand Challenge requires a breadth of coordination typical of an entire industrial strategy unto itself, rather than just a single pillar of one. The name we give to such a propositional strategy is "National Longevity Development Plan," which would consist of national and international initiatives.

Concerns are identified and addressed throughout this section in the order in which they were originally raised in *Ageing: Science Technology and Healthy Living*. Text that is italicised and in quotation marks is from the direct concerns and recommendations presented by the House of Lords report, while unitalicised text represents independent Aging Analytics Agency commentary.

Concern: Evidence was submitted to the Committee prior to the pandemic.

10. We received most of the evidence for this inquiry before the start of the COVID-19 pandemic. The pandemic has highlighted issues related to ageing, some of which are outlined in a short post-script to this report. That section includes evidence about the impacts of the pandemic that we received from medical experts who very kindly gave of their time to write to us, having been unable to give evidence as planned in March 2020. We undertook a separate inquiry on The Science of COVID-19, including evidence about health impacts.

The report then briefly summarises the impact of the pandemic on the prospects of the Grand Challenge in the post-script.

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The COVID-19 pandemic has shown tragically how poor health makes people more vulnerable to further health risks, and has highlighted the health inequalities associated with deprivation—including for ethnic minorities. The pandemic has harmed the health of the wider population, and the longer-term health impacts—including on mental health—are unknown, increasing the need for action to encourage and facilitate healthy ageing.

Little is made, however, of the fact that several concerns raised throughout the entire HoL report look anachronistically pessimistic in light of the COVID-19 pandemic. For example, in the Technology and Services chapter we have the following statement:

Lack of awareness of products and services is a barrier to uptake. Stuart Butterfield said: “people simply do not understand that those [telecare] technologies are available. Typically, people come across them only when their loved one has had an unplanned health event.” Similarly, he said that there is a “lack of staff awareness and staff training to be able to use the tools”, such that there are “local authorities that buy systems that sit unused”. He commented that “GPs are not really aware of technologies”, and that they “typically do not want to get involved in [responding to alerts]”, but that they could be made aware of the benefits in terms of helping patients who have the most problems and frequent GPs’ appointments.

As of 2021, a small majority of the population have elderly or vulnerable relatives in their extended family, and will have given some thought as to what technological recourse may be available if one of them becomes housebound or isolated.

Likewise GPs will also have had to familiarise themselves rapidly with systems such as telemedicine, telecare, rapid testing and diagnosis, all of which have expanded massively since this inquiry and are now household terms. It could in fact be the case that a lack of basic familiarity with the idea of telemedicine and telecare is simply no longer a cause for concern.

There is a point to be added here regarding **political capital**: Covid has made certain things politically viable in terms of public consent, cooperation and enthusiasm with regard to the promotion of social movements, public expenditure, and mandatory lifestyle alterations.

As of 2021, the public is more likely than before to consent to extreme measures in order to make a final decisive effort to do whatever is necessary to avoid another episode like the recent year-long lockdown.

Government now possesses the following new forms of political capital:

- **Awareness of economic incentives:** A feeling among the public that the future of the economy is linked to the future of the immune system (a self-evident example of health-as-wealth).

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- **Willingness to adopt collective action:** A “total war”-style willingness to participate in grand schemes and concerted efforts to adjust lifestyle for the greater good of the economy.
- **Covid fatigue: Fear of a “new normal” of lockdowns and a demand for preventive solutions:** Covid fatigue and willingness to make the problem go away with a set of well-defined, bold preventive measures. There is a fear that the government is short-termist and reactive and that future governments will lapse into a “new normal” of lockdowns every few years whenever there is any sort of pandemic.
- **Coordination as a perceived virtue:** a lack of coordination regarding the pandemic is the greatest criticism levelled against sitting governments by opposition parties.

For these reasons, there is enhanced political viability to many of the measures the Committee may recommend, **provided** it is clear that this political capital is spent on an agenda that will make a serious, tangible, definitive and lasting impact on future waves of the current or future pandemics, rather than being the first step in some “new normal.” This is especially true regarding the recommendations in **Chapter 4: LIFESTYLE AND ENVIRONMENTAL INFLUENCES ON HEALTHY AGEING** and **Chapter 5: TECHNOLOGY AND SERVICES**.

Concern: The goal of adding five extra years of Health Longevity for UK citizens by 2035 is behind schedule.

“(Summary) In 2017 the Government identified “Ageing Society” as one of the Industrial Strategy’s four Grand Challenges, with a mission to “ensure that people can enjoy at least five extra healthy, independent years of life by 2035, while narrowing the gap between the experience of the richest and poorest.” We are not on track to meet this target. For men, we heard that it will take 75 years to achieve the target at current rates of improvement, not the 15 years that remain. For women, healthy life expectancy at birth has decreased in the past decade, further widening the gap between healthy life expectancy and life expectancy, and making the Government’s target even harder to achieve.”

Not only is it “not on track”, the government is *even* more unnecessarily behind schedule than the Committee may suppose, and can afford to be more ambitious. The goal of adding five extra years of Healthy Longevity for UK citizens is even completely doable using existing preventive medicine technologies. It does not require intensive radical biomedical innovation, but the optimisation of existing, known and validated technologies, and the emulation of best practices in preventive medicine from countries like Singapore which have the smallest gaps between life expectancy and HALE.

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Perhaps unusually for a large parliamentary democracy, the UK is in many respects a preventive medicine powerhouse to rival such countries. Consider for example BEIS's support for AI Centres for Healthcare in Leeds, Oxford, Coventry, Glasgow and London. Each has partners across the UK to develop more intelligent analyses of medical imaging.

The products developed at the centres will offer more personalised treatment for patients while freeing up doctors to spend more time caring for patients. The investment in large scale genomics and image analysis can drive new understanding of how complex diseases develop, in a proactive step to ensure people get the right treatment at the right time. Consider also NHSX, the new joint organisation for digital, data and technology for overseeing the digital transformation of the health care system.

The UK is rapidly equipping itself with the toolkit it needs to meet its own Grand Challenge without recourse to advanced biomedicine or R&D-stage therapies. The vast majority of impacts towards their goal of adding 5 years of HALE to the UK population by 2035 will be due to the use (at scale) of preventive medicine technologies and policies focused on early disease diagnosis and preventive treatment.

The UK is already prioritising this realm of activity aside from their Ageing Society grand challenge, through a broad NIH focus on preventive medicine, the 2019 launch of an NIH department to validate and recommend mHealth apps to prevent NCDs, and the launch of several prominent AI Centres for Healthcare. However, these initiatives need to be integrated synergistically with their Ageing Society industrial strategy, and used to help meet the short-term goals of their 2035 goal.

However, the extent to which the optimisation of existing practices can add extra healthy years to the lives of UK citizens is limited: there will come a time when they will begin yielding diminishing returns, and the question will naturally arise as to how additional years of HALE will be added. This will require a combination of innovations in advanced biomedicine *and* precision, personalised and preventive (P4) medicine. It is then that the support and financing of key biomedical technologies can be considered necessary. Finally, there is still much scope for financial incentives to encourage healthy lifestyles. The UK is no stranger to such measures, which may include for example minimum unit pricing on alcohol. A similar measure to this would be the use of sales tax measures for public health purposes.

Governments might use a similar strategy to encourage physical activity by increasing taxes on goods and services associated with sedentary behavior, and reducing taxes on goods and services associated with fitness and exercise, as has been tried in Canada. There is also the possibility of offering tax breaks and/or subsidies to health and life insurance companies who roll out internal financial incentives (such as discounts or reduced insurance rates) to their clients for

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maintaining a healthy lifestyle, as is common in regions like Singapore with very competitive levels of HALE.

Concern: It has proved difficult to identify reliable markers for ageing in general, rather than for individual diseases.

91. Given that people accumulate damage at different rates, the speed at which individuals age can vary significantly. A person's 'biological age' can therefore be out of step with their chronological age. This leads to some people ageing more slowly and reaching old age in better health. Increasingly, researchers and clinicians are seeking to identify biological indicators that can help determine a person's biological age. These 'biomarkers' of ageing can be assessed over time to determine an individual's rate of ageing, and to establish whether interventions, drugs or lifestyle changes can help alter that rate.

92. Biomarkers are often biochemical measurements taken from samples of blood, saliva or tissues; for example, measuring blood lipids, levels of inflammation or fasting glucose levels. Biomarkers can also include measurements taken from non-invasive tests, such as measures of physical capability (e.g. grip strength and gait speed), and cognitive function (e.g. processing speed). Dr Riccardo Marioni of the University of Edinburgh told us that, ideally, biomarkers should be inexpensive, so they can be used at the population level, and as minimally invasive as possible.

93. There is no single biomarker that can be used to assess how 'well' a person is ageing. Various 'toolkits' have been developed which identify key biomarkers for a range of functions associated with the ageing process. Professor Graham Kemp of Liverpool University told us that developing these toolkits is challenging, as often "the data simply was not there" to identify reliable markers for ageing in general, rather than for individual diseases.

94. Considerable attention is being paid to underlying biological processes which affect multiple aspects of ageing, some of which may be able to provide more holistic measures of how well a person is ageing and offer routes to intervene in the ageing process. For example, measurements of certain molecules that attach to an individual's DNA (known as epigenetic markers) have shown a strong correlation with chronological age. This process and others are discussed in the following section."

Aging Analytics Agency maintains that biomarkers are essential to all sectors of the Longevity Industry. They are needed to measure not just biological health, but also psychological wellness and financial wellness. The significance of biomarkers in the Longevity Industry is central since they are the primary metric in Geroscience, Regenerative Medicine, multiple AgeTech implementations and especially in P4 Medicine. Biomarkers also provide the prime source of data for the AI for Longevity Industry, Drug Discovery and Development, Clinical Trials and for

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Translational Research. For these reasons, standardised metrics are needed to evaluate the biomarkers.

Regarding the correct assessment that “there is no single biomarker that can be used to assess how ‘well’ a person is ageing”, it is important therefore to develop and promote the widespread use of a comprehensive panel of biomarkers.

Several of Aging Analytics Agency’s strategic partners, including Longevity.International, have documented many of the aging biomarkers and identified from among them those which, by the metrics we describe - and never before described in pre-existing literature - belong to a category we have named Minimum Viable Panel (MVP).

Indeed there is a great deal of scope for eliminating wasteful strategic thinking on the topic of biomarkers. For example, the above-mentioned points (91 explicitly, implicitly and 92, 93, 94, implicitly) appear to refer to the “biological age” biomarker definition, but this is very often conflated with the “disease predictor” biomarkers, with practically useless results. **It is important to think hard about the biomarkers we need and why.**

For although 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 good news is that 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 which 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 recommend that the UK Government develop a consensus on which biomarker panels must be favoured according to three qualities:

- 1) Accuracy (the measure of the precision of the single biomarker or the panel to predict overall biological age)
- 2) Availability (material capacity of extensive implementation for the reference character; i.e., for the single biomarker or the panel)
- 3) Actionability (combination of both the accuracy and availability of a Biomarker or a Panel)

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In Q1 2021, we are following up on this report with a new, open-access, extended and enhanced edition, titled '[The Rising Wave of Human Biomarkers of Longevity: Landscape Overview 2021](#)', along with an associated IT-Platform to make the report's key conclusions, take-aways and predictions maximally usable and understandable for Longevity scientists, companies, investors, policy makers and the general public.

The project uses comprehensive analytical frameworks to rank and benchmark existing panels of biomarkers of aging, health and Longevity according to their ratios of accuracy vs. actionability, identifying the panels of biomarkers that can have the greatest impact on increasing both individual and national Healthy Longevity in the next few years.



The Rising Wave of Human Biomarkers of Longevity: Landscape Overview 2021

Analytical Report

Increasing Potential of Longevity Biomarkers in Practical Applications

LONGEVITY INTERNATIONAL

AGING ANALYTICS AGENCY

DEEP KNOWLEDGE GROUP

www.longevity.international
www.aginganalytics.com
www.dkv.global

The importance of benchmarking Longevity Biomarkers and Biomarker Panels by their *ratio of accuracy vs. actionability*, rather than just their accuracy, cannot be overstated.

In order for this domain of technologies to actually accelerate the translation of Longevity theory into practice, and enable short-term progress in the extension of Healthy Human Longevity, they need to consist of biomarkers that are market-ready and obtainable to the majority of doctors, clinicians and nation's citizenry.

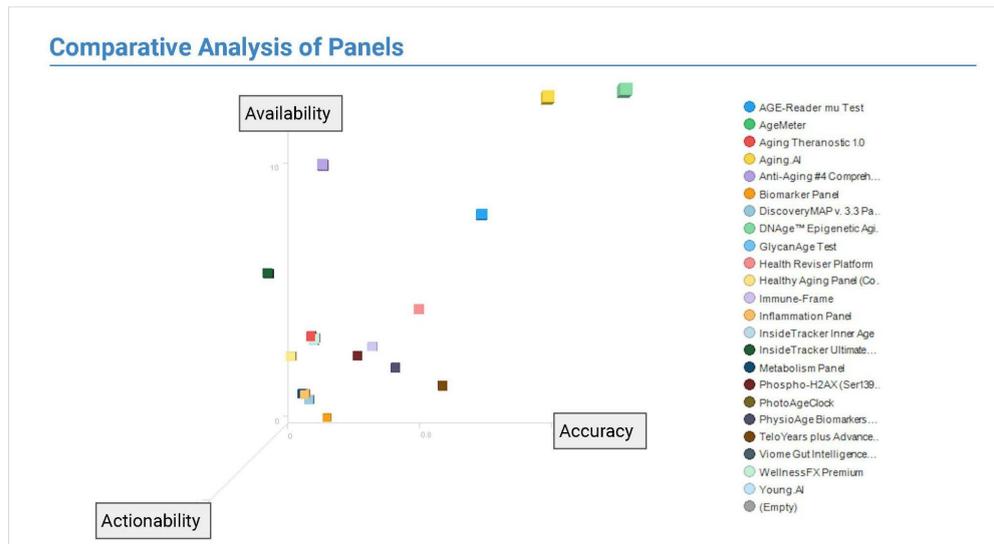
We now have biomarkers and biomarker panels that are market-ready; actionable enough (i.e., with comparatively low cost and invasiveness) to be developed, applied and used at scale; and accurate enough to prove useful in validating the safety and effectiveness of lifestyle, behavioural and Precision Medicine-focused interventions, and to track their changes on individual and population-level Healthy Longevity.

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With this in place, the Longevity Industry (as well as national governments) have no excuse not to use them for the purposes of therapeutic validation on the one hand, and optimisation of population health on the other.



The upcoming project is produced by Aging Analytics Agency for the open-access international Longevity Industry knowledge and collaboration platform, [Longevity.International](https://longevityinternational.com), in order to foster a maximum degree of international collaboration and transparency.

It is Aging Analytics Agency's hope that releasing the report and IT-Platform in an open-access manner via Longevity.International will encourage scientists, companies and other industry stakeholders to make their own contributions to the platform, in an effort to eventually arrive at a robust consensus framework.

Using this data the report provides advice to the industry leaders for the conception, development and maturation of their action plans, providing insurance organisations with a tool to improve their customer services and risk pricing principles; and to policy makers, in order to combat the problem of ageing population and realise that opportunity of National Healthy Longevity.

We recommend that the UK government commission a special task force of industry experts to create a consensus framework of actionable biomarkers of aging and Longevity which can be used on a population level at scale to both **(1)** track progress in the government's goal to add 5 extra years of Health-adjusted Life Expectancy to the UK population by the year 2035, and **(2)** validate the effects of both short-term preventive medicine technologies and policies and R&D-phase Longevity-focused interventions, so as to accelerate the rate of clinical translation of Longevity therapeutics.

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Concern: UK Research and Innovation and the National Institute for Health Research should commit to working more closely to ensure rapid translation of ageing research into clinical benefit.

"180. We recommend that UK Research and Innovation and the National Institute for Health Research commit to working more closely to ensure rapid translation of ageing research into clinical benefit."

Aging Analytics Agency emphatically agrees with supporting programs for accelerating clinical translation, and prioritising support of groups (companies, labs, etc.) that can demonstrate human efficacy in some form.

While the majority of the UK government's short-term strategies for adding 5 extra years of healthspan to the UK population by the year 2035 necessarily lie in market-ready preventive medicine technologies and policies, they will need to begin prioritizing efforts to accelerate clinical translation of R&D-stage biomedical therapies and interventions now in order to preserve momentum when preventative medicine-based strategies have exhausted their impact.

With this in mind, we recommend that the UK government consider four specific actions:

- Prioritising funding for groups (companies, labs, etc.) that can demonstrate human efficacy in some form, whereby funding and support is provided in a tiered manner, with the largest levels of support going to groups that can demonstrate market readiness.
- Enabling fast-track approval for companies working on drug repurposing (i.e., applying drugs and therapies whose safety has already been demonstrated for other clinical indications for ageing and age-related disease).
- Enabling fast-tracking of drugs and therapies that can demonstrate efficacy, and considering case-by-case approval of drugs based on an evaluation of safety alone, as opposed to safety and efficacy
- Creating a specific task-force involving experts and stakeholders from both industry and academia, to roadmap and validate safe and effective approaches for human validation prior to the stage of clinical trials.

A number of sensible approaches exist, including:

- In silico human modeling
- In vitro tests using human cells and tissues
- Human-animal chimeras (e.g. human-mouse chimeras) for safety, toxicity and efficacy testing. This approach is already common in immuno-oncology research, and a wide array of validated approaches can be applied for testing of ageing-focused interventions

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- In vivo administration of sub-therapeutic doses using microfluidic chips (i.e., in vitro “skin-on-a-chip” testing)

A cross-sector task force of industry experts should be convened to create a specific consensus framework for safe and effective approaches to pre-clinical-trial methods of human validation of intervention safety and efficacy.

Once this consensus framework is achieved, an action plan to incorporate these methods of drug and therapy evaluation into the UK's existing medical regulatory system and infrastructure should be developed. Financial incentives to promote the use of these methods of testing among UK companies should be deployed in order to make them standard practice.

Secondarily, the UK government should consider implementing frameworks for accelerated approval whereby companies that can demonstrate human safety and efficacy using these methods are fast-tracked to the clinical trial stage of drug and therapy evaluation.

Concern: It is very difficult to get funding in the UK for ageing research, to the extent that people are sending in grant applications for US funding work on ageing processes identified here in the UK.

182. A common theme in our evidence was that the UK has the potential to be a major global player in the development of treatments for ageing. Jim Mellon thought the UK could be in the “top three” leading countries in treatments for ageing. Professor Cox said that the UK has historically been “fantastic at developing drugs”, having developed “a quarter of all the drugs in use globally.”

However, Professor Cox expressed concern that the funding situation for biomedical research into ageing means that the UK is missing out on opportunities. She told us: “Despite an early UK lead in cell senescence research, the bulk of exciting studies are now being carried out in the USA, as researchers benefit from the focus on ageing of the NIA [US National Institute for Aging], significant ring-fenced funding, government lobbying by AFAR [American Federation for Aging Research] and the more entrepreneurial attitude of US universities. While many traditional UK universities are excellent at basic discovery science, funding is extremely patchy and UK basic science can also be stifled by poor tech transfer and a lack of administrative speed and flexibility needed when working with commercial partners.”

184. Professor Akbar found it “very difficult to get funding in the UK for ageing research”, to the extent that he currently had “a grant application in [for US funding] with a colleague in California to work on an ageing process which we identified here in the UK.”

185. Professor Cox suggested that the reason funding is easier to access in the US than the UK is because the US spends a larger fraction of its overall research budget on ageing research: “The [US National Institute for Aging] takes up 10% of the [National Institutes for Health] budget.

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That comes in at \$3.9 billion a year ... It is hard to get a definite figure for [overall] UKRI funding but it is about £6 billion, 10% of which is £600 million. That sounds horrendous, but it is 0.4% of what we spend on treating illness in the NHS, instead of keeping people well."

The suggestion in paragraph 185 is a clear example of the long-term costs attached to the approach described in the original challenge specification, of coping with rather than ameliorating the problems of physical aging. It is in our *economic* interests to address the problem further upstream. This figure is indeed "horrendous", and we suspect, unsustainable. That is to say not strategic at all, but tactical. The latent potential of aging-related and translation is almost universally underestimated by all except those who study it in detail as does Aging Analytics Agency.

Furthermore, as with the overlooking of the possibility of using MVP panels of mass marketable biomarkers, the easy options are being overlooked here also. Simple incentives practiced abroad can be replicated in the UK. For example the Australian government has developed a practice of matching grants. On 4 June 2020, the Australia Minister for Health Greg Hunt announced that as part of the Big Freeze 4 fundraising event at the MCG, the Coalition Government will match donations, dollar-for-dollar, up to \$2 million, to invest in new clinical trials for Australians suffering from motor neuron disease. It would be perfectly in keeping with the UK government and ethos of the British government to replicate these policies where needed.

Concerns about the division of public health responsibilities and its effect on efforts to develop public health advice, including for healthy ageing.

"271 It was clear from our evidence that public health advice for healthy ageing requires involvement from national government, local government and their agencies. The current allocation of responsibilities for public health in England was set out in the Health and Social Care Act 2012. The Secretary of State retained overall responsibility for improving health. National public health functions were delegated to Public Health England (PHE), which was created following the Act. Local authorities were given responsibility for improving the health of their local populations and for public health services.

272. Some witnesses were concerned about this division of public health responsibilities and its effect on efforts to develop public health advice, including for healthy ageing. For example, the Physiological Society wrote: "The fragmentation of commissioning between local and national government in England for various aspects of lifelong health, encourages a siloed approach to policy making. This has the potential to create barriers that will make it difficult to achieve healthy ageing targets. Structural barriers between commissioning organisations, separate budgets and differing organisational priorities make it much more difficult to implement broad, ambitious projects that may have the most potential to improve health outcomes."

Aging Analytics Agency recommends seeking means for greater levels of *coordination* among municipalities rather than seeking to solve the problem through recentralisation. A

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one-solution-fits-the-whole-nation approach may not be a good idea, given the diversity of factors such as population density, and the fact that some municipalities such as Manchester have what amounts to their own partial, localised ageing industrial strategies.

The Grand Ageing Challenge will only be met if local areas move to coherent population health systems which maximise the contribution of the four pillars of population health: chronic care management, quality and safety, public health, and health policy. National government has a significant role to play, and the activities of each government department are crucial in shaping the environment in which communities can thrive and achieve the best possible health. Local systems must become local population health systems. We would also urge close coordination across the four Home Nations. Whereas on the one hand "UK population health" denotes the health of a single population circulating freely throughout the islands, on the other hand devolution outside of England creates arbitrary holes in the UK's irreducibly complex industrial strategy as it applies to Scotland, Wales and Northern Ireland.

Concern: Two million people in the UK people aged over 75 live alone and could be at risk of loneliness. We heard about the use of technology to reduce social isolation and loneliness by enabling older people to connect with friends and family on social media or communication platforms.

"286. Remaining in one's own home and community (referred to as 'ageing in place') is important to many older people, and can contribute to an improved sense of health and wellbeing. The Centre for Ageing Better explained that independent living can be facilitated by "supportive products, services and environments that maintain people's functional ability so that they can continue to take part as active and productive members of society, even when their health limits their intrinsic capacity". However, we heard it will be important to ensure that increased "independence does not result in loneliness and an absence of support."

314. Two million people in the UK people aged over 75 live alone and could be at risk of loneliness. We heard about the use of technology to reduce social isolation and loneliness by enabling older people to connect with friends and family on social media or communication platforms. Age UK told us that technology can be an effective way to deliver 'befriending' services, such as their 'A Call in Time' service. No Isolation, a Norwegian technology company, described their product 'KOMP', a one-button screen and communication system for older people with limited digital skills with which they can stay in touch with their families. The Challenge, a UK charity, explained that, as well as directly improving social connections, technology can help indirectly "by providing older people with the tools to stay living independently in their homes for longer, and therefore stay connected to the community in which they live."

The technologies referenced and alluded to in the above paragraphs Aging Analytics Agency would recognise as belonging to the AgeTech subsector of the Longevity Industry.

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Age Technology, often shortened to AgeTech, is an emerging subset of the HealthTech sector that focuses on technology and innovation to improve the lives of older people. It consists of smartphone apps, smart wearable devices, genomics, IoT, Ageless Design, HealthTech monitors and sensors. AgeTech solutions are by their nature market ready and therefore should form part of the “optimisation of existing technology” agenda mentioned previously.

Specific UK issues and challenges of national importance that we believe AgeTech has the potential to substantially impact include:

- Alleviating the economic burden of the nation's ageing population
- Protection and treatment of COVID-19 in the elderly
- Social isolation, loneliness and mental health
- Increased economic activity and participation among the 60+ demographic
- Much-needed reforms to care homes and social care among the nation's elderly.

A joint project between Aging Analytics Agency and Biogerontology Research Foundation, the AgeTech UK Analytics IT-Platform aims to serve as the most comprehensive interactive database of Companies, Investors, R&D Hubs, Funding Bodies and Influencers in the UK AgeTech Ecosystem made to date, profiling and visualizing connections between 1200+ entities applying advanced technology to the challenge and opportunity of the UK's ageing population.

Concern: Devices such as trackers may be necessary to assist with “self-monitoring”.

“310. ‘Non-medical products’ that provide information about some aspect of health—such as fitness trackers and apps—may be able to contribute to healthy ageing. Dr Nyman said that there is “good evidence” that devices such as trackers are motivational and that they can assist with “self-monitoring”. Dr Paola Zaninotto, Associate Professor in Medical Statistics at UCL, said that this type of device “has proved to be very valuable” for research purposes, for example when collecting data on physical activity in older people.”

As mentioned previously, this sector, in which the UK excels, and which we have documented extensively, has a role to play in biomarker tracking. Outside of the Asia-Pacific region, the UK has the highest levels of investment in mobile health (mHealth), and like Asia-Pacific countries the government seems to be proactively prioritizing the use of mHealth to decrease the economic burden of health issues upon the national economies, which may be a contributing factor to this interesting observation.

The UK National Health Service has in recent years taken an active stance on supporting increased access to health resources for its citizens. In 2017, after four years of debate on how to effectively analyze new mHealth apps, the NHS (and NHS Digital in particular) launched its library

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of mHealth Apps in 2017, allowing NHS-approved reviewers to assess potential mobile health apps available to UK citizens, and approve them for inclusion on the platform if they comply with government safety and effectiveness standards.

Given the UK government's high-level prioritisation of developing their AI public and private sector resources, and choosing AI as one of their four main Industrial Strategy Grand Challenges, combined with the nation's overall reputation as an international leader in AI, we can expect the technological sophistication of mHealth apps, as well as the number of which incorporate modern and advanced AI techniques and technologies in the UK to increase in the coming years.

Aging Analytics Agency recommends the UK government should do everything possible to develop its mHealth sector with a specific emphasis on tracking and monitoring, and utilise the UK government's existing prioritisation of mHealth as a tool to combat NCDs in its population in synergy with its goal of adding 5 extra years of HALE to its population by the year 2035.

Concern: There is not a coordinated, cross-government strategy for achieving the mission, which may be related to the lack of clarity over responsibility for the mission.

"360. We asked witnesses what data is being used to test whether the mission is being achieved. Elaine Rashbrook said that "a range of metrics is available", but that there is a need to "[identify] which are the most appropriate to measure progress". Dr Dixon told us that "at the high level the mission is trackable", as data are available on disability-free life expectancy by socioeconomic group. However, she added that the end of the mission is a "long way into the future", and:

"the question is how we are going to capture and evaluate the other impacts that we think are so important to the mission that we should be generating along the way. That is where there is a need for us to look at the policy actions that are needed. It would be great if those policy actions were all set out ... in a cross-government strategy so it was really clear what each department was going to contribute to those policies, and then we could evaluate the extent to which those policies were having the impacts they specifically wanted."

She added that, for the mission, it was important to "ensure the social impacts are sitting alongside these broader economic impacts and capture both those together", but the current evaluation is "not sophisticated enough" to assess social impacts."

This is correct. Government needs to use transparent and reverse-engineerable analytical methodologies to benchmark technologies, products, services and policy programs by the likely level of social impact per dollar spent. E.g. benchmarking technologies and core products by their level of social impact ranking them by level of market readiness. 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. We propose putting special emphasis on a specific set of the most important metrics, listed below, as a means of measuring

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the practical effectiveness of the execution of a plan. Specifically, we recommend that they give highest emphasis to the following 9 metrics:

- (CAGR = Compound Annual Growth Rate)
- Health expenditures per capita (current US\$), CAGR (5 years)
- HALE, CAGR (5 years)
- Healthcare efficiency score, CAGR (5 years)
- HALE CAGR (5 years) / Health expenditures per capita (current US\$), CAGR (5 years)
- CAGR (5 years)
- Number of people 65+ employed CAGR (5 years) / Health expenditures per capita (current US\$), CAGR (5 years)
- Life expectancy, CAGR (5 years) vs. Health expenditures per capita (current US\$), CAGR (5 years)
- HALE vs. life expectancy
- Healthcare expenditures vs. Government spending
- 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.

“368. We also heard concern that there is not a coordinated, cross-government strategy for achieving the mission, which may be related to the lack of clarity over responsibility for the mission. The Government’s website lists a range of initiatives associated with the Grand Challenge (Box 1), but it is not clear how they are intended to fit together to achieve the mission. Several of the initiatives associated with the Ageing Society Grand Challenge are not specific to healthy ageing or to the aims of the mission. For example, the £210 million investment in the ‘from data to early diagnosis’ Challenge Fund was included as part of a £300 million investment in the Ageing Society Grand Challenge in 2018, but it has a broader focus than conditions of ageing or improving healthy life expectancy.”

The reasons for the overall stalling of the strategy described throughout Chapter 6, can be summarised quite simply: Aging is such a multifarious problem, with solutions necessitating involvement of such diverse industries, that solving it requires a breadth of coordination typical of an entire industrial strategy unto itself rather than just a single pillar of one, a propositional concept the literature of Deep Knowledge Group would refer to as a “National Longevity Development Plan”. As an example of how a National Longevity Development Plan approach

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would differ from the current Grand Challenge approach: A National Longevity Development Plan would have welcomed the inclusion of the £210 million investment in the 'from data to early diagnosis' Challenge Fund as part of the £300 million investment into the Ageing Society Grand Challenge in 2018 (mentioned in paragraph 368), as a legitimate and relevant preventive measure that will make a large short-term impact, and would have developed a robust system of metrics for validating it as such.

Recommendation Benchmarking

The above is a narrow selection of concerns from the complete document. They are linked to a total of 22 original recommendations.

In the next section, these 22 recommendations have been evaluated and ranked in full according to our classification framework.

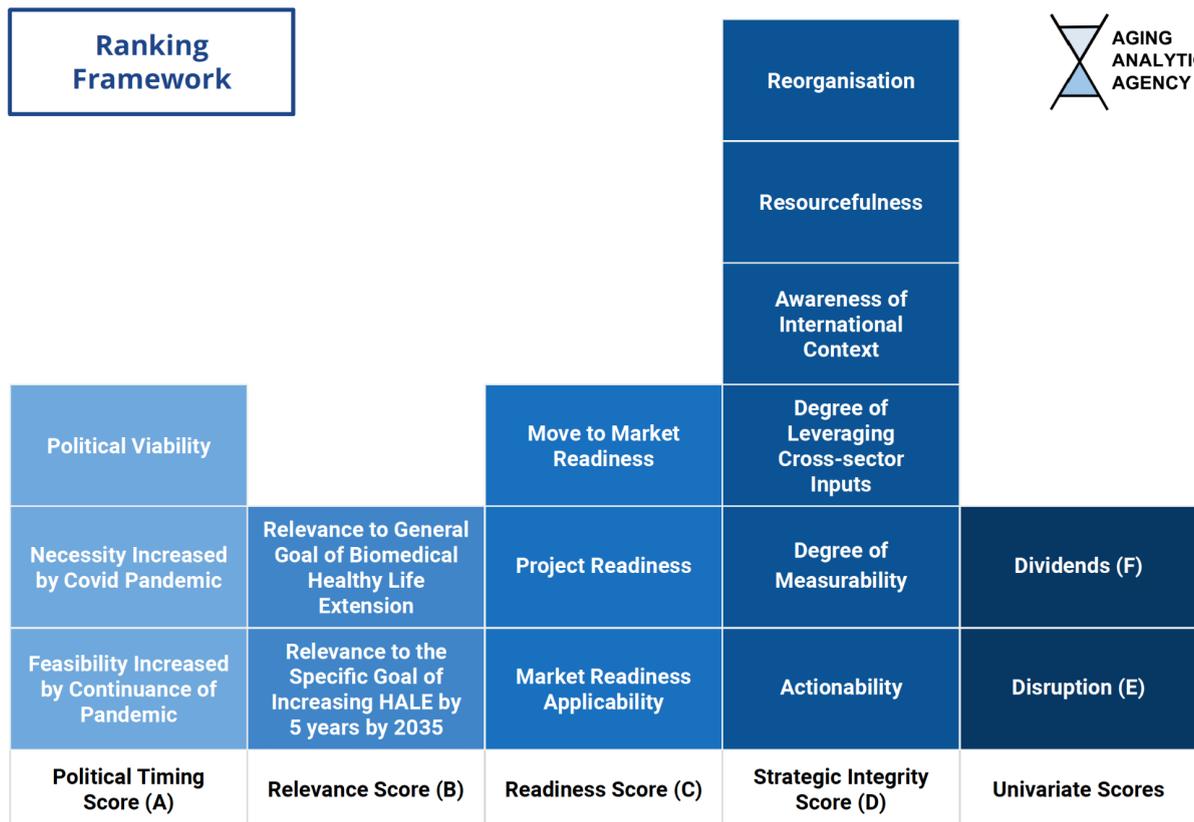
And in future documents, proposals from various world regions and municipalities will be subject to the same framework, with a view to benchmarking global governance / HALE ranking, finding correlations between positive and negative rankings in (1) actual national health and economy parameters and rankings, and (2) policy initiative rankings, which we will use to create a system that enables semi-automated SWOT and practical recommendations tuned to the specifics of regions (nations and municipalities).



Recommendation Benchmarking

Introduction

In addition to the the responses offered by Aging Analytics Agency to specific recommendations representing key concerns, here the recommendations laid out in the House of Lords Science and Technology Select Committee document "[Ageing: Science, Technology and Healthy Living](#)" have been individually scored on strengths of the qualities of political timing, relevance/necessity, project readiness and the extent to which the recommendation represents a move to market readiness, strategic integrity, degree of technological disruption, and social dividends.



All such variables describe the proximity of a given solution to what Aging Analytics Agency considers to be the ideal form of a national Longevity development plan: a coordinated governmental effort focused on the socially-inclusive extension of National Healthy Longevity (i.e., population-level Health Adjusted Life Expectancy) combined with a Longevity industrial

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strategy that encompasses the full scope of the industry, prioritizes sectors and technologies with maximum market readiness and near-term social impact, and effectively leverages the existing strengths, assets and resources of the nation in a synergetic, cross sector manner.

These scoring system is designed to reveal 3 main tiers:

Tier 1: National Longevity Development Plan

Aging Analytics Agency has long proposed that the industrialisation of Longevity requires a form of national strategy for orchestrating an increase in healthy lifespan as comprehensive as a national industrial strategy would be today. The name Aging Analytics Agency uses for such a propositional strategy is National Longevity Development Plan, a particular form of industrial strategy whereby government seizes the initiative in developing a framework to change the deficit model of the "Ageing Society" to an asset model of "Healthy Longevity," harnessing the "Longevity Dividend" to benefit all members of the society.

Recommendations by the Committee which work to elevate current industrial strategy to the level of a national Longevity development plan are those with a score more than 10.

Tier 2: 2035 Objective

Recommendations which are necessary to or highly relevant to the UK Government's stated aspiration of a 5 year increase in HALE by 2035, but not necessary or highly relevant to full scale industrialisation of Longevity belong to this tier.

Tier 3: No Major Strategic Ramifications

This tier may include positive developments but nothing pivotal, e.g. an increase in funds for some line of research of uncontested importance, or the fixing of flaws that exist at a project level e.g. a lack of general accountability. Negative recommendations would also belong in this category, but none have earned a net negative score.

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Framework Description

The proposed ranking score uses weighted average of qualitatively-assessed metric scores corresponding to various evaluative factors that impact the strength and relevance of specific recommendations made in the House of Lords report with respect to the stated goals and aims of the UK's Ageing Society Industrial Strategy, Ageing Society Grand Challenge and the stated goal of adding 5 extra years of socially-inclusive Health-Adjusted Life Expectancy (HALE) to UK citizens by the year 2035.

A summary of the ranking framework (and their individual metric scores) can be found below, followed by their example application to a select number of recommendations found in the House of Lords Report.

Political Timing Score (A)

1. Feasibility increased by continuance of pandemic

- *+1 if the continuance of pandemic would presumably have a positive impact upon the feasibility and relevance of the recommendation*
- *0 if the continuance of pandemic would presumably have no clear impact upon the feasibility and relevance of the recommendation*
- *-1 if the continuance of pandemic would presumably have a negative impact upon the feasibility and relevance of the recommendation*

E.g. Has the pandemic altered the public mood so as to make these recommendations more politically viable?

2. Necessity increased by covid pandemic

- *+1 if the necessity for (and contextual relevance of) the recommendation is increased due to the covid pandemic*
- *0 if the necessity for (and contextual relevance of) the recommendation does not appear to be impacted by the covid pandemic*
- *-1 if the necessity for (and contextual relevance of) the recommendation is lessened by the covid pandemic*

E.g. Has the pandemic made some recommendations less necessary?

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3. Political viability:

A qualitative assessment of the extent with which the measure reflects current public sentiment

- *-1 if active persuasion would be needed to gain public support*
- *0 if the recommendation seems to be readily acceptable to the public if at no great cost*
- *+1 if the recommendation is likely to have widespread support by the public given current public sentiment*

Relevance Score (B)

1. Relevance to the specific goal of increasing HALE by 5 years by 2035

- *+1 if the recommendation seems strictly necessary to achieve the 2035 goal by the deadline*
- *0 if the recommendation would assist achieving the 2035 goal by the deadline, but does not seem strictly necessary for it*
- *-1 if the recommendation seems unlikely to impact the likelihood of achieving the 2035 goal by the deadline*

E.g., Irrespective of other factors such as feasibility and readiness, if it were implemented, with success, what would be the impact of the recommendation on the goal 2035?

2. Relevance to general goal of biomedical healthy life extension

- *+1 if the recommendation seems clearly relevant*
- *0 if the relevance of the recommendation is ambiguous*

E.g. A mass investment in relevant biotechnologies might get a +1 for intrinsic reasons, even if it's an overreach with regard to the 2035 goal. But some urban planning solutions would get a zero, even if it's commendable within that time frame.

3. Readiness Score (C)

1. Market Readiness Applicability

- *+ 1 if the sector which the recommendation seeks to advance consists primarily of technologies which have already proven mass marketable e.g. AgeTech*
- *0 if this is not the case*

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- *-1 if the sector or domain that the recommendation pertains to is not primarily one of mass marketable products*

2. Project Readiness

- *-1 if some major project stands in the way of the recommendation,*
- *0 if the recommendation constitutes a major project which can begin immediately,*
- *+1 if the groundwork already exists for the recommended project)*

3. Move to Market Readiness

- *+ 1 if the recommendation involves a project whose deliverable would be market-ready or near-market ready upon attainment.*
- *0 if this is not the case*
- *-1 the recommendation involves a project whose deliverable is expected to be far from market readiness upon attainment.*

Strategic Integrity Score (D)

1. Actionability

- *+1 if the recommendation features a concrete action plan*
- *0 if the recommendation features a general aspiration*

2. Degree of measurability

- *+1 if the recommendation features (or refers to an implicit, existing) method of tracking progress towards the recommendation's stated goal, and if the deliverable featured in the recommendation can be tangibly measured to assess success and attainment*
- *0 if it remains unknown, or hard to verify, whether the deliverable featured in the recommendation can be tangible measured to assess success and attainment*
- *-1 if the deliverable features in the recommendation is clearly abstract and not measurable, trackable, or verifiable upon attainment*

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3. Degree of leveraging cross-sector inputs

- *+1 if the recommendation includes cross-sector coordination (across academia and government and industry)*
- *0 if cross-sector coordination doesn't to apply given the nature of the recommendation,*
- *-1 the recommendation could seemingly benefit from cross-sector coordination, but recommendation fails to specify such coordination as a goal*

4. Awareness of international context

- *+1 if the recommendation includes an analysis of similar practices internationally (i.e., seeks to leverage best practices and avoid worst cases from other countries)*
- *0 if this is not a relevant expectation given the nature of the recommendation*
- *-1 for failing to include an analysis of similar practices internationally (i.e., seeks to leverage best practices and avoid worst cases from other countries) when relevant*

5. Resourcefulness

- *+1 if the recommendation seeks to optimise and/or leverage existing assets and resources at the UK's disposal (i.e., existing national assets or strengths)*
- *0 if the recommendation involves fundamental innovations to achieve its stated goal or deliverable*
- *-1 if the recommendation seeks to innovate unnecessarily*

6. Reorganisation

How much institutional upheaval does the recommendation entail?

- *+1 if the proposal involves a reorganisation involving a consolidation of strategy*
- *0 if the recommendation necessitates no reorganisation*
- *-1 the reorganisation implied by or necessitated by the recommendation represents a fragmentation of strategy*

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Univariate Scores

Disruption (E)

- How preventive a measure is the recommendation with regard to the individual?
- +2 if related to biomedical technologies or interventions
- + 1 if relating to P4 (Preventive, Precision, Personalised, Predictive) medicine
- 0 if related to diet and lifestyle alterations
- -1 if related to merely coping with aging (e.g. adjusting the carrying capacity of health systems)

Dividends (F)

Does the recommendation aid in social activity and inclusivity, general functionality, economic participation or productivity, irrespective of whether it increases HALE?

- +1 the recommendation aids in these regards
- 0 if the recommendation entails no clear effects



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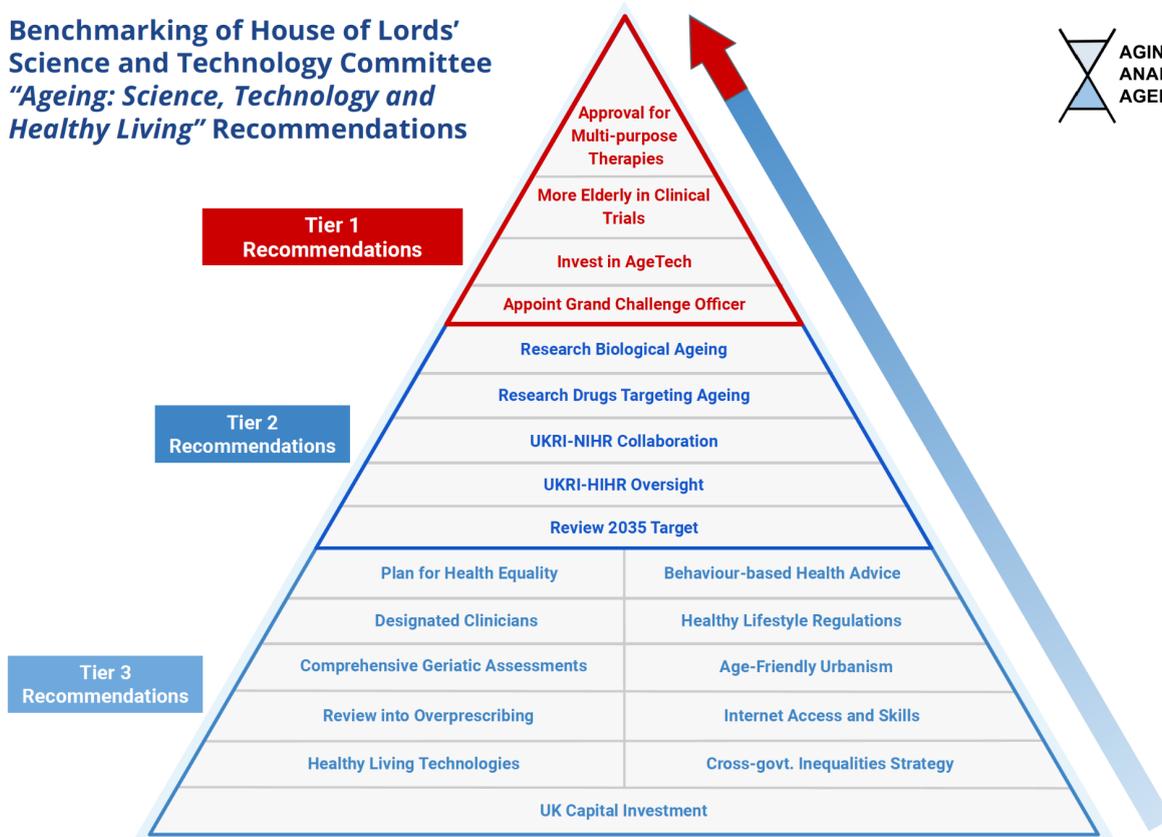
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Scored Concerns and Recommendations of the House of Lords Science and Technology Select Committee's 'Ageing: Science, Technology and Healthy Living' Report

In this section is listed all the specific, explicit recommendations made by the House of Lords Science and Technology Select Committee throughout *Ageing: Science, Technology and Healthy Living*.

First, they are listed here categorised by "tier", which is a rank determined by the scoring framework we devised in the previous section Framework Description. **Second**, the same recommendations are listed again in full, with each recommendation's scores (as derived by the recommendation benchmarking framework described in the preceding section), with explanatory commentary by Aging Analytics Agency analysts beneath. The recommendations made by the report itself are represented by bold italicized text, preceded by key concerns (which do not qualify as direct recommendations), marked in italicized text, which provide additional context and background for each recommendation. Finally, key commentary by Aging Analytics Agency analysts is represented below each recommendation in unitalized text.

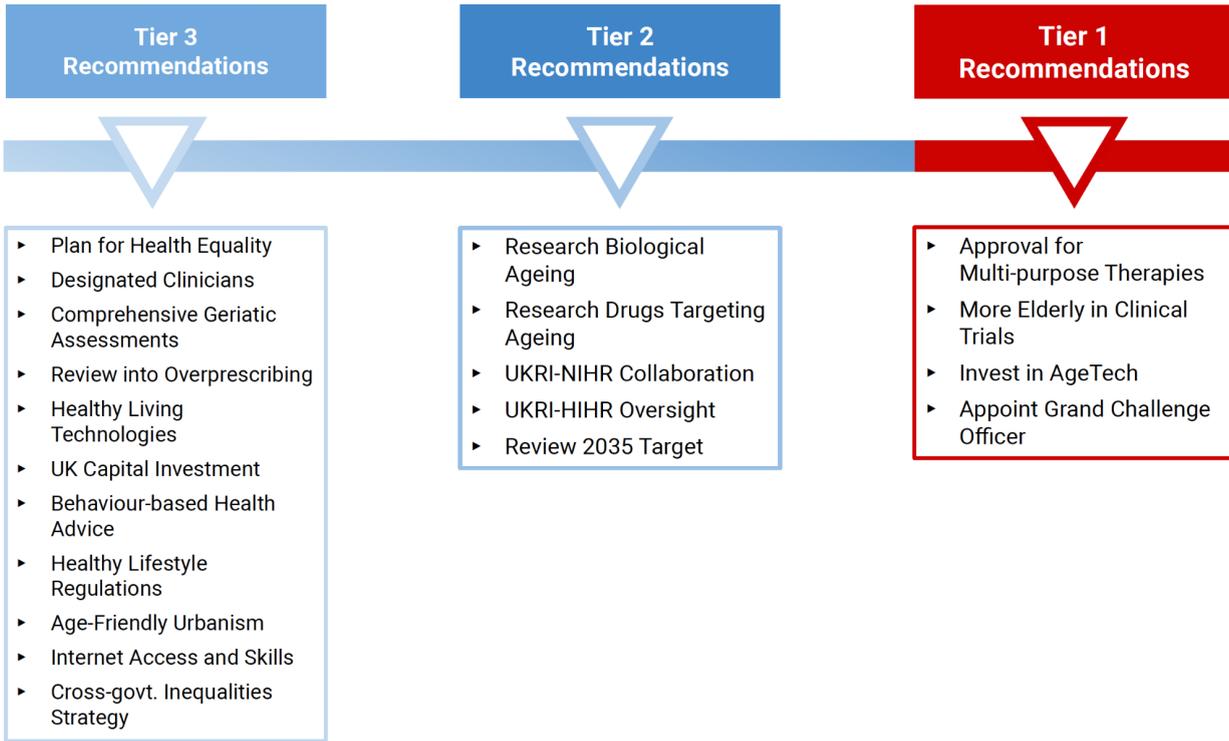
Benchmarking of House of Lords' Science and Technology Committee "Ageing: Science, Technology and Healthy Living" Recommendations





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Benchmarking of House of Lords' Science and Technology Committee "Ageing: Science, Technology and Healthy Living" Recommendations



Tier 1 Recommendations

Approval for Multi-purpose Therapies

"We recommend that the Medicines and Healthcare products Regulatory Agency (MHRA) show greater willingness to approve trials which target multiple conditions. It should also explore the use of novel trial endpoints, such as using biomarkers of ageing as measures of success in treatments targeting the ageing process." (Paragraph 156)

More Elderly in Clinical Trials

"We recommend that the Medicines and Healthcare products Regulatory Agency (MHRA) ensures that older people are included more frequently in clinical trials, particularly where the drug will be used primarily in that population. When developing novel trial designs for drugs targeting the ageing process, as recommended above, these should also allow for inclusion of people with multimorbidity." (Paragraph 166)

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Invest in AgeTech

"We recommend that the Government makes targeted and strategic investments in research for the design, evaluation and uptake of data-driven services, assistive robot technologies and AI for older people, in order to develop national expertise and critical mass in this important area." (Paragraph 305)

Appoint Grand Challenge Officer

"We recommend that the Secretary of State for Health and Social Care appoints a senior responsible officer for achieving the mission of the Ageing Society Grand Challenge, as this does not appear to be covered by the senior responsible officer for the challenge." (Paragraph 376)

Tier 2 Recommendations

Research biological aging

"We recommend that UK Research and Innovation commit to funding further research into the biological processes underlying ageing as a priority, in particular to address gaps in understanding the relevance of ageing hallmarks to humans. Research to identify accurate biomarkers of ageing in humans should also be prioritised, to support studies to improve health span." (Paragraph 178)

Research drugs targeting aging

"We recommend that UK Research and Innovation and the National Institute for Health Research support further research into drugs that target the ageing process— including proof of concept trials using repurposed drugs (such as in the TAME trial)." (Paragraph 17)

UKRI-NIHR collaboration

"We recommend that UK Research and Innovation and the National Institute for Health Research commit to working more closely to ensure rapid translation of ageing research into clinical benefit." (Paragraph 180)

UKRI-HIHR oversight

"We recommend that the Chief Medical Officer is given responsibility for overseeing the coordination of ageing research between UK Research and innovation and the National Institute for Health Research." (Paragraph 181)

Review 2035 Target

"We recommend that the Government review the feasibility of the target to increase healthy life expectancy by five years by 2035, and revise or re-commit to it. The Secretary of State for Health and Social Care should commit to reporting annually to Parliament on progress towards the

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target. The Government should also revise or re-commit to the target to reduce inequalities and outline measurable targets for the reduction in inequalities it hopes to achieve by 2035.” (Paragraph 36)

Tier 3 Recommendations

Plan for Health Equality

“We recommend that the Government, along with NHS England, Public Health England, and other agencies, prioritise reducing health inequalities. In its response to this report we request that the Government sets out a plan for reducing health inequalities over the next Parliament.” (Paragraph 31)

Designated Clinicians

“We recommend that, as was proposed in 2013, the NHS ensures that all older patients have a designated clinician. This clinician would have oversight of the patient’s care as a whole, and should coordinate activity across multidisciplinary teams, which should include members from across the health and social care sectors. The clinician could be from either primary or secondary care, depending on the patient’s needs.” (Paragraph 67)

Comprehensive Geriatric Assessments

“We recommend that designated clinicians for older people ensure that Comprehensive Geriatric Assessments are used regularly for older patients, particularly for those with multimorbidity. The Government should ensure that training in how to conduct Comprehensive Geriatric Assessments is a core part of medical training, and that training is provided on an ongoing basis, in particular to GPs.” (Paragraph 68)

Review into Overprescribing

“We recommend that the review into overprescribing—which is due to report to the Secretary of State for Health and Social Care in late 2020—should be published as soon as possible.” (Paragraph 81)

Healthy Living Technologies

“When allocating funding through the Ageing Society Grand Challenge, we recommend that the Government supports the deployment of technologies that contribute to healthier and independent living—both those available now and those that may become available in future. This should prioritise disadvantaged groups in order to bring the greatest health benefits, whilst also realising economic benefits of innovations that are developed in the UK.” (Paragraph 349)

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UK Capital Investment

"We recommend that the Government ensure the UK remains a global leader in drug research and development. It should work towards making the UK a more attractive environment for growth capital investment, to stop UK innovations moving abroad after the discovery stage of research." (Paragraph 192)

Behaviour-based Health Advice

"We recommend that organisations with responsibility for healthy ageing advice incorporate findings about the benefits of healthy behaviours that may have a larger impact upon people's behaviour than existing messaging. The benefits of building up good levels of physical fitness and cognitive reserve should be promoted, particularly to people in disadvantaged groups that suffer the worst health." (Paragraph 248)

Healthy Lifestyle Regulations

"We recommend that the Government implement a concerted and coordinated set of national policies to support healthy ageing, including: regulatory and fiscal measures, actively to encourage people to adopt lifestyles that support healthy ageing; increasing the reach of the NHS Health Check to those in disadvantaged groups who will benefit the most; and working with local authorities on the funding of local services, housing and infrastructure to encourage and facilitate healthier living across the life-course, including the necessary services to maintain health and independence in old age." (Paragraph 284)

Age-Friendly Urbanism

"We recommend that the Government use planning rules to ensure that homes and communities are accessible for people with limited mobility and adaptable as their needs change with age. The Government should ensure that sufficient funds are available—for example through the Disabled Facilities Grant—to facilitate improvements to existing homes. The priority should be areas with poor housing and infrastructure, in order to reduce health inequalities." (Paragraph 292)

Internet Access and Skills

"We recommend that the UK Government ensures internet access for all homes so that older people can access services to help them live independently and in better health. The Government should promote and support lifelong digital skills training so that people enter old age with the ability to use beneficial technologies. Greater support should be provided to the large proportion of the current older generation which lacks these skills, so that they do not miss out on the benefits of available technologies." (Paragraph 338)

Cross-govt. Inequalities Strategy

"We recommend that the cross-government strategy explicitly addresses the issue of reducing inequalities in healthy ageing, without 'passing the buck' to wider Government goals or statutory

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obligations. In producing the strategy, the Government should seek wide input from stakeholders; most importantly, from older people.” (Paragraph 380)

These specific recommendations put forward in the Committee’s report which are listed in full below with their preambles included. Each is then scored according to Aging Analytics Agency’s framework and a justification provided beneath.

Tier 1 Recommendation Scores

Approval for Multi-purpose Therapies

“Understanding of the underlying biological processes of ageing has advanced significantly in animal models, but translation to human ageing is incomplete. The lack of accurate biomarkers for human ageing is an impediment to assessing an individual’s biological age. (Paragraph 126)

Promising advances have been made in the development of drugs that target the underlying processes of ageing. These could delay the onset of age related diseases and reduce polypharmacy. Research into repurposing drugs is particularly welcome, as such drugs have already been tested for safety, dosage and tolerability. (Paragraph 144)

The fact that clinical trials are usually approved only if they target a single indication poses a challenge to research into drugs that target underlying ageing processes. The novel design of the TAME trial in the US hopes to provide proof of concept for trials targeting the ageing process itself. (Paragraph 155)

We recommend that the Medicines and Healthcare products Regulatory Agency (MHRA) show greater willingness to approve trials which target multiple conditions. It should also explore the use of novel trial endpoints, such as using biomarkers of ageing as measures of success in treatments targeting the ageing process. (Paragraph 156)”

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): +1

D2 (Degree of measurability): +1

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- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): +2
- F (Dividends - does the recommendation aid in social activity and inclusivity?): -1

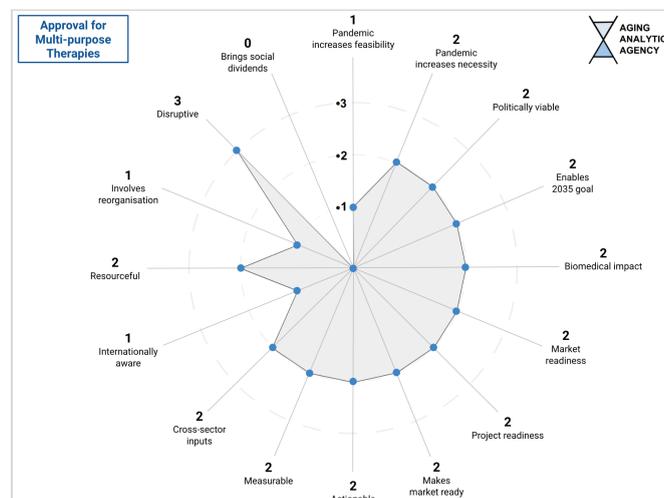
TOTAL SCORE: 12

This recommendation scores high in the Political Timing Score (A). Aging Analytics Agency strongly supports this as an eminently feasible and necessary step to achieving the current 2035 goal or anything similar. Furthermore the present circumstances provide a useful political climate in which to garner public support to fast-track biomedical efforts.

Having seen vast portions of the national budget directed toward shielding the nation's economy and health from the pandemic, and having adapted their lifestyles and expectations accordingly, the public would likely be extremely welcoming of such regulatory conditions as the recommendation describes.

During and shortly after the second world war, the nation made a coordinated effort to cope with an inundation of wounded veterans. When the war was over, they refused to allow the health system to re-fragment and slump back into an "old normal" of health inequality, resulting in today's National Health Service.

The remaining political capital which presently exists for coping with the current crisis, should likewise be repurposed and redirected toward developing preventive innovations for averting a "new normal" of repeated pandemics for which the UK remains perpetually unprepared, a long-term fear at the back of the minds of many.



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More Elderly In Clinical Trials

"Historically, clinical trials excluded older people and people with multimorbidity, and some continue to do so. This is a particular issue for drugs targeting the ageing process, as older people and those with multimorbidity will be the main recipients of such drugs. (Paragraph 165)

We recommend that the Medicines and Healthcare products Regulatory Agency (MHRA) ensures that older people are included more frequently in clinical trials, particularly where the drug will be used primarily in that population. When developing novel trial designs for drugs targeting the ageing process, as recommended above, these should also allow for inclusion of people with multimorbidity. (Paragraph 166)"

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability):-1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): 0

D5 (Resourcefulness): +1

D6 (Reorganisation): 0

E (Disruptiveness): +2

F (Dividends - does the recommendation aid in social activity and inclusivity?): -1

TOTAL SCORE: 11

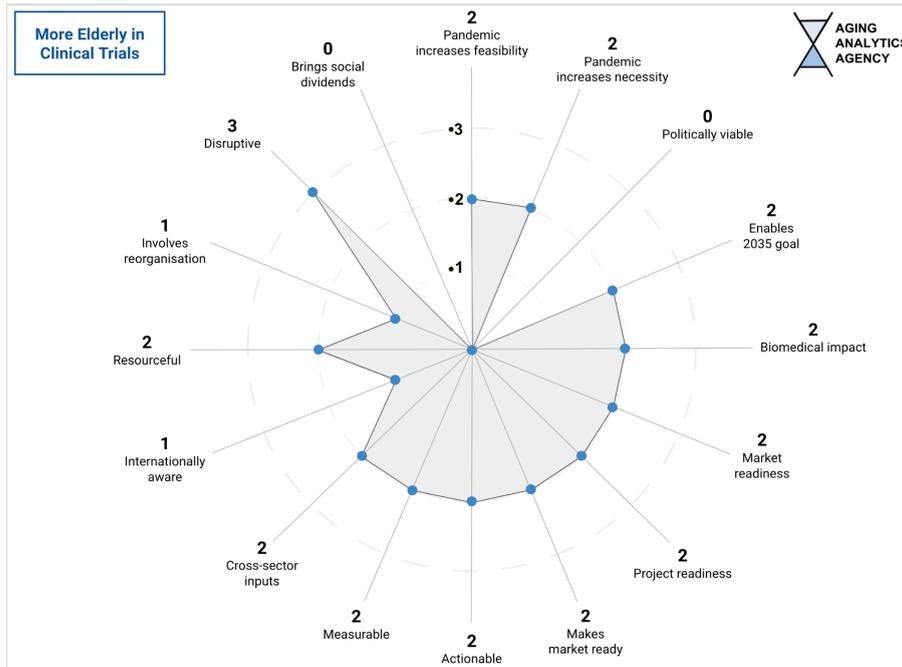
This recommendation earns a +2 for disruptiveness as it realistically anticipates the future restorative potential of aging biomedicine. Equal participation across all age groups in clinical trials is long overdue and necessary to uncover how aging unfolds over decades.

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However, we would like to point out that many of the risks inherent in clinical trials, both in terms of patient safety and investment risk, can be eliminated with the judicious use of biomarkers.



Invest in AgeTech

“More widespread use of telecare services—particularly modern digital systems with monitoring capabilities—may enable more people to live independently in their homes for longer in old age. The upcoming digital telephone switchover provides impetus for this change and is an opportunity for local authorities to introduce more comprehensive services to facilitate safe and independent living. (Paragraph 298)

Data-driven services and emerging robotics and AI systems could provide significant support to older people, to enable them to live independently for longer. The results of ongoing projects in the UK and abroad will help to determine what role robotics can play. (Paragraph 304)

We recommend that the Government makes targeted and strategic investments in research for the design, evaluation and uptake of data-driven services, assistive robot technologies and AI for older people, in order to develop national expertise and critical mass in this important area. (Paragraph 305)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report

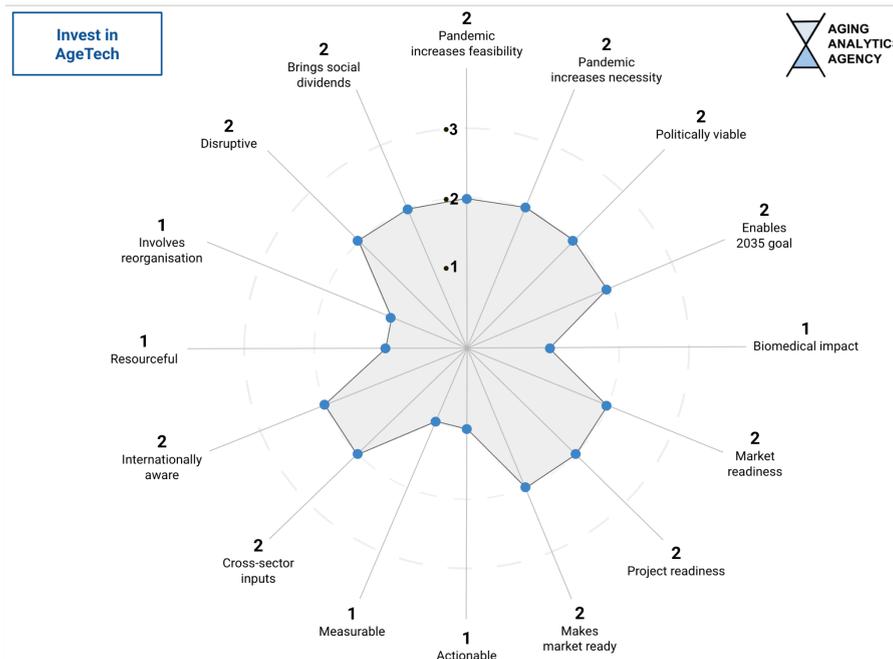


Official Response, Analysis of Report & Benchmarking of Recommendations

- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): +1
- C3 (Move to market readiness): +1
- D1 (Actionability): 0
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): 0
- D6 (Reorganisation): 0
- E (Disruptiveness): +1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 11

This garners a strong score on “leveraging of cross-sector inputs” (D3). Aging Analytics Agency views AI and digital technologies as crucial from drug discovery for digital technologies for the elderly (AgeTech). Also shows good awareness of international context (D4) and readiness (C), as countries such as Japan already have advanced in market-ready digital products for the elderly, including for example elderly care robots.



Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



Official Response, Analysis of Report & Benchmarking of Recommendations

Appoint Grand Challenge Officer

"It is not clear who in Government is responsible for overseeing the Ageing Society Grand Challenge mission, aside from broad ministerial oversight from the Secretary of State for Health and Social Care. We are concerned that this policy has no clear ownership. (Paragraph 374)

The position taken by the Government that the challenge and the mission are overlapping but distinct is confusing, and we are concerned that achieving the mission does not appear to be at the core of the Grand Challenge. (Paragraph 375)

We recommend that the Secretary of State for Health and Social Care appoints a senior responsible officer for achieving the mission of the Ageing Society Grand Challenge, as this does not appear to be covered by the senior responsible officer for the challenge. (Paragraph 376)"

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): 0

C1 (Market readiness applicability): 0

C2 (Project readiness): 0

C3 (Move to market readiness): 0

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): 0

D5 (Resourcefulness): +1

D6 (Reorganisation): +1

E (Disruptiveness): +1

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

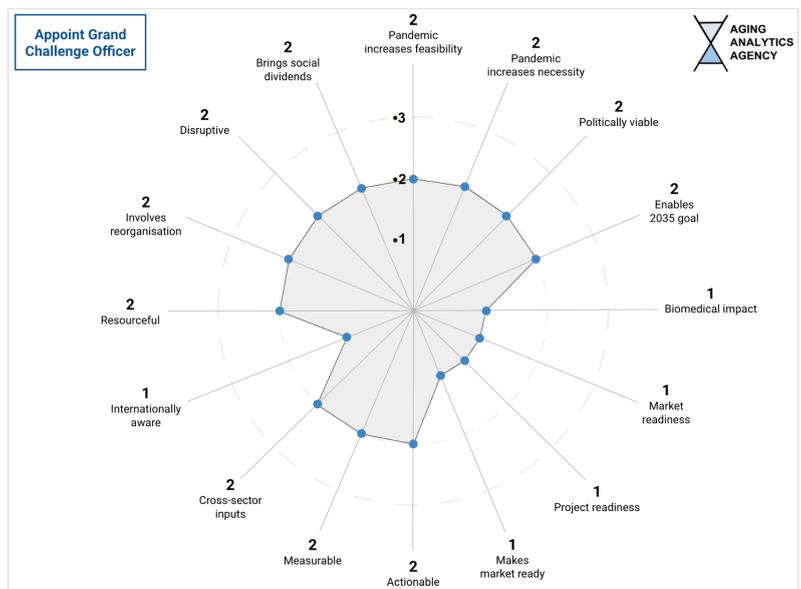
TOTAL SCORE: 11

Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



Official Response, Analysis of Report & Benchmarking of Recommendations

This largely addresses the need for accountability and helps to make coordination possible. However, the government should think twice about whether all industrial-scale, innovative, and biotechnological solutions for the Age Society Grand Challenge will continue to fit within the purview of the Minister for Health and Social Care in the longer term.



Tier 2 Recommendation Scores

Research drugs targeting aging

“We recommend that UK Research and Innovation and the National Institute for Health Research support further research into drugs that target the ageing process — including proof of concept trials using repurposed drugs (such as in the TAME trial). (Paragraph 179)”

Score

A1 (Feasibility increased by continuance of pandemic): +2

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): 0

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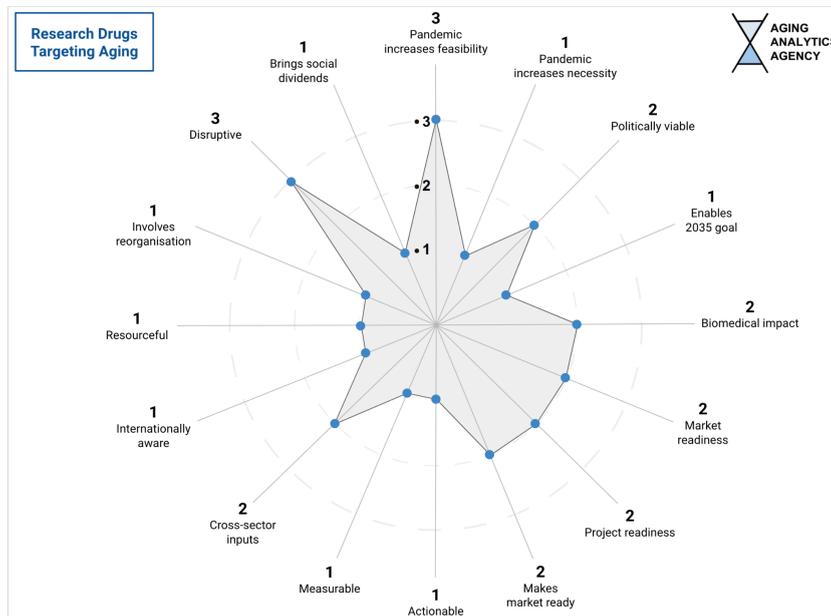


Official Response, Analysis of Report & Benchmarking of Recommendations

- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): 0
- D6 (Reorganisation): 0
- E (Disruptiveness): +2
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 10

This proposal earns a strong +1 for both resourcefulness (D5) and market readiness (C3). The weakness of many industrial strategies globally is that a lack of cross-sector input (a value also earning this recommendation a +1) often leads strategists unaware of when and when not to innovate. The repurposing of existing drugs is a long term strategy favoured by Aging Analytics Agency and earn.



UKRI-NIHR collaboration

"We recommend that UK Research and Innovation and the National Institute for Health Research commit to working more closely to ensure rapid translation of ageing research into clinical benefit. (Paragraph 180)"

Score

- A1 (Feasibility increased by continuance of pandemic): +1

Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report

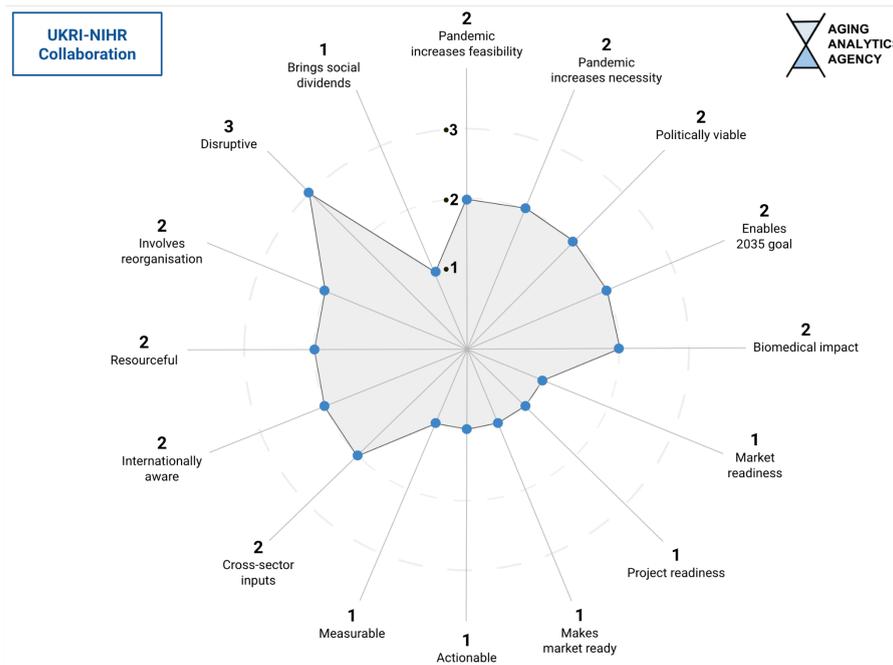


Official Response, Analysis of Report & Benchmarking of Recommendations

- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): +1
- C1 (Market readiness applicability): 0
- C2 (Project readiness): 0
- C3 (Move to market readiness): 0
- D1 (Actionability): 0
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): +2
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 10

This scores strongly on and cross-sector coordination (D3) and very strongly on disruption (E). Accelerated clinical translation of biomedicine has the potential to profoundly alter the entire nature of the challenge. However, rapid translation will require the judicious use of biomarkers if it is to meet the needs of the 2035 goal (B1).



Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



Official Response, Analysis of Report & Benchmarking of Recommendations

UKRI-HIHR oversight

"We recommend that the Chief Medical Officer is given responsibility for overseeing the coordination of ageing research between UK Research and innovation and the National Institute for Health Research. (Paragraph 181)"

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): 0

C2 (Project readiness): +1

C3 (Move to market readiness): 0

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): +1

D5 (Resourcefulness): +1

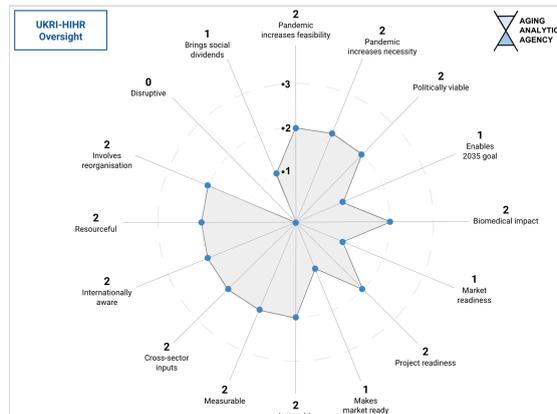
D6 (Reorganisation): +1

E (Disruptiveness): -1

F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 10

This recommendation scores very strongly in leveraging cross-sector inputs (D3). Aging Analytics Agency supports this expansion of the remit of the Chief Medical Officer to encompass the coordination of research with UKRI, given the amount of cross-sector innovation which we view as strictly necessary to meet the 2035 goal.



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Official Response, Analysis of Report & Benchmarking of Recommendations

UKRI-NIHR to Research Lifestyle Factors

“There is a need to better understand the scientific basis of the mechanisms by which lifestyle factors affect ageing. There is also a need to understand how requirements change in old age in order to develop advice covering, for example: the nutritional needs of older people; the benefits of physical activity for cognitive health; and the impacts of sedentary time. (Paragraph 249)

We recommend that UK Research and Innovation and the National Institute for Health Research ensure that they support interventional studies to establish the mechanisms by which lifestyle and environmental factors affect health in old age, in order to improve advice for healthy ageing. (Paragraph 250)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): 0

C1 (Market readiness applicability): 0

C2 (Project readiness): +1

C3 (Move to market readiness): 0

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): +1

D5 (Resourcefulness): 0

D6 (Reorganisation): 0

E (Disruptiveness): 0

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 10

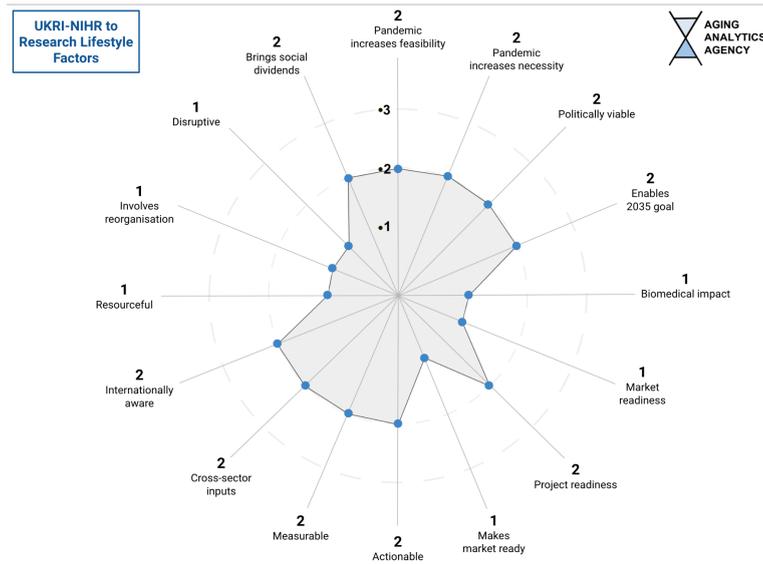
Aging Analytics Agency supports this proposal but it scores a +1 for cross-industry coordination on the condition that it not overlook the latent utility of wearable devices and other digital technologies in obtaining lifestyle data. Furthermore, the use of wearables should not be restricted to researching lifestyle factors. The increase in use and popularity of connected digital devices and health-related mobile apps has produced a novel set of large, diverse, and complex data sets known as “digital biomarkers.”

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These are defined as objective, quantifiable, physiological, and behavioural measures that are collected by sensors embedded in portable, wearable, implantable, or digestible devices.



Define Roles and Responsibilities for all Govt. Bodies.

“Public Health England’s advocacy for a life-course approach to healthy ageing is to be commended. Early uptake and adherence to a healthy lifestyle may continue into mid- and later life, but it is never too late to benefit from an improved lifestyle. Interventions tend to be more successful if they are designed with an understanding of what motivates people at different ages and the transition points at which they are more likely to act on public health advice. (Paragraph 260)

A balanced approach to public health advice can help to achieve healthy ageing, with general messages provided to the whole population and tailored advice for groups with specific needs—in particular, disadvantaged groups who suffer from the worst health. (Paragraph 270)

We recommend that the Government clearly defines the roles and responsibilities for healthy ageing among national and local government and their agencies. The creation of the National Institute for Health Protection should be used as an opportunity to revitalise work to promote healthy ageing across the life-course, including by improving coordination across the sector and drawing on the best information for developing public health advice. (Paragraph 275)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

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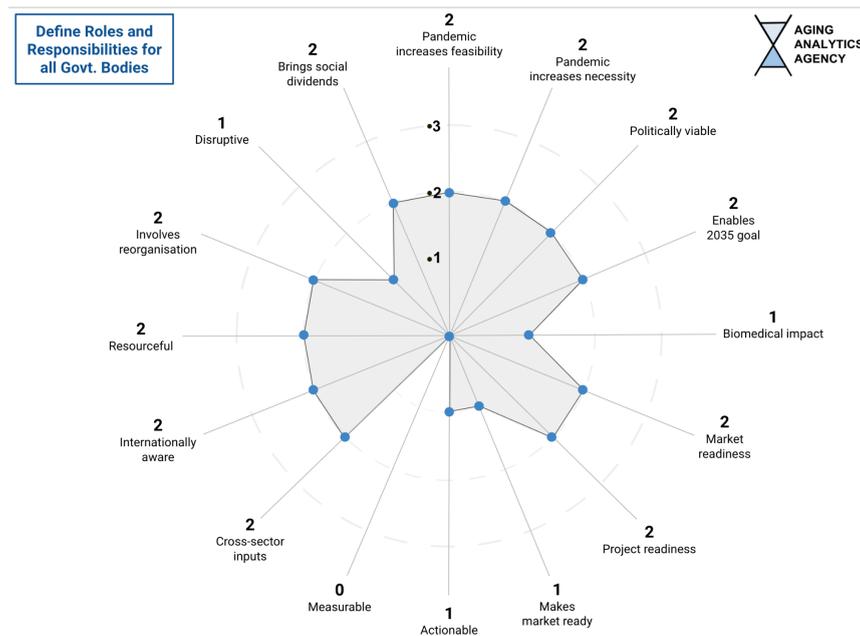


Official Response, Analysis of Report & Benchmarking of Recommendations

- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): +1
- C3 (Move to market readiness): 0
- D1 (Actionability): 0
- D2 (Degree of measurability): -1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 10

Two recent developments make this recommendation politically timely (A): 1) The public have adopted a positive attitude to lifestyle adjustments during the pandemic; and 2) Coordinated delivery of health advice, not to mention accountability in this area, are now supreme political virtues, rendering many national elections in the past year effectively referenda on these issues.



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Review 2035 Target

"The Government is not on track to achieve the Ageing Society Grand Challenge mission to ensure five years of extra healthy life by 2035 while reducing inequalities, and does not appear to be monitoring progress towards the mission. It is hard to see how the target could be met without significant changes to the way it is managed. (Paragraph 362)

We recommend that the Government review the feasibility of the target to increase healthy life expectancy by five years by 2035, and revise or re-commit to it. The Secretary of State for Health and Social Care should commit to reporting annually to Parliament on progress towards the target. The Government should also revise or re-commit to the target to reduce inequalities and outline measurable targets for the reduction in inequalities it hopes to achieve by 2035. (Paragraph 363)"

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): 0

C2 (Project readiness): 0

C3 (Move to market readiness): +1

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): -1

D5 (Resourcefulness): +1

D6 (Reorganisation): +1

E (Disruptiveness): +1

F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

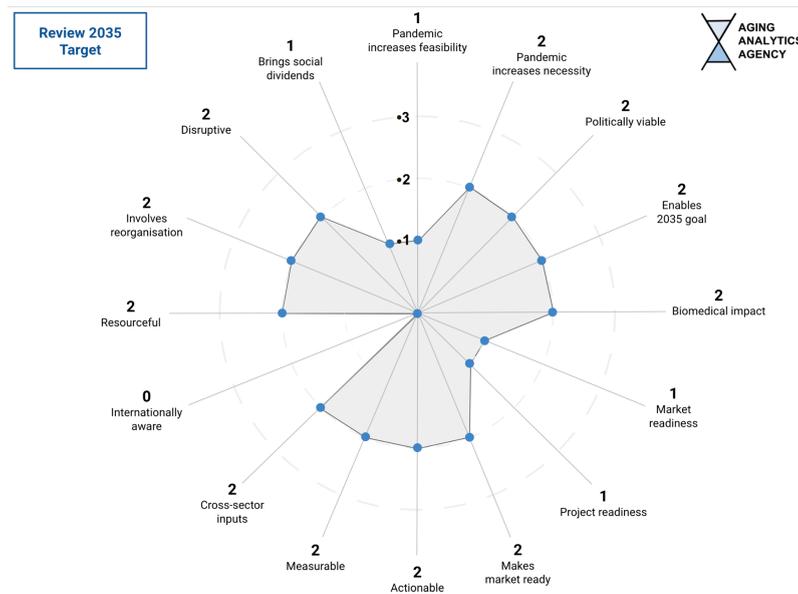
TOTAL SCORE: 10

Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



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This scores -1 on D4 (awareness of international context): a profound lack of confidence in the ultimate feasibility of this goal, even granted sufficient political will, suggests a failure to consider international examples extensively documented by Aging Analytics Agency which demonstrate that the challenge can be met using the UK's existing assets resources.



Research Biological Aging

“How to target ‘anti-ageing’ drugs to provide the greatest benefit to the individual, the NHS and society will be an important issue in future but requires further research and evidence from clinical trials. A health economics analysis of such treatments will be needed to determine the optimal time and populations for intervention. (Paragraph 170)

There has been a lack of effort since our report in 2005 to ensure research into ageing—as opposed to research into specific age-related disease—is properly funded, co-ordinated and included within the remit of particular research councils. This may have contributed to the poor translation of basic research into clinical trials or new medicines. (Paragraph 177)

We recommend that UK Research and Innovation commit to funding further research into the biological processes underlying ageing as a priority, in particular to address gaps in understanding the relevance of ageing hallmarks to humans. Research to identify accurate biomarkers of ageing in humans should also be prioritised, to support studies to improve health span. (Paragraph 178)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

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Official Response, Analysis of Report & Benchmarking of Recommendations

- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0
- B2 (Relevance to general goal of biomedical healthy life extension): +1
- C1 (Market readiness applicability): 0
- C2 (Project readiness): +1
- C3 (Move to market readiness): +1
- D1 (Actionability): 0
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): 0
- D6 (Reorganisation): 0
- E (Disruptiveness): +2
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 10

This recommendation scores high in Readiness (C) and Resourcefulness (D5: Resourcefulness).

The judicious use of biomarkers represents “a move to market readiness” (C3). (D5: Resourcefulness), however is contingent on an accurate appraisal of existing assets. We recommend 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.

The recommendation also scores high in Disruption (E) as research into biomarkers and hallmarks of aging is of critical importance not only to short term preventive solutions such as would be more than sufficient to meet the 2035 goal, but also to every facet of the emerging Longevity Industry as documented extensively by Aging Analytics Agency.

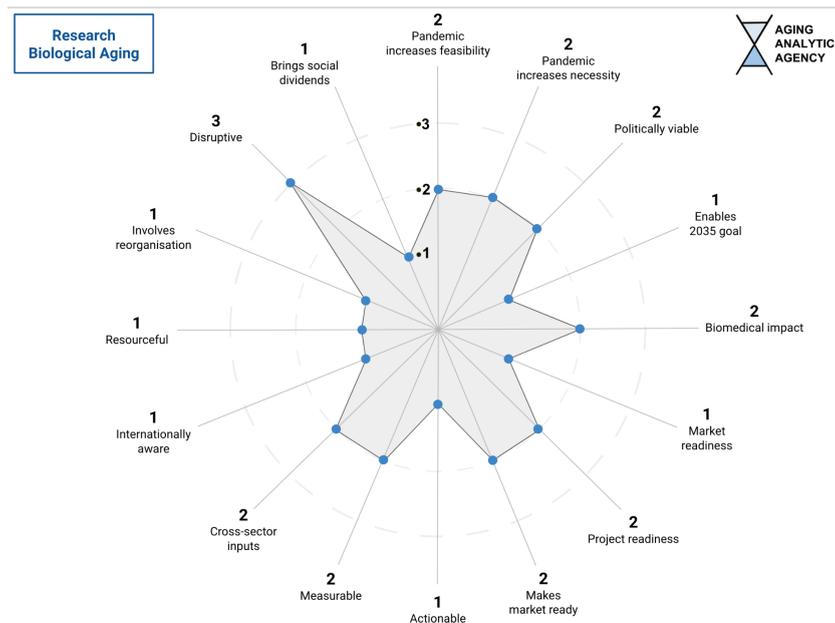
However, regarding (D3: Leveraging of cross-regional inputs): The role of artificial intelligence in biomarker development is frequently hinted at, e.g. in references to the use of AI in drug discovery, but never explicitly acknowledged.

Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



Official Response, Analysis of Report & Benchmarking of Recommendations

This recommendation only scores a +1 for D3 on the assumption that the critical role of AI in biomarker discovery is understood by the Committee.



Health Minister & New Officer Produce Cross-Govt. Strategy

“We are concerned that there is not a cross-government strategy for achieving the mission. Without one, the Ageing Society Grand Challenge is unlikely to achieve the mission of increasing healthy life expectancy by five years while reducing inequalities. (Paragraph 377)

The Government’s statement that the part of the mission pertaining to inequalities is not the sole responsibility of the Ageing Society Grand Challenge is confusing. Other aspects of policy will contribute to this goal, but that does not mean that reducing inequalities should not be at the core of the cross-government strategy for healthy ageing. (Paragraph 378)

We recommend that the Secretary of State for Health and Social Care—along with the senior responsible officer—produces a cross-government strategy which clearly states how the Government plans to achieve the Ageing Society Grand Challenge mission by 2035. The strategy should include a roadmap for how the Government intends to achieve the mission, and should specify the departments responsible for working towards the target. (Paragraph 379)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1



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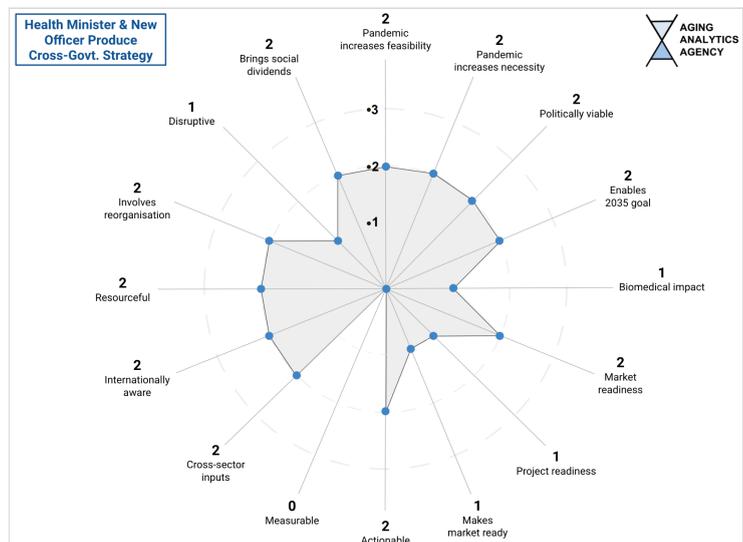
Official Response, Analysis of Report & Benchmarking of Recommendations

- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): 0
- C3 (Move to market readiness): 0
- D1 (Actionability): +1
- D2 (Degree of measurability): -1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 10

Assets under the Minister's control may be enough to meet the 2035 challenge, which, as we have said, is largely about optimising existing resources. However, if we look to the current model of Singapore, as we advise, we see that even their current precision medicine program is coordinated by the Research, Innovation and Enterprise Council (RIEC), which is chaired by the Prime Minister of Singapore.

The distinction between assigning the challenge to an officer of the health ministry, or something on the order of ministry in itself, symbolises the distinction between Longevity as a facet of industrial strategy, and what Aging Analytics Agency would refer to as a Nation Longevity Development Plan, propositional concept, the precursors to which exist in industrial strategies across the world, which we have documented extensively.



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Tier 3 Recommendation Scores

Plan for Health Equality

“Life expectancy in the UK continues to rise, but since 2011 it has risen at a slower rate. Healthy life expectancy is not keeping pace with increases in life expectancy, resulting in a growing period of poor health towards the end of life. Inequalities in healthy life expectancy are stark, with people in the least deprived groups living more than 18 years longer in good health than those in the most deprived groups. (Paragraph 30)

We recommend that the Government, along with NHS England, Public Health England, and other agencies, prioritise reducing health inequalities. In its response to this report we request that the Government sets out a plan for reducing health inequalities over the next Parliament. (Paragraph 31)”

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): -1

A3 (Political viability): 0

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0

B2 (Relevance to general goal of biomedical healthy life extension): 0

C1 (Market readiness applicability): +1

C2 (Project readiness): 0

C3 (Move to market readiness): -1

D1 (Actionability): 0

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): +1

D5 (Resourcefulness): +1

D6 (Reorganisation): +1

E (Disruptiveness): -1

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

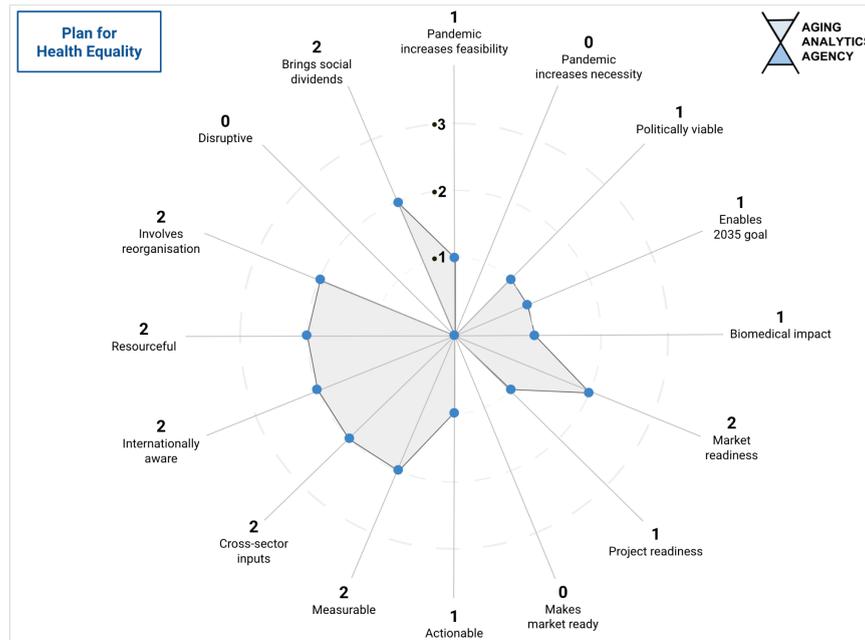
TOTAL SCORE: 4

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Official Response, Analysis of Report & Benchmarking of Recommendations

Aging Analytics Agency agrees that the task remaining must be to exemplify the immediate state of public health and that the first step must be for a concrete short term plan to be published.



Designated Clinicians

“Multimorbidity—the state of having two or more long-term conditions—is more common in old age. There is evidence that the rate of multimorbidity is increasing, so it will become an increasing issue for the NHS. The environmental and biological factors driving the development of multimorbidity are not fully understood. (Paragraph 47)

Care pathways are not well coordinated or integrated for older people, particularly those with multimorbidity. Patients often have to see multiple doctors, with multiple specialisms, with little coordination between specialists to reduce the burden on patients. (Paragraph 66)

We recommend that, as was proposed in 2013, the NHS ensures that all older patients have a designated clinician. This clinician would have oversight of the patient’s care as a whole, and should coordinate activity across multidisciplinary teams, which should include members from across the health and social care sectors. The clinician could be from either primary or secondary care, depending on the patient’s needs. (Paragraph 67)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): -1

A3 (Political viability): 0



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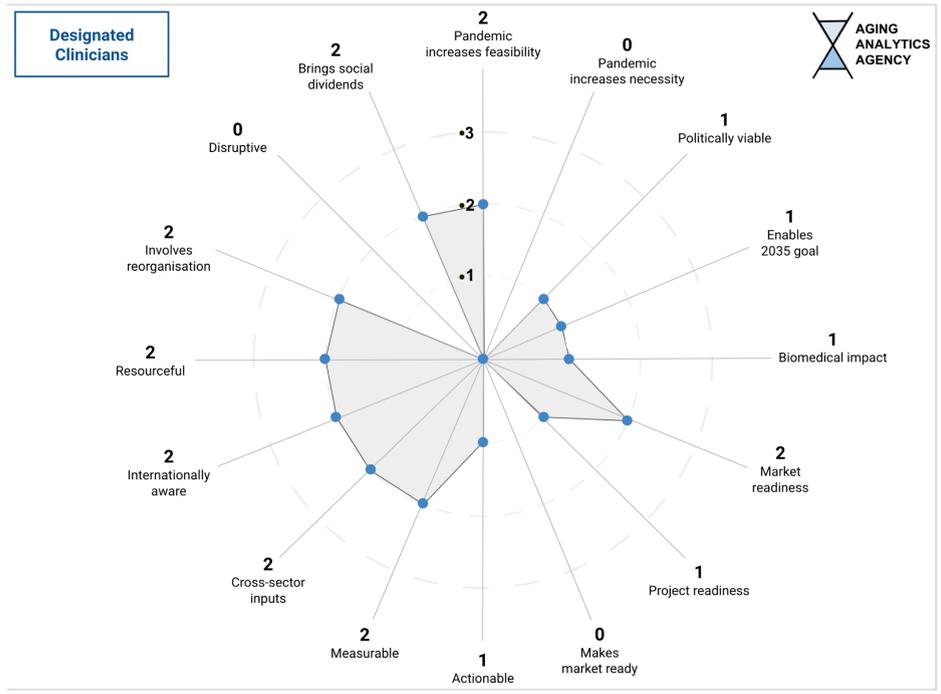
Official Response, Analysis of Report & Benchmarking of Recommendations

- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): 0
- C3 (Move to market readiness): -1
- D1 (Actionability): 0
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- E (Disruptiveness): -1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 4

Aging Analytics Agency is emphatic about the need for coordination and this recommendation scores strong on Dividends (F).

Productive participation by the elderly in society will be vital for maintaining the political and financial conditions necessary for the nation to proceed with the longer term generation-long struggle for greater National Healthy Longevity.



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Official Response, Analysis of Report & Benchmarking of Recommendations

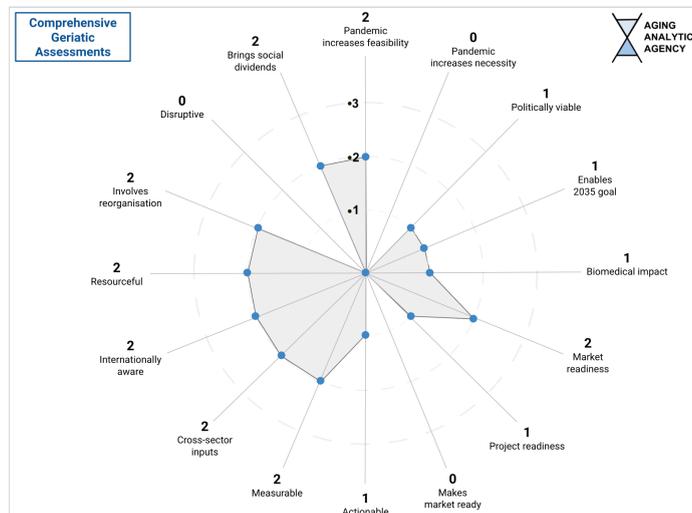
Comprehensive Geriatric Assessments

“We recommend that designated clinicians for older people ensure that Comprehensive Geriatric Assessments are used regularly for older patients, particularly for those with multimorbidity. The Government should ensure that training in how to conduct Comprehensive Geriatric Assessments is a core part of medical training, and that training is provided on an ongoing basis, in particular to GPs. (Paragraph 68)”

Score

- A1 (Feasibility increased by continuance of pandemic): +1
- A2 (Necessity increased by covid pandemic): -1
- A3 (Political viability): 0
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): 0
- C3 (Move to market readiness): -1
- D1 (Actionability): 0
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): -1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 4



Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



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Review into Overprescribing

"Medicine reviews are a core component of Comprehensive Geriatric Assessments, and if these are used more widely, with the involvement of multidisciplinary teams, the incidence of polypharmacy and the risk of adverse drug reactions should reduce. (Paragraph 80)

We recommend that the review into overprescribing—which is due to report to the Secretary of State for Health and Social Care in late 2020—should be published as soon as possible. (Paragraph 81)"

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): -1

A3 (Political viability): 0

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0

B2 (Relevance to general goal of biomedical healthy life extension): 0

C1 (Market readiness applicability): +1

C2 (Project readiness): 0

C3 (Move to market readiness): -1

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): +1

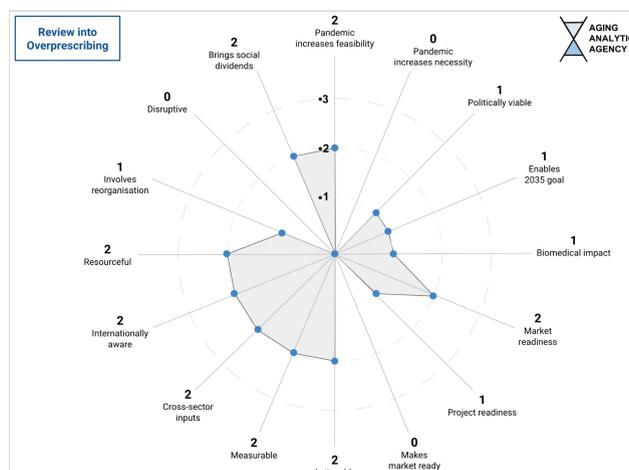
D5 (Resourcefulness): +1

D6 (Reorganisation): 0

E (Disruptiveness): -1

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 4



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UK Capital Investment

"The UK has historically been a major player in drug research and development, and has the potential to be a key player in the development of treatments targeting the processes of ageing. However, companies in the UK struggle to commercialise such innovations and often have to move abroad to access finance. (Paragraph 191)

We recommend that the Government ensure the UK remains a global leader in drug research and development. It should work towards making the UK a more attractive environment for growth capital investment, to stop UK innovations moving abroad after the discovery stage of research. (Paragraph 192)"

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): 0

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): -1

C2 (Project readiness): 0

C3 (Move to market readiness): 0

D1 (Actionability): 0

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): +1

D5 (Resourcefulness): +1

D6 (Reorganisation): +1

E (Disruptiveness): +2

F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 8

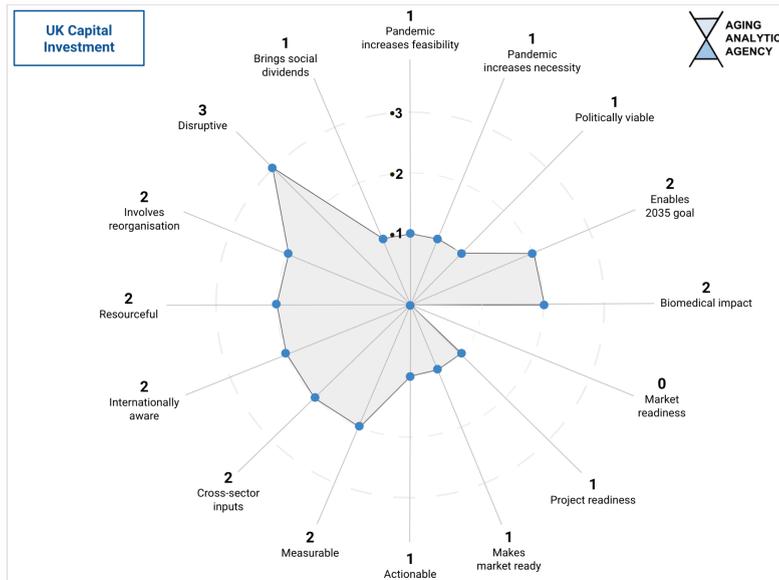
This recommendation scores strongly on (D4), assuming the UK government does not overlook lessons from abroad, such as the biomedical research incentives provided by countries such as

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Australia, which are described in Aging Analytics Agency's response to the Committee's recommendations.



Behaviour-based Health Advice

“There was scepticism from the research community that the target of five extra years of healthy life can be achieved by 2035, and a view that the focus of the Industry Strategy Challenge fund on technological solutions and data analysis is unlikely to help deliver the target. (Paragraph 202) Lifestyle and environmental influences on healthy ageing

The UK has the opportunity to be a leader in understanding the impacts of lifestyle on health, using its well-established cohort studies in conjunction with its expertise in emerging areas of biomedical research. To achieve this, it is important that longitudinal cohort studies are provided with longer-term funding that gives greater security to these studies. It is also important that cohort studies recruit sufficient numbers of people from different ethnicities and socioeconomic groups to better understand health inequalities in older adults and how these may be resolved in the longer term. (Paragraph 220)

The impacts of smoking and excessive alcohol consumption upon ageing—and the potential for ill health and disability in old age—may be an important issue for some people when considering their behaviours and so could be an effective part of public health messaging. (Paragraph 224)

Eating a balanced diet and maintaining a healthy body weight into old age are key to healthy ageing. Dietary advice has to reflect the nutritional needs of older people and the diversity of those needs. (Paragraph 230)

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The benefits of physical activity are a cornerstone of public health advice, but a more detailed understanding of its positive effects—and the negative effects of sedentary time—could allow the development of advice that is more targeted. This is important throughout the life-course, including for older adults who have lower levels of physical activity. (Paragraph 239)

Cognitive ability and psychological stresses are key aspects of health throughout the life-course, but they also influence general health and might affect the underlying processes of ageing. Cognitive activities—including education, training and good-quality employment—and reduced stress are means of improving health in later life. (Paragraph 245) Ageing: Science, Technology and Healthy Living 111

The factors that contribute to healthy life expectancy are well known, and form the basis of healthy ageing advice, namely: not smoking, avoiding excessive alcohol consumption, eating a balanced and nutritious diet, maintaining a healthy body weight, and being physically active. There is also evidence of the role of cognitive activity and reduced stress in healthy ageing. (Paragraph 246)

Despite the evidence linking behaviours throughout the life-course to health in old age, the potential gains from healthy behaviours are not being fully achieved. Different aspects of the evidence could potentially have an impact upon people's behaviours, for example: the fact that healthy lifestyles can reduce the time spent with disability in old age; and the discovery that behaviours can modify underlying processes of ageing. (Paragraph 247)

We recommend that organisations with responsibility for healthy ageing advice incorporate findings about the benefits of healthy behaviours that may have a larger impact upon people's behaviour than existing messaging. The benefits of building up good levels of physical fitness and cognitive reserve should be promoted, particularly to people in disadvantaged groups that suffer the worst health. (Paragraph 248)''

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): 0

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): 0

D2 (Degree of measurability): -1

D3 (Degree of leveraging cross-sector inputs): 0

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D4 (Awareness of international context): +1

D5 (Resourcefulness): +1

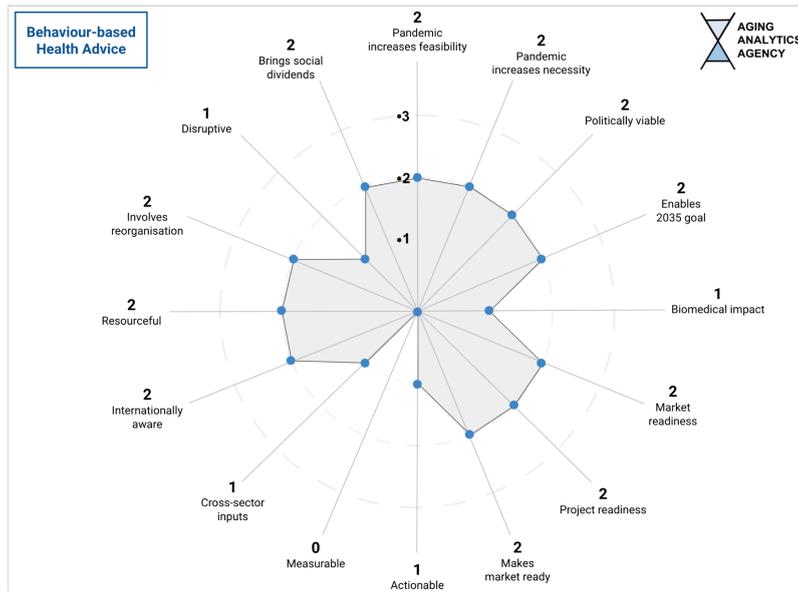
D6 (Reorganisation): +1

E (Disruptiveness): 0

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 9

Aging Analytics Agency has documented these factors extensively across many jurisdictions and environments across the globe.



Healthy Lifestyle Regulations

“We recommend that the Government implement a concerted and coordinated set of national policies to support healthy ageing, including: regulatory and fiscal measures, actively to encourage people to adopt lifestyles that support healthy ageing; increasing the reach of the NHS Health Check to those in disadvantaged groups who will benefit the most; and working with local authorities on the funding of local services, housing and infrastructure to encourage and facilitate healthier living across the life-course, including the necessary services to maintain health and independence in old age. (Paragraph 284)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

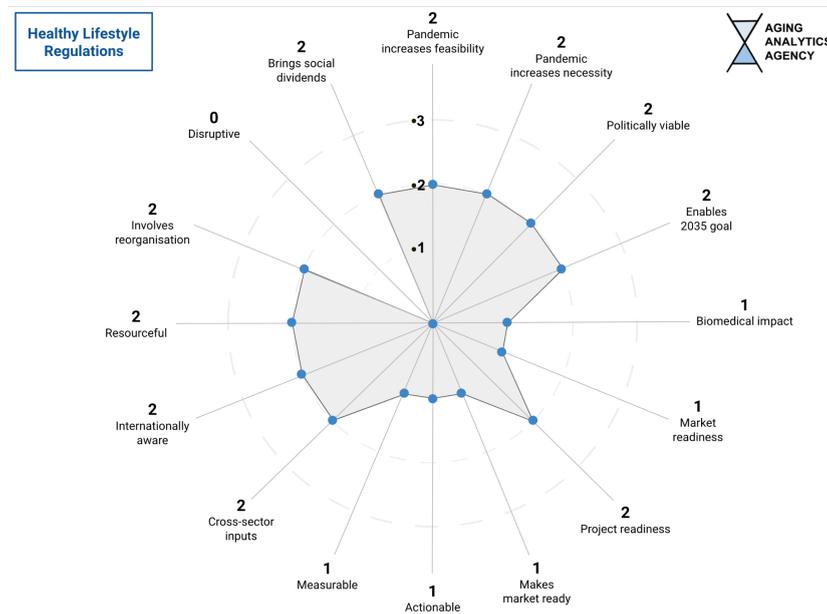
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- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): 0
- C2 (Project readiness): +1
- C3 (Move to market readiness): 0
- D1 (Actionability): 0
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): -1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 9



Age-Friendly Urbanism

“We recommend that the Government use planning rules to ensure that homes and communities are accessible for people with limited mobility and adaptable as their needs change with age. The Government should ensure that sufficient funds are available—for example through the Disabled Facilities Grant—to facilitate improvements to existing homes. The priority should be areas with poor housing and infrastructure, in order to reduce health inequalities. (Paragraph 292)”

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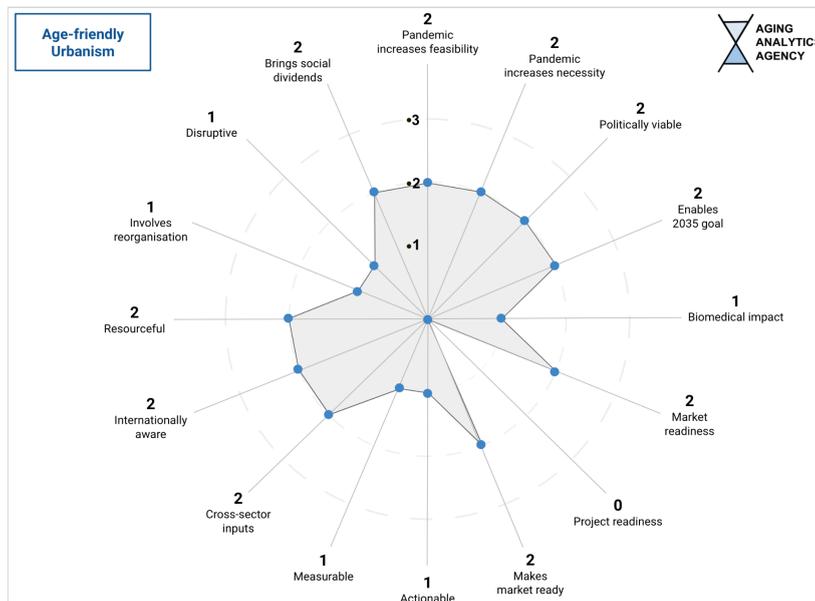
Official Response, Analysis of Report & Benchmarking of Recommendations

Score

- A1 (Feasibility increased by continuance of pandemic): +1
- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness):-1
- C3 (Move to market readiness): +1
- D1 (Actionability): 0
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 9

This has a strong score in awareness of international context (D4), as it appears to follow the examples and aspirations of many nations such as those laid out by the WHO Global Network for Age-Friendly Cities.



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Internet Access and Skills

"The use of wearable and implantable technologies for monitoring health conditions and administering treatments is likely to become increasingly common. Such technologies have potential to provide more precise and timely treatment, and could contribute to better health and greater independence in old age. (Paragraph 309)

Non-medical devices can be a source of useful information for individuals seeking to live more healthily. It will be necessary for the Government to continue to monitor developments in the sector to ensure an appropriate approach to standards. (Paragraph 313)

The Government is to be commended for developing its loneliness strategy. Older people need strong social contacts, with the priority being face-to-face interactions. There is also the need for people to develop digital skills to use technologies that can reduce social isolation and loneliness. (Paragraph 318)

With much healthcare data now held electronically, alongside data generated by non-medical devices, there is a valuable opportunity to develop more sophisticated methods of monitoring and predicting how well people age. There is a need to further reduce technical barriers to data integration across different platforms and administrative barriers to providing anonymised patient data for clinical trials. (Paragraph 325)

In order to improve uptake and usefulness of technologies and services that can contribute to healthier and independent living in old age, it is important to base the process of development and deployment around older people's needs, preferences and abilities. It is beneficial for older people to be involved in the design of these products and services. (Paragraph 329)

Public trust in data security is key if data-driven services and new technologies are to be deployed widely and used to their potential. Ongoing public engagement will be necessary to reassure the public on matters of trust and privacy regarding healthcare data, so that people are more willing to share data that can contribute to their own healthcare and to the development of wider advice for healthy ageing. (Paragraph 333)

We recommend that the Government ensures internet access for all homes so that older people can access services to help them live independently and in better health. The Government should promote and support lifelong digital skills training so that people enter old age with the ability to use beneficial technologies. Greater support should be provided to the large proportion of the current older generation which lacks these skills, so that they do not miss out on the benefits of available technologies. (Paragraph 338)"

Score

A1 (Feasibility increased by continuance of pandemic): +1

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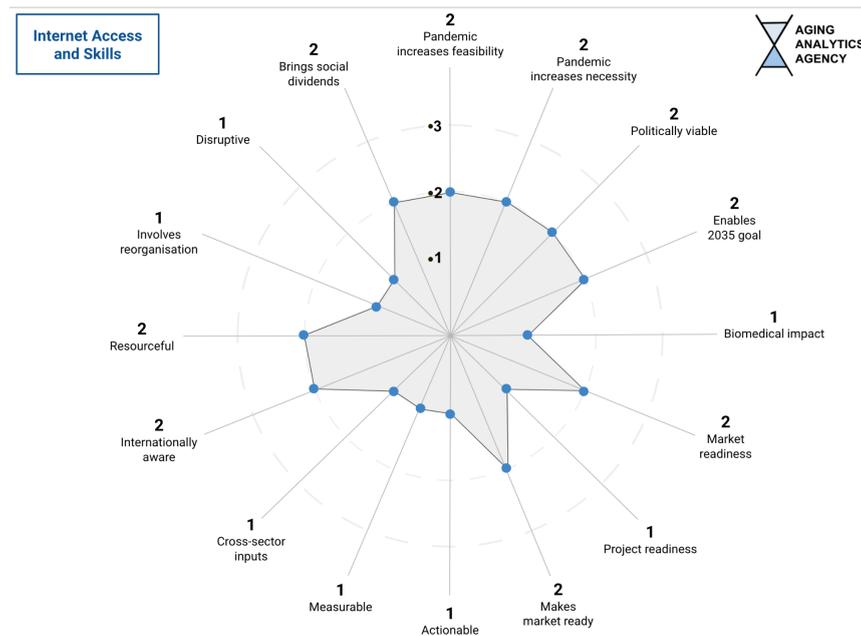


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- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): 0
- C3 (Move to market readiness): +1
- D1 (Actionability): 0
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): 0
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 9

This also scores +1 on Market Readiness Applicability, as an industry of age-friendly digital technologies is already beginning to take root internationally, and +1 on “awareness of international context” as it appears to follow international examples of nations such as Japan which have embraced this industry.



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Healthy Living Technologies

“The funding for new innovation in products and services seems to be aimed more at larger companies, presumably in the hope of achieving commercialisation more quickly and with less risk. However, small and medium-sized enterprises contribute significantly to innovation, and there would be merit in these organisations having easier access to funding to support innovation. (Paragraph 343)

There is significant potential for development of new technologies and services to support healthier and independent living in old age, including medical devices and robotics. There is scope for further deployment of existing technologies such as telecare and ‘activities of daily living’ systems. (Paragraph 344)

Technology and services can contribute to independence and social connectedness in old age, and to health to a lesser extent, but it seems unlikely that they can add five years of healthy and independent living by 2035. Moreover, there is a risk of technology and services widening health inequalities in old age, due to barriers to uptake that are more prevalent in disadvantaged groups. The Government will have to intervene decisively and for the long-term in order to make these tools ubiquitous and beneficial for the whole population in old age. (Paragraph 348)

When allocating funding through the Ageing Society Grand Challenge, we recommend that the Government supports the deployment of technologies that contribute to healthier and independent living—both those available now and those that may become available in future. This should prioritise disadvantaged groups in order to bring the greatest health benefits, whilst also realising economic benefits of innovations that are developed in the UK. (Paragraph 349)”

Score

- A1 (Feasibility increased by continuance of pandemic): +1
- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): 0
- C3 (Move to market readiness): +1
- D1 (Actionability): 0
- D2 (Degree of measurability): -1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1

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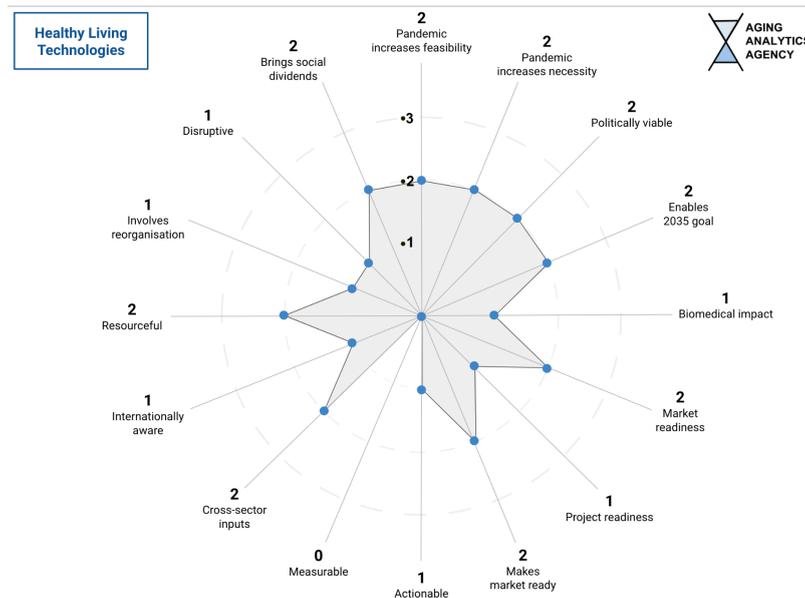
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D6 (Reorganisation): 0

E (Disruptiveness): 0

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 8



Cross-govt. inequalities strategy

“We recommend that the cross-government strategy explicitly addresses the issue of reducing inequalities in healthy ageing, without ‘passing the buck’ to wider Government goals or statutory obligations. In producing the strategy, the Government should seek wide input from stakeholders; most importantly, from older people. (Paragraph 380)”

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): 0

C1 (Market readiness applicability): 0

C2 (Project readiness): 0

C3 (Move to market readiness): 0

D1 (Actionability): 0

D2 (Degree of measurability): 0

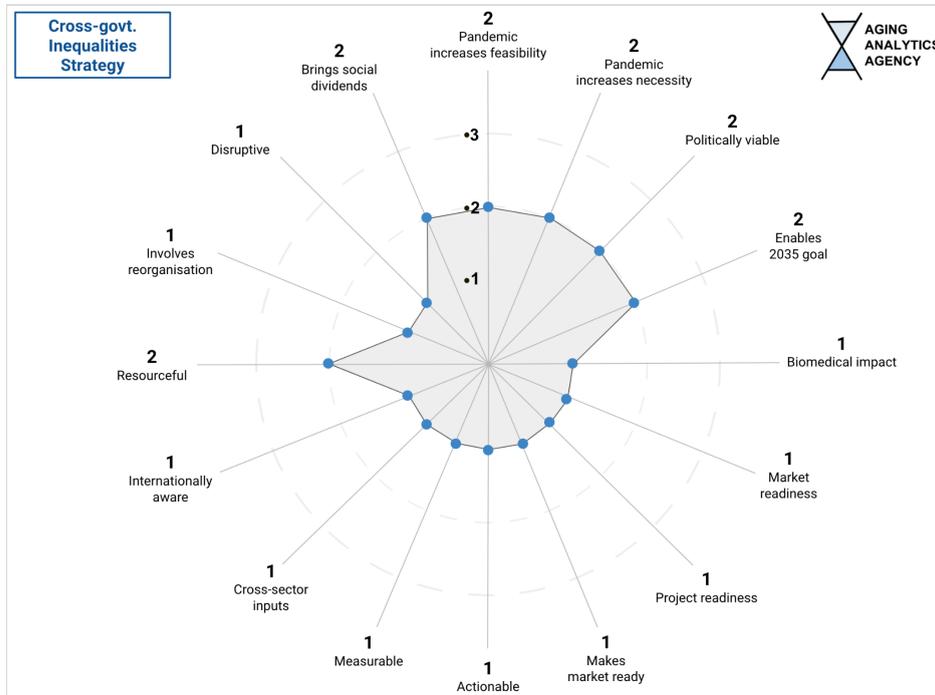
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- D3 (Degree of leveraging cross-sector inputs): 0
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 6





Summary and Key Take-Aways

We would recommend a greater awareness of international context (D4) to help settle this question. We would reiterate that while this may suffice for the short term, the Aging Society Grand Challenge to the future shape of the economy may prove so politically central that the aforementioned stopping of the buck may ultimately be optimally placed at the top tier of government, in order to allow for what may prove to be the necessary degree of cross sector coordination as the industrialisation of Longevity progresses.

- Consider the move to AgeTech for example. This is the recurring theme in our advice: the optimisation of existing assets.
- Recommendations that make up Tier 1 (national Longevity development plan) should not, by having surpassed Tier 2 (2035 goal), be regarded as ipso facto necessary next steps for meeting the 2035 goal. Rather, they represent the necessary measures for the eventual industrialisation of Longevity. For example, the Committee was extremely prescient in identifying the need to invest in research into the mechanisms underlying aging, however the high scores recommendations received for this should not be mistaken for advice to the effect that disruptive biotechnological innovation such as would result from this research is a necessary first step to achieving the 2035 goal.
- **The Committee was correct to identify the need for minimally invasive, easily obtainable biomarkers, but little mention was made of digital biomarkers.** Many of the high scores provided are contingent on the Committee not losing sight of the notion implicit throughout the document: that AI must have a central role in biomarker development, which in turn must have a central role in drug discovery. This is strongly implied but never mentioned explicitly in one place.
- The majority of the recommendations which score high in project readiness belong to Tier 3.
- Tier 2 consists mainly of small steps which could be taken in order to achieve disruptive benefits / progress quick enough to meet the 2035 deadline, e.g. regulatory reform, repurposing of drugs etc.
- Therefore, while Tier 3 recommendations should be regarded as constituting the easy logical next steps, and Tier 1 recommendations should be regarded as necessary investments for the long term, maximum care, attention, and deliberation should be given to implementing Tier 2 recommendations.
- In a nutshell, this entails a short term agenda of **using UKRI-NIHR collaboration to harness AI and other market-ready digital technologies to develop a minimum viable panel of biomarkers, using an comprehensive appraisal of existing assets to toe the line of market readiness and project readiness.**

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It is our hope that this open-source framework can be used to refine and optimise future analyses and official governmental recommendation documents to maximise their actionability and relevance to the contextual realities of the UK national situation, to provide the UK government and associated advisory bodies with the full arsenal tools to optimise, monitor, track and effectively execute their strategic vision to transform challenge of aging into opportunity of Longevity.

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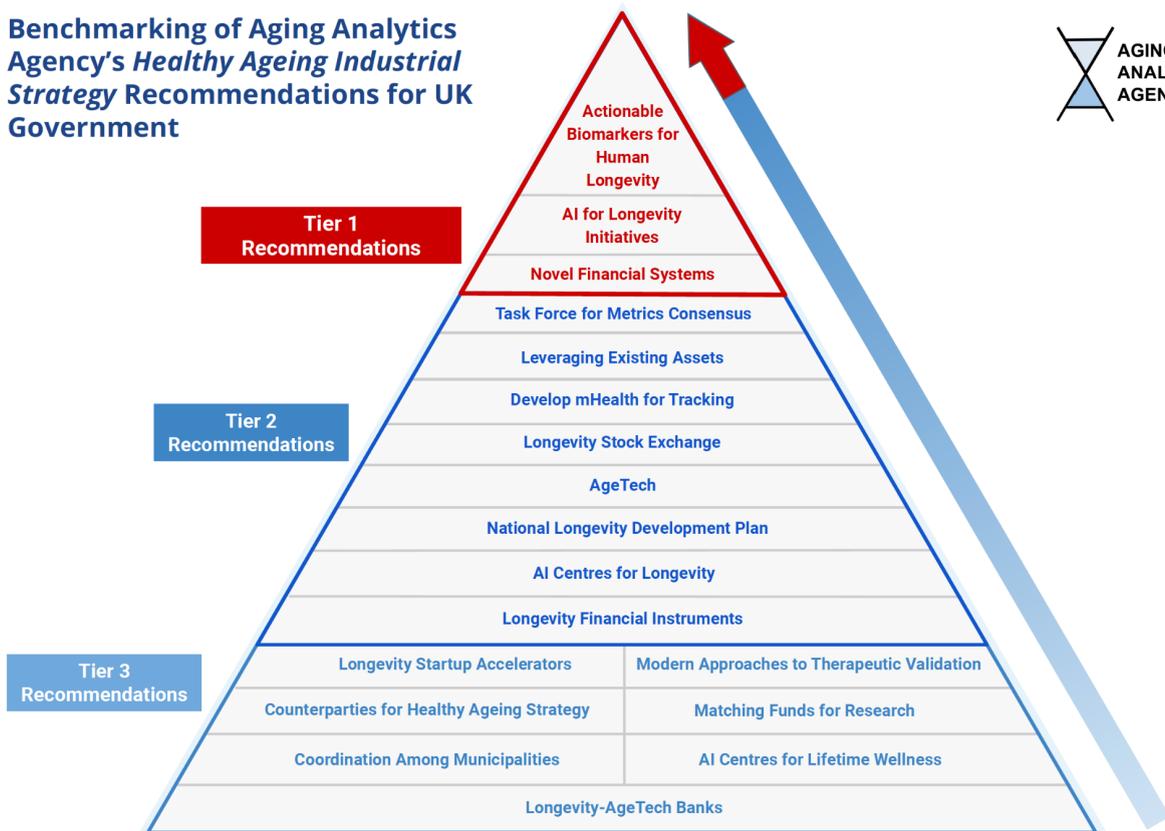


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Benchmarking of Aging Analytics Agency Recommendations

To demonstrate the strength and relevance of our supplementary advice, Aging Analytics Agency has subjected its own updated set of recommendations to the UK government on how to optimize the execution of the Healthy Ageing Industrial Strategy (which were originally submitted as evidence to the [Ageing: Science, Technology and Healthy Living](#) report) to the same ranking framework used to benchmark the House of Lords Science and Technology Committee's report recommendations in the preceding section of the present document. In order to provide meaningful points of comparison with the committee's advice, the recommendations listed below are Aging Analytics Agency's own independent commentary on the government's strategic agenda rather than, as offered previously, a commentary on the committee's own recommendations.

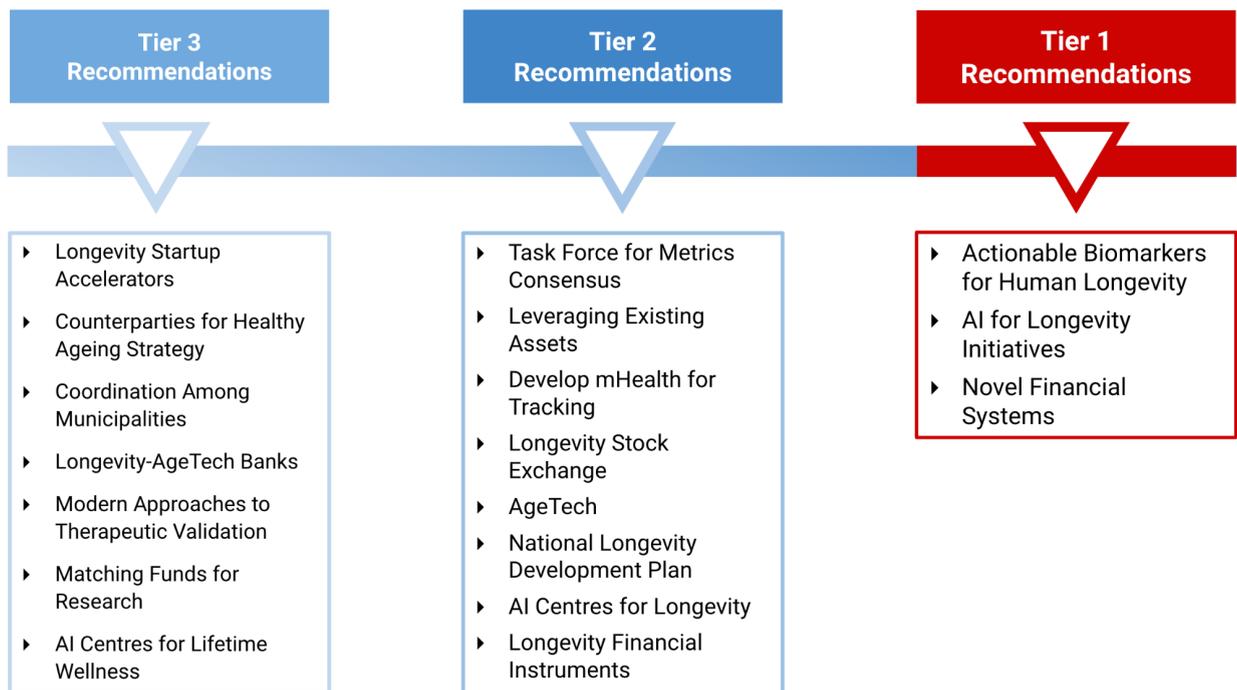
Benchmarking of Aging Analytics Agency's Healthy Ageing Industrial Strategy Recommendations for UK Government





Official Response, Analysis of Report & Benchmarking of Recommendations

Benchmarking of Aging Analytics Agency's Healthy Ageing Industrial Strategy Recommendations for UK Government



Each recommendation is organized according to Tier (i.e., Tier 1, 2 or 3) under a main heading that briefly summarizes the recommendation, followed by a detailed explanation of the recommendation in practice, the total and individual scores of each recommendation as derived by the recommendation benchmarking framework described earlier, and finally, a brief commentary on points of alignment and/or divergence between the recommendation and similar recommendations made by the House of Lords Science and Technology Select Committee in their "Ageing: Science, Technology and Healthy Living" report.

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Tier 1 Recommendations

Actionable Biomarkers of Human Longevity

Biomarkers are a measurable indicator of some biological state or condition. They 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 components 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, capable of serving as a standard metric for industrial output in the 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 practice.

The importance of benchmarking Longevity Biomarkers and Biomarker Panels by their *ratio of accuracy vs. actionability*, rather than just their accuracy, cannot be overstated. In order for this domain of technologies to actually accelerate the translation of Longevity theory into practice, and enable short-term progress in the extension of Healthy Human Longevity, they need to consist of biomarkers that are market-ready, and obtainable to the majority of doctors, clinicians and nation's citizenry.

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

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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 optimise the existing toolkit of regenerative medicine to address the damage of aging, which is already thoroughly researched. And thus out of this paradigm shift arose the field of rejuvenation biotechnology. Now once again, the technology is ahead of the science, the funding, and the political leadership and 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 optimise 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, large-scale data mining, analysis and management is a question of political coordination.

Consider this 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 are 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.

As the Precision Health industry is growing, we will see an increasing emphasis on the creation and validation of a wide diversity of Biomarkers of Aging, which will enable the extension of healthspan and the maintenance of optimal health for the population via continuous AI-empowered monitoring of fluctuations in personalized Biomarkers of Aging.

P4 (Preventive, Predictive, Personalized and Participatory) Medicine, being the cornerstone of lifespan and healthspan extension, will be the central platform for the utilization of a wide array of Longevity Biomarkers for healthcare by both the general public, and by progressive governments seeking to optimise their population-level National Healthy Longevity.

Support and development of Biomarkers of Human Longevity has been a priority of Aging Analytics Agency and its parent company, Deep Knowledge Group, for many years, and, indeed, one of the factors that influenced its first investment in the Longevity Industry in 2014 (in In Silico Medicine, which has gone on to hold Series A and B rounds from other investors including Wuxi AppTec, Pavilion Capital, Qiming Venture Partners, Eight Roads, F-Prime Capital, Lilly Asia

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The project uses comprehensive analytical frameworks to rank and benchmark existing panels of biomarkers of aging, health and Longevity according to their ratios of accuracy vs. actionability, identifying the panels of biomarkers that can have the greatest impact on increasing both individual and national Healthy Longevity in the next few years.

The Rising Wave of Human Biomarkers of Longevity: Landscape Overview 2021

Analytical Report

Increasing Potential of Longevity Biomarkers in Practical Applications



www.longevity.international
www.aginganalytics.com
www.dkv.global

The importance of benchmarking Longevity Biomarkers and Biomarker Panels by their *ratio of accuracy vs. actionability*, rather than just their accuracy, cannot be overstated. In order for this domain of technologies to actually accelerate the translation of Longevity theory into practice, and enable short-term progress in the extension of Healthy Human Longevity, they need to consist of biomarkers that are market-ready, and obtainable to the majority of doctors, clinicians and nation's citizenry.

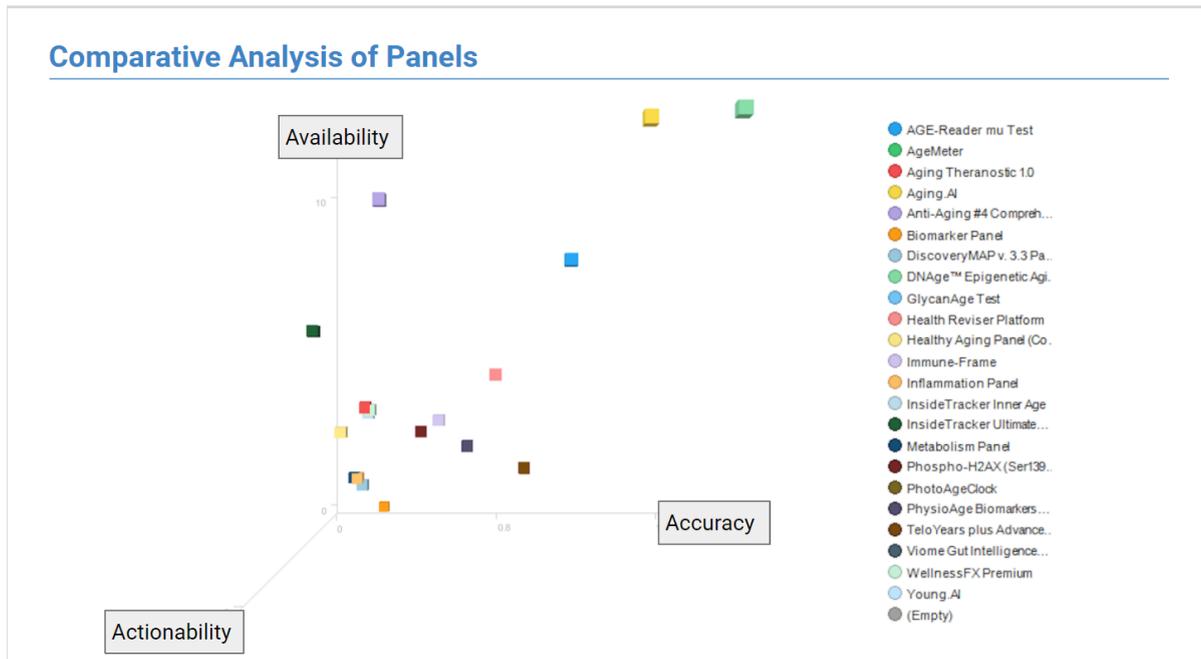
We now have biomarkers and biomarker panels that are market ready, actionable enough (i.e., with comparatively low cost and invasiveness) to be developed, applied and used at scale, and accurate enough to prove useful in validating the safety and effectiveness of lifestyle, behavioural and Precision Medicine-focused interventions, and to track their changes on individual and population-level Healthy Longevity.

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With this in place, the Longevity Industry (as well as national governments) have no excuse not to use them for the purposes of therapeutic validation on the one hand, and optimization of population health on the other.



The upcoming project is produced by Aging Analytics Agency for Deep Knowledge Group's international Longevity Policy-focused subsidiary and open-access Longevity Industry knowledge and collaboration platform, [Longevity.International](https://longevityinternational.com), in order to foster a maximum degree of international collaboration and transparency.

It is our hope that releasing the report and IT-Platform in an open-access manner via Longevity.International will encourage scientists, companies and other industry stakeholders to make their own contributions to the platform, in an effort to eventually arrive at a robust and consensus framework.

Using this data the report provides advice to the industry leaders for the conception, development and maturation of their action plans, providing insurance organizations with a tool to improve their customer services and risk pricing principles, and to policy makers, in order to combat the problem of Ageing Population and realise that opportunity of National Healthy Longevity.



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Longevity Biomarkers: Industry Ecosystem IT-Platform

Longevity Biomarkers Major Parameters

80 Companies	130 Investors
40 Research Labs	80 Scientists & CEOs
165 Biomarkers	100 Biomarker Panels
9 Sectors	3 Amplitude Levels
3 Conditioning Stages	6 Operational Categories

Dynamic Graphs & Interactive Charts

Role of AI in Biomarker Discovery

Interactive Mindmaps

Industry Sector Mindmaps

SWOT and TRL Analysis of Longevity Biomarkers

Strengths	Weaknesses
<ul style="list-style-type: none"> Most commonly used biomarkers serve as sensitive indicators of biological age. Simple, non-invasive, economic and robust biomarkers. Simple, non-invasive, economic and robust biomarkers. Simple, non-invasive, economic and robust biomarkers. Information biomarkers can be used to assess physical and cognitive performance and to predict the risk of mortality in the entire population and in a relatively young population. Using advanced technologies, biomarkers can be used to assess the performance of specific tissues, organs, systems, and overall health. 	<ul style="list-style-type: none"> Complex and potentially unreliable biomarkers. Highly specific and potentially sensitive biomarkers require and demand high-quality data and high-quality analysis. Age is not correlated with health markers (DNA-methylation, telomere length, etc.) and is not correlated with cognitive and physical performance. Age is not correlated with health markers (DNA-methylation, telomere length, etc.) and is not correlated with cognitive and physical performance. Age is not correlated with health markers (DNA-methylation, telomere length, etc.) and is not correlated with cognitive and physical performance.

Longevity Biomarkers 2021 Full Report

The Rising Wave of Human Biomarkers of Longevity: Landscape Overview 2021

Analytical Report

Increasing Potential of Longevity Biomarkers in Practical Applications

Analytical Report Summaries & Teasers

The Rising Wave of Human Biomarkers of Longevity: Landscape Overview 2021

Increasing Potential of Longevity Biomarkers in Practical Applications

The Rising Wave of Human Biomarkers of Longevity: Landscape Overview 2021 is an sometimes special analytical report study by Aging Analytics Agency that uses comprehensive analytical Biomarkers to use and benchmark existing panels of biomarkers of aging, health and Longevity according to their relative accuracy vs. reliability, identifying the areas of biomarkers that can have the greatest impact on increasing both individual and national Healthy Longevity in the next few years, for use by a wide variety of strategic decision makers including companies, investors, governments and insurance companies.

Using this data, the report and IT Platform provides practical recommendations to key industry leaders in order to more intelligently and effectively optimize the conception, development and validation of their action plans and strategic goals, thereby ensuring organizations work to best to improve their commercial interests and the public good, and to policy makers, in order to combat the problem of Aging Population and to transform it into the opportunity of National Healthy Longevity for the total benefit of their citizens and national economy.

80 Companies	130 Investors	40 Research Labs	80 Scientists & CEOs	165 Biomarkers	100 Biomarker Panels
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Comparative Analysis of Longevity Biomarkers

The project is designed to offer key strategic recommendations regarding technologies and biomarkers implementations within the reach of companies, entities and nations in order to assist them in optimizing their developmental action plans and strategies, providing specialized guidance for business and investment core decisions.

It delivers:

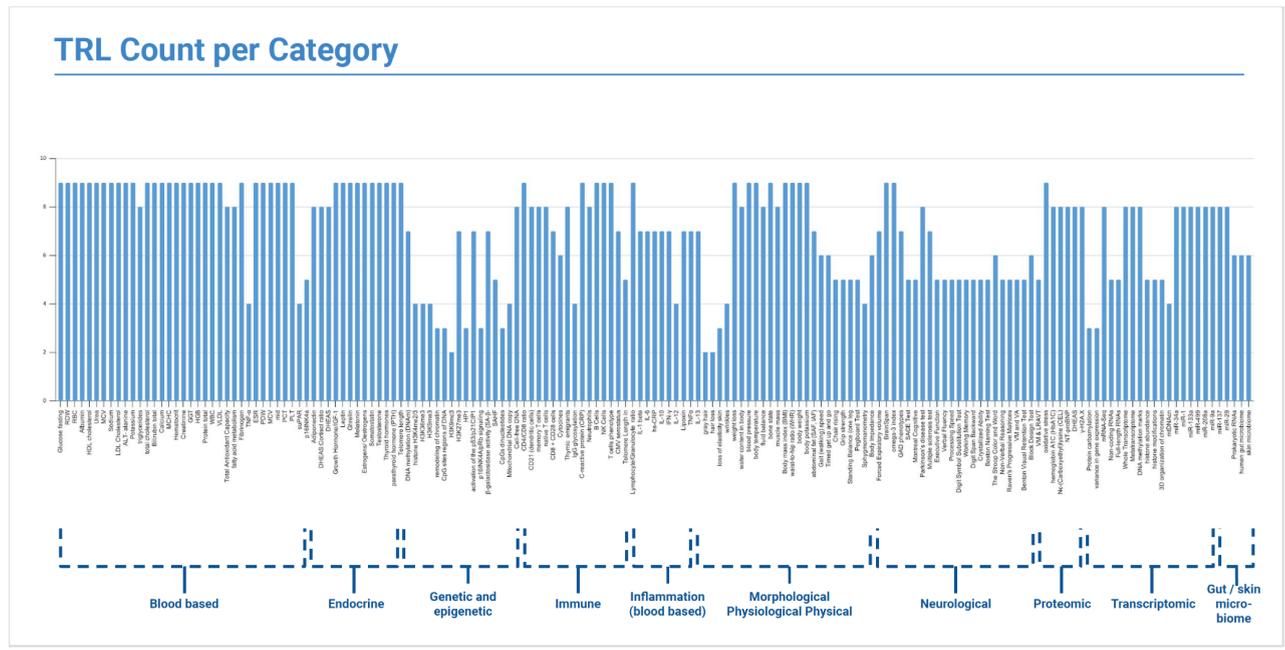
- A "most comprehensive" list of single biomarkers of aging and panels, their advantages and strengths, disadvantages and weaknesses, and future perspectives, challenges and opportunities with a focus on technologies currently used for assessment.
- Concrete analysis of recent novel biomarkers of aging just entering R&D processes today, emerging tools, and novel assay platforms awaiting approval or standardization for clinical implementation, one step away from being market-ready within the next several years.

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- Highlights regarding why AI platforms will come to be a necessary and indispensable component of Longevity biomarker discovery, research and development.
- Overview of different categories of panels, whether for Research Use Only or Approved for Clinical Use.
- Classification of most advanced ageing biomarkers (ageing clocks), their combinations with AI systems, and SWOT and Technology Readiness Level (TRL) analysis of each category with reviews of example use cases and action points. Overview of ageing biomarker mobile applications currently on the market.
- Brief overview of ageing clock application in the insurance industry, concerning technological, and ethical aspects.
- Conclusions and practical recommendations regarding the application of ageing clocks.

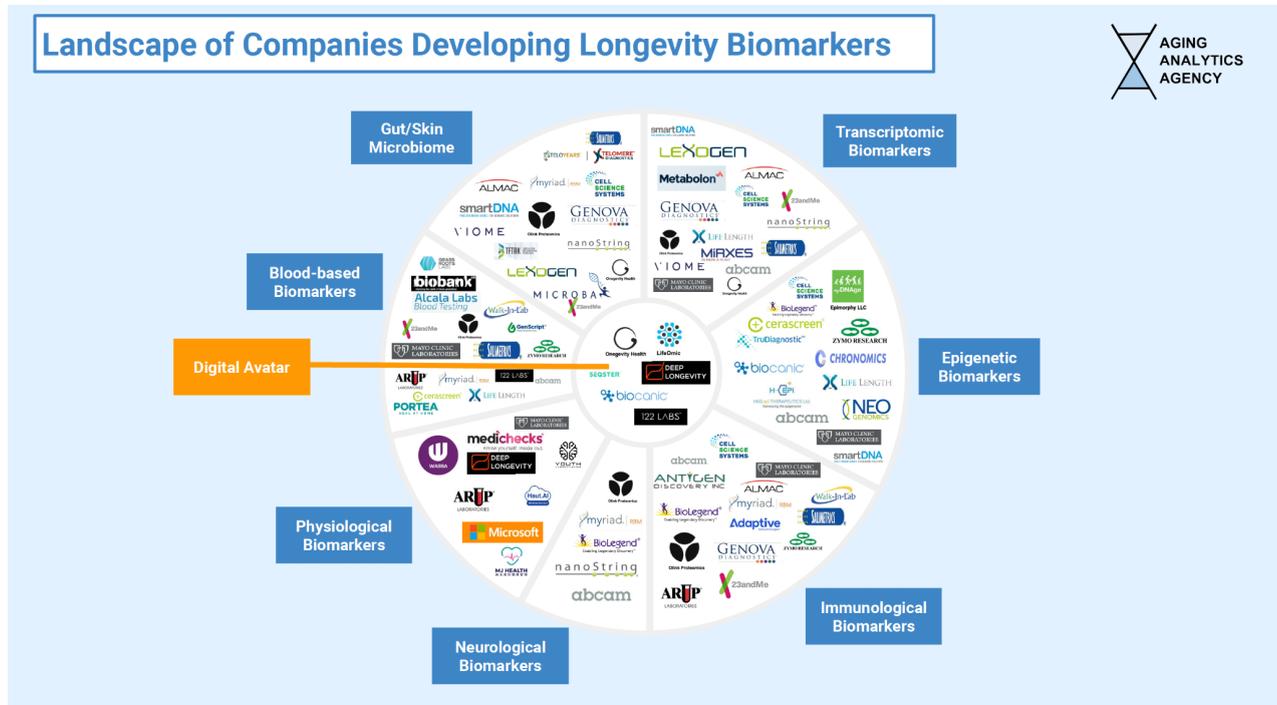


The parties with early access to this report will gain expertise in the current state of ageing biomarkers technology and market, insights about relative technological and economical traits of each biomarker group, and their applicability in various healthcare industries, as well as the insurance industry (which we will be discussing in detail in a future article in the present series).

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The project is designed to provide all stakeholders, including companies, investors, governmental and policy-focused organizations as well as the general public, with:

- Concrete deep analysis of which biomarkers and biomarker panels are available today: their strengths and weaknesses, accuracy, availability and current actionability, technology readiness levels (TRLs), and peculiarities of each type of Longevity biomarkers related to its uses for real-time and precision monitoring of health status, and biological age.
- Tangible estimations of which biological age biomarkers and implementations are consolidated, or their current conditioning stage for precision assessment of health status and endpoints of clinical trials and therapies, the use in insurance risk assessments.
- Highlights regarding the role of digital biomarkers, and AI platforms and how they will become necessary and indispensable components of ageing and Longevity biomarker discovery, research, development and users daily use; overview of mobile apps containing actionable biomarkers or ageing clocks.

It is our hope that this open-source platform will serve as an ideal starting group to galvanise the UK government's own efforts towards the support, development and dissemination of a truly actionable consensus panel of market-ready biomarkers of human ageing and Longevity.

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

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- They might assume that the missing bridge on the road to HALE-extending preventive medicine is still progress in biotech methods, rather than increased precision and personalisation.
- 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 enough to take immediate action. As such government strategic bodies therefore risk limiting their strategic ambitions with regard to time frames.

Thus, we recommend that the government make the development of both precise and actionable, implementable panels of ageing biomarkers one of their top priorities, and **create 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.**

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): +1

D2 (Degree of measurability): 0

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): 0

D5 (Resourcefulness): +1

D6 (Reorganisation): +1

E (Disruptiveness): +1

F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 11

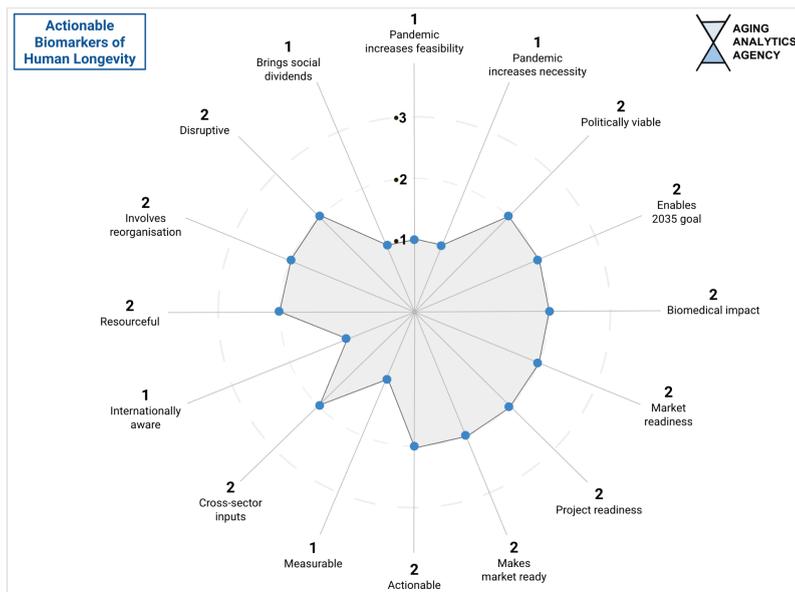
Point of Comparison: The report refers directly to the need for actionable biomarkers in the paragraph: "Dr Riccardo Marioni of the University of Edinburgh told us that, ideally, biomarkers should be inexpensive, so they can be used at the population level, and as minimally invasive as possible." There is however no explicit acknowledgement that this is the *current* stumbling block

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in attaining the 2035 goal, nor any thorough exploration of how existing resources can be repurposed in order to take the shortest possible route to attaining a minimum viable panel.



AI for Longevity Initiatives

We recommend that the government prioritise the application of AI for Longevity. Of all the distinct technologies and toolsets driving progress in the global Longevity Industry, the one with the greatest potential to create real-world impact on human Longevity in a short timeframe, and the one with the highest cost-effectiveness ratio, is the application of AI and data science to Longevity. Unfortunately, despite being the pillar with the greatest promise, it happens to be the most underrepresented and underfinanced within the global Longevity Industry.

There are many reasons for the enormous potential of AI in Longevity generally:

- First, Longevity is unprecedentedly complex, both as a science (dealing with the deepest levels of biology, health and disease) and as an industry (being composed of the intersection of many distinct, individually complex domains of frontier science and technology). AI, data science and mathematics are being applied in the R&D precisely for the purpose of processing data that is too voluminous and complex for humans to address manually - it is the engine not only for neutralizing complexity but also for yielding its power to create new-positive results.
- Second, with the inevitable increase in distinct data points on the nature of aging, the number of specific biomarkers of aging and Longevity as well as amount of distinct Longevity therapies and technologies, AI will become the only tool for managing this enormous volume of data, both as it applies to P4 Medicine and Precision Health (real-world practical implementation of

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Longevity technologies) as well as with regard to the core Longevity R&D (which will not reach the level of marked-readiness for a number of years).

- Third, AI is an industry vertical that is very well funded, with leading nations currently competing to win the global AI race, to develop and secure the most advanced AI technologies and IP, and to capture the highest densities of AI specialists. Ongoing developments in core AI innovation in and of itself are rapidly implementable (being a virtual, digital technology that can be replicated, transmitted near-instantaneously, and utilized at zero material cost once developed), thus being capable of having immediate accelerative impacts on Longevity.
- Fourth, AI is a self-evolving and self-accelerating technology, in the sense that the latest advances in AI make it easier to develop the next paradigm shift in AI, consequently invoking an exponential effect.
- Fifth, many technologies and techniques for extending Healthy Human Longevity, for preventive medicine and for maintaining an optimal state of precision health are already innovated, validated and ready for use, however, they lack an infrastructure for scaling them to the masses. This is why we predict that the vast majority of practical, real-world effects in terms of extending healthspans in the next several years will come from existing, validated technologies, thus making it a data aggregation and analysis challenge, rather than a biomedical or biotech R&D problem.

In our opinion, AI for Longevity is the “smart money” sector of the industry which can achieve tremendous results and accelerated timelines in terms of progress in actual, tangible, real-world Healthy Human Longevity, even with modest levels of funding compared to other sectors.

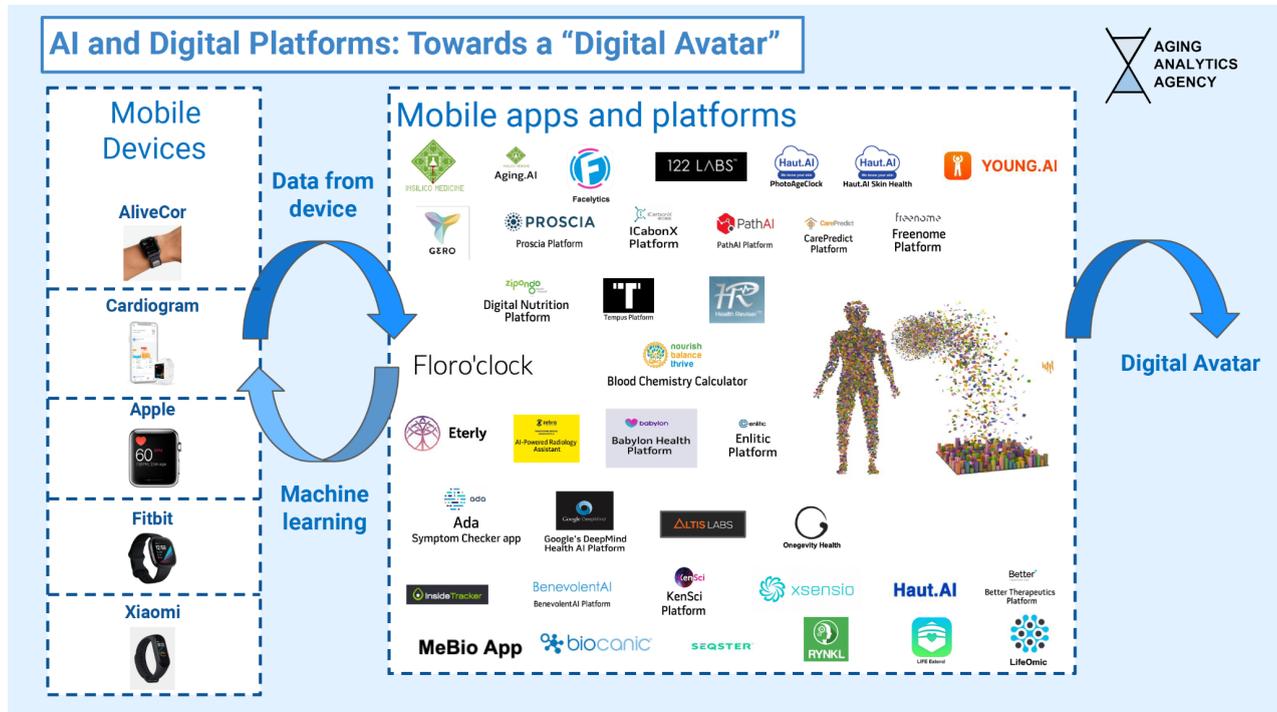
We predict that this is the precise role AI will play in the Longevity space during Q1- 2025: i.e., the aggregation, development and deployment of biomarkers of aging, health and Longevity, Preventive Medicine diagnostics and prognostics, Precision Health technologies and therapeutics as well as integrated wealthspan-extending AgeTech and WealthTech solutions for financial wellness across extended periods of Healthy Longevity.

The apex of AI for Human Biomarkers of Longevity, and its most robust and advanced embodiment, will be as the enabling force for creating a so called digital avatar of the full human body, taking into account thousands if not tens of thousands of personalized biomarkers (with at least several hundreds of precise biomarkers of aging and Longevity), both biological as well as psychological and behavioural.

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It is clear that AI will soon become not just a complementary but fundamental tool in developing, refining and applying biomarkers of Human Longevity, serving the foremost catalyst in accelerating progress in this domain, and as acting as the initial trigger in a chain reaction that will lead to rapid progress in the translation of Longevity theory into practice. Indeed, the metaphor of the nuclear chain reaction is not out of place here; in previous reports, Longevity policy proposals, and other materials, we have argued that what the Longevity Industry needs most from national governments is a full-fledged commitment to transform the challenge of aging population into the opportunity of optimized National Healthy Longevity, on the same scale and with the same ambition as the Manhattan Project, and the creation of the atomic bomb. This remains true today, and such a commitment would create just as fundamental and widespread change as did the Manhattan Project, although in a positive rather than negative direction this time.

Score

- A1 (Feasibility increased by continuance of pandemic): +1
- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): +1
- C1 (Market readiness applicability): 0

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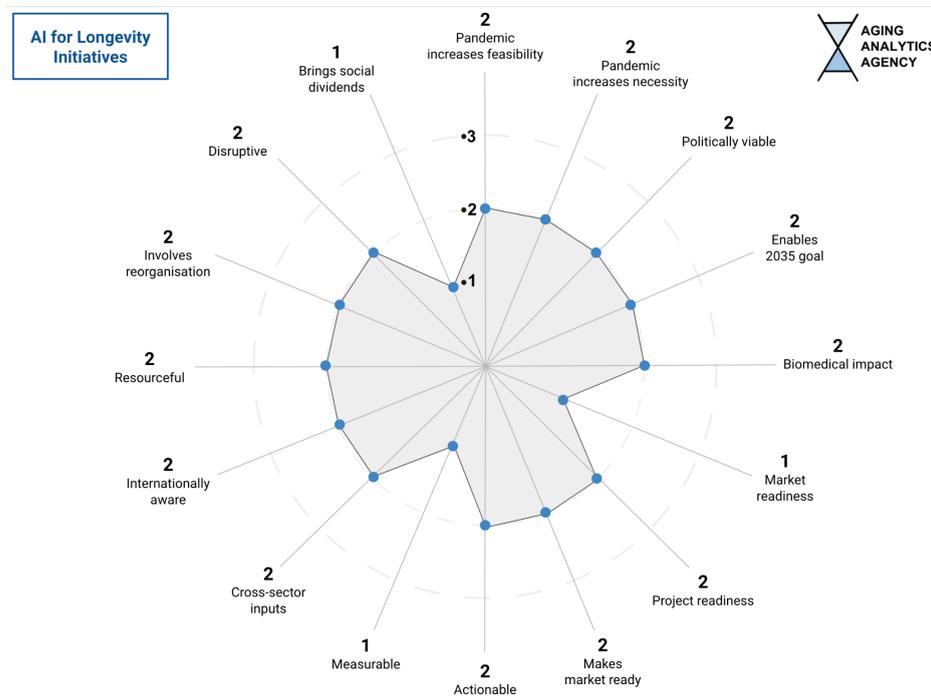


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- C2 (Project readiness): +1
- C3 (Move to market readiness): +1
- D1 (Actionability): +1
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): +1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 13

Point of comparison: The Committee's document mentions AI in drug discovery explicitly, but omits to mention the link between the two: that AI can accelerate progress by developing biomarkers that are maximally accurate, available, and actionable.



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Novel Financial Systems

The gap between life expectancy and Health-Adjusted Life Expectancy (HALE) varies widely among developed countries, and could to some extent be seen as a gap between nations which have and have not made efforts to embrace the paradigm shift from treatment to Precision Health in response to the Silver Tsunami.

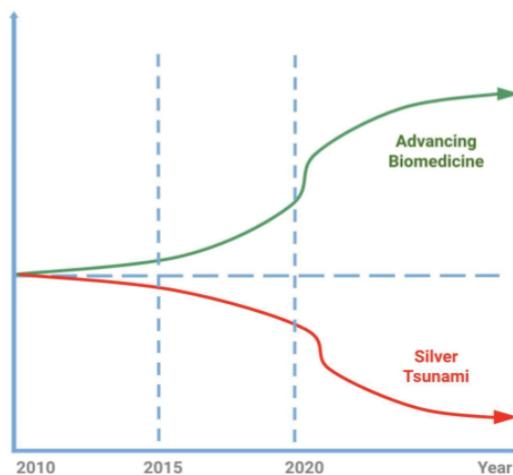
Some countries, upon reaching this inflection point, have taken financial initiatives, while some others have stagnated. Japan for example experienced an economic boom 50 years ago that nearly allowed it to exceed the USA in GDP while its life expectancy nearly overtook the USA, although without an equal increase in its citizens' healthspan.

This gap had an initial negative impact on Japan's national economy, which has been stagnating for the past 20 years as a result. Now however Japan's government is making great efforts in financial engineering to account for this gap.

It should be noted however that they have only succeeded in delaying the collapse of their economy, not fixing the fundamental cause behind it. Japan and its major financial institutions are motivated more than any other nation today in adopting a combination of advancements in biomedicine and in the financial sphere to synergistically avoid stagnation and collapse in the face of this big gap.

However, there are alternative positive scenarios available, which are more likely to be explored by the more progressive, technocracy-driven nations and financial institutions. There are two main scenarios, of how the two megatrends - Advancing Biomedicine and the Silver Tsunami are going to collide:

The Collision of Two Opposed MegaTrends



The Longevity Industry is characterized by the collision of two opposed MegaTrends: Advancing Biomedicine (Extension of Healthy Longevity) and Ageing Population (Silver Tsunami). Developed nations are set to either sink or swim in the face of the oncoming Silver Tsunami, and their success depends on how proactively they deploy broad, well-funded national plans to extend Healthy Longevity and financial reform to neutralize the economic pressures of their aging populations. They have the opportunity to transform the deficit-model of aging into the opportunity and asset-model of Healthy Longevity.

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A range of novel financial institutions that could ride this rising tide and bring about a positive scenario are expected to appear and develop: Longevity-focused venture funds, Longevity-AgeTech banks, Longevity index funds and hedge funds, and even a specialized stock exchange for Longevity-focused companies and financial products.

This industrialisation of Longevity could be considered complete when, under such circumstances, Health Longevity (especially as measured by metrics such as Health-Adjusted Life Expectancy or HALE) can be regarded as an asset class in itself.

To this end we recommend that the UK Government ministers plan for the long term to coordinate the development of a succession of novel financial systems.

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): 0

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): +1

D5 (Resourcefulness): +1

D6 (Reorganisation): +1

E (Disruptiveness): +2

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 13

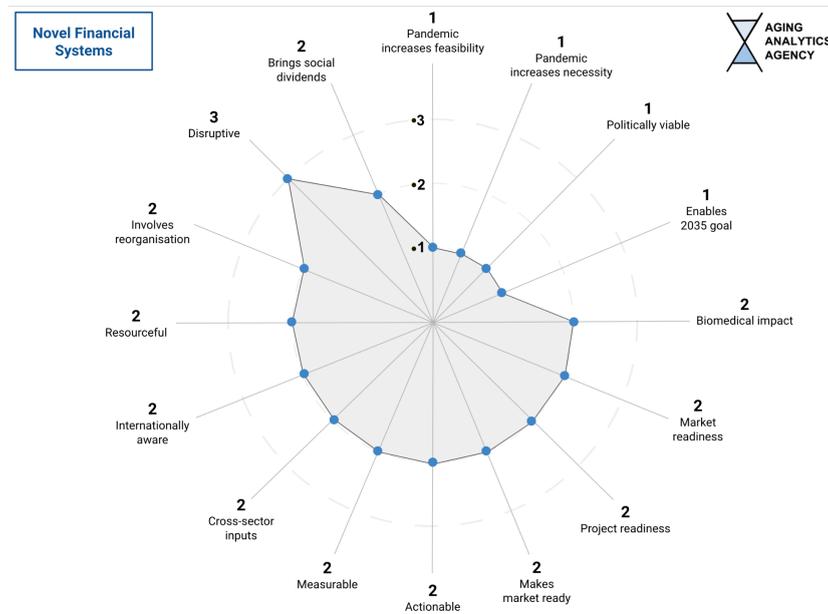
Point of Comparison: Neither the Committee's nor the Government's preferred strategies include financial industry reform. But it is Aging Analytics Agency's position that the advancement of FinTech will prove a necessary condition not only for improving the lives of the elderly prior to 2035, but also to eventually making an asset class of Healthy Longevity, a long term interest

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which ought to be of equal concern to the Committee given the raison d'être of the Upper House.



Tier 2 Recommendations

Task Force for Metrics Consensus

UKRI needs to create a specific task-force of industry experts to create a consensus framework for metrics used to periodically measure intermediary progress towards their 2035 goal. These should include the use of (1) actionable and scalable biomarkers of ageing to **predictively** assess impact on National HALE periodically, as well as financial incentives (e.g., tax breaks) to motivate the UK population to contribute their anonymized data for this purpose, and (2) non-biomedical frameworks (such as self-reporting systems and anonymized data monitoring via smartphones) for non-biomedical aspects including social inclusivity, social isolation and loneliness, etc.

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): +1

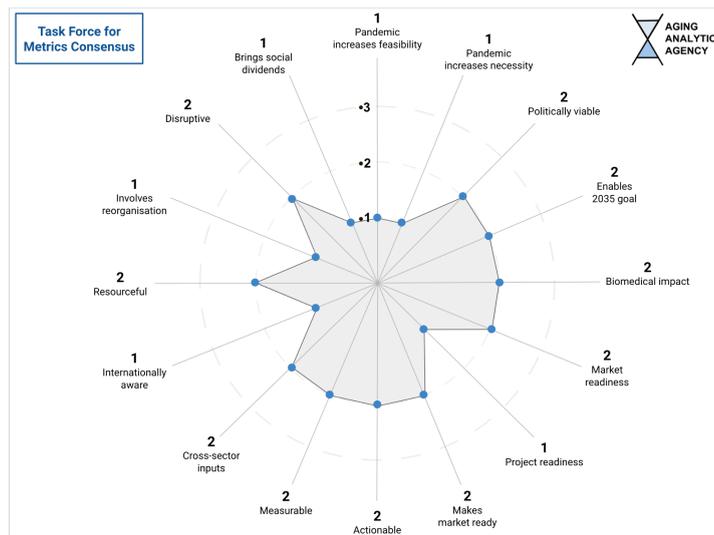
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- C2 (Project readiness): 0
- C3 (Move to market readiness): +1
- D1 (Actionability): +1
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): +1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 10



Leveraging Existing National Assets

The UK, with its network of AI centres for Health and its commitment to digital health, is a preventive medicine powerhouse, and the government's goal can be achieved using existing preventive medicine technologies; the optimization of existing, known and validated technologies; and the emulation of best practices in preventive medicine from other countries like Singapore with the smallest gaps between life expectancy and HALE.

Score

- A1 (Feasibility increased by continuance of pandemic): 0
- A2 (Necessity increased by covid pandemic): 0
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

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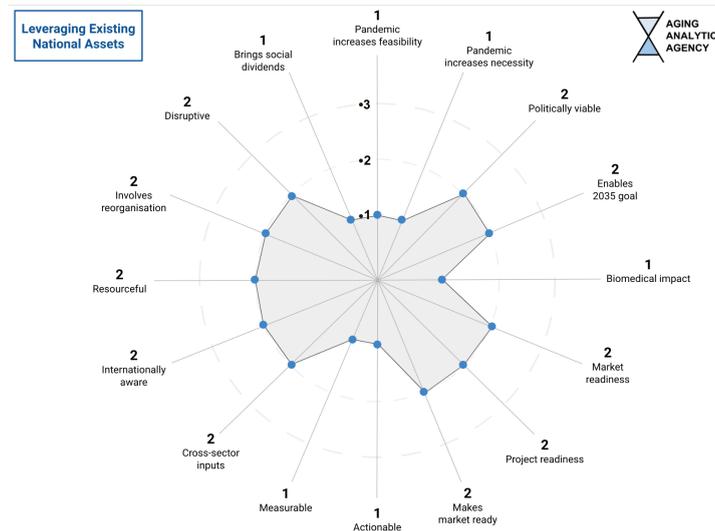


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- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): +1
- C3 (Move to market readiness): +1
- D1 (Actionability): 0
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): +1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 10

Point of comparison: The Committee's document makes various references to digital health, but does not make explicit the potential necessary role of digital health in obtaining a minimum viable panel of market ready biomarkers. Wearable devices for example are a market ready way of continually measuring and collecting vital health information - or "digital biomarkers".



Support and Prioritize mHealth

Aging Analytics Agency recommends the UK government should do everything possible to develop its mHealth sector with a specific emphasis on tracking and monitoring. The prioritisation of tracking and monitoring would serve the need for actionable, market ready, accessible preventive health diagnostics and prognostics mechanisms. To this end we recommend not only

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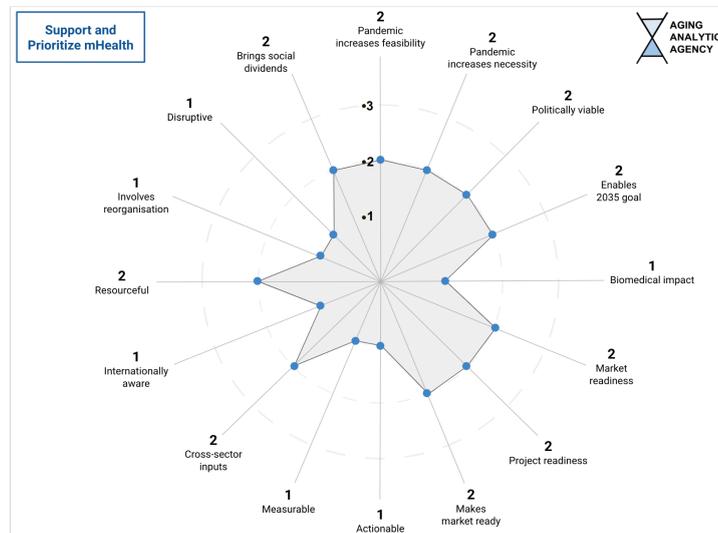
prioritising support and funding for UK mHealth, but also subsidising access and seeking synergies between the existing mHealth department of NIH and the Healthy Ageing ISCF.

Score

- A1 (Feasibility increased by continuance of pandemic): +1
- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): +1
- C2 (Project readiness): +1
- C3 (Move to market readiness): +1
- D1 (Actionability): 0
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 10

Point of comparison: The Committee's document mentions mobile health but not its potential role in digital biomarkers development, hence the emphasis on tracking and monitoring.





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Longevity Stock Exchange (specialized stock exchange for Longevity start-ups)

A Longevity stock exchange marks the end of the journey toward a fully-fledged, multifarious global commercial industry, when Health Longevity has become a quantifiable product, and the platforms for various types of Longevity company have been established, along with a Longevity index fund, and we see the emergence of a new type of digital asset platform stock exchange.

Such an entity would be the first of its kind in the world, and if it is supported by key government officials, and integrated with the Longevity startups ecosystem, it could easily secure the position as a leading, progressive Longevity financial hub. *The ultimate goal of this project would be the deployment of a Longevity Industry index (similar to the NASDAQ-Composite, which serves as an indicator of expectations on the growth of the USA tech industry).*

Alternative Stock Exchanges are usually associated with uprising wealth within regional boundaries. They facilitate brokers to do their business in the selling of shares to companies and vice versa with heightened efficiency. They enhance companies' access to capital and the chance to also increase their views and their public image. All savvy businesses can increase the power of stock sharing to expand and enhance their companies. While advantages to financial and regulatory costs are connected with being listed on the alternative stock exchange, the benefits far outweigh the disadvantage. A Longevity based stock exchange would provide further access to capital, profile enhancement, control maintenance, reduction of the cost of capital and increase the ability to attract more investment.

However, the establishment of such a stock exchange should involve the use of modern, sophisticated approaches to human-centered validation of Longevity therapeutics and technologies (including biomarkers of human Longevity, and the other platforms for human experimentation and validation discussed previously) as a necessary prerequisite for companies to be listed on such exchanges.

The first nation to establish a specialized Longevity Stock exchange will have effectively created something resembling a perpetual motion machine for the further growth of its national Longevity Industry, having built an engine for providing its companies with sufficient investment and accelerating the market-readiness of their technologies, products and services. The nation that establishes marketplaces for both shares in publicly-traded Longevity companies and financial instruments and derivatives built as a second layer upon its Longevity Industry would be capable of attracting several trillions of £ in potential wealth that is currently inaccessible.

Current financial products' levels of sophistication are limited by status-quo financial and legal frameworks, but new technologies, platforms and frameworks have the potential to allow for the creation of truly innovative financial products and systems. In our view, the ideal solution for designing novel financial instruments and products is to establish a new specialized financial marketplace in the form of a specialized stock exchange with a formal license, to serve as the base and launching pad for a wider variety of financial instruments and systems tied to the Longevity Industry.

Eventually, this could take the form of a Longevity Industry financial index, similar to the NASDAQ

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composite, which would represent the current state of the Longevity Industry in one particular region. We suspect that these types of frameworks will most likely emerge in regions that have recognition within the broader international financial community, stability, and a prospective domestic Longevity Industry, yet which are large enough to encompass the behavior of the Longevity Industry globally.

At the present time, we see London and the US as the most prospective regions in this regard, although Switzerland, Singapore and Hong Kong have fairly strong prospects as well. A Longevity Stock Exchange provides increased liquidity, which in turn would enable greater flexibility and a greater leverage for the further growth of the companies listed on the exchange, and as such, greater opportunities for the advancement of the full-scope Longevity Industry as a whole globally. More broadly, Singapore as a smart city-state currently has the smallest gap between Health-Adjusted Life Expectancy (HALE) and life expectancy, and is very well known for rapidly implementing frameworks for the balanced strategic support of innovative startups and technologies, and for quickly attracting foreign talents for highly focused industry development, which may serve as an efficient basis and ecosystem not only for accelerated technology innovation, but also financial innovations as well.

Specialized stock exchanges are nothing new. Currently, for example, investors can dig into about 50 major commodity markets worldwide. Those include markets for soft commodities such as wheat, coffee, cocoa and other agricultural products, and markets for commodities that are mined, such as gold and oil. NASDAQ fits that profile as well; it was created as a stock exchange for IT-companies and is currently the home of tech-oriented stocks. Several examples of the successful implementation of innovative approaches to legal and regulatory frameworks, administration and management exist, which lay good groundwork for structuring the right approach to establishing a Longevity Stock Exchange, including the Alternative Investment Market (AIM), a subsidiary of the London Stock Exchange, which gives medium-sized companies opportunities to be publicly listed in an intermediate way, providing them with a framework for raising tens of millions of pounds (rather than just several millions at best) by opening up access to the broader conservative investment community, which prefer to deal only with tradeable, highly liquid assets.

Establishing a Longevity Stock Exchange would require the public listing of at least 100 Longevity-focused companies to create good enough diversity and potential volume for trading. Thereafter, the more advances there are in Longevity, the more even the most conservative investors will want to invest. By that point they will have been well advised that Longevity is an industry like no other. It is by such means that increased global Longevity will be transformed from a threat into an opportunity.

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): 0

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0

B2 (Relevance to general goal of biomedical healthy life extension): +1

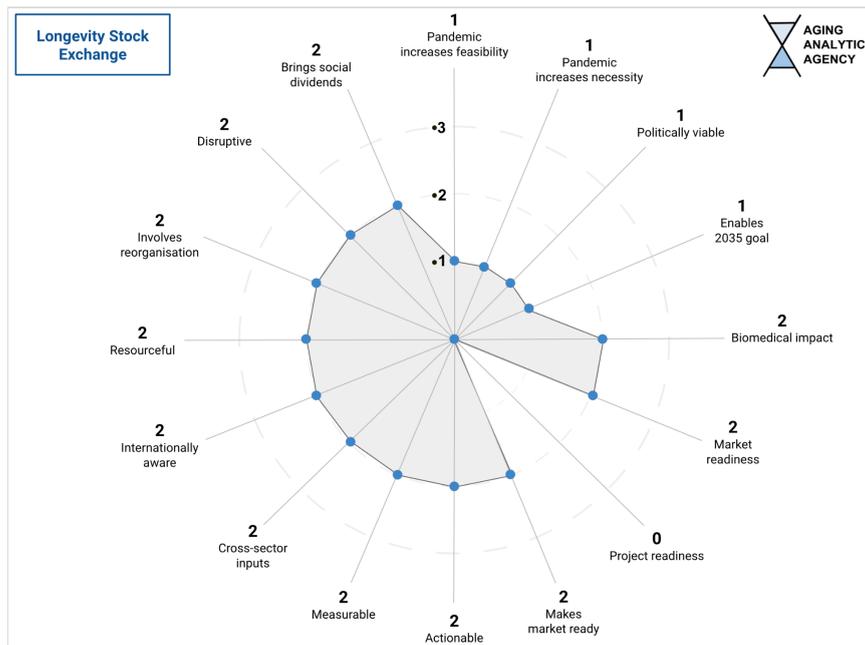
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- C1 (Market readiness applicability): +1
- C2 (Project readiness): -1
- C3 (Move to market readiness): +1
- D1 (Actionability): +1
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): +1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 10



Support and Prioritization of AgeTech

Aging Analytics Agency's position is that there are many such specific UK issues and challenges of national importance that we believe AgeTech has the potential to substantially impact, including alleviating the economic burden of the nation's ageing population, protection and treatment of COVID-19 in the elderly, social isolation, loneliness and mental health, increased economic activity and participation among the 60+ demographic, and much-needed reforms to

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care homes and social care among the nation's elderly. We would refer the Committee to Aging Analytics Agency's AgeTech Analytics Platform.

Score

A1 (Feasibility increased by continuance of pandemic): +1

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): 0

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): 0

D2 (Degree of measurability): 0

D3 (Degree of leveraging cross-sector inputs): 0

D4 (Awareness of international context): +1

D5 (Resourcefulness): +1

D6 (Reorganisation): 0

E (Disruptiveness): 0

F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 10

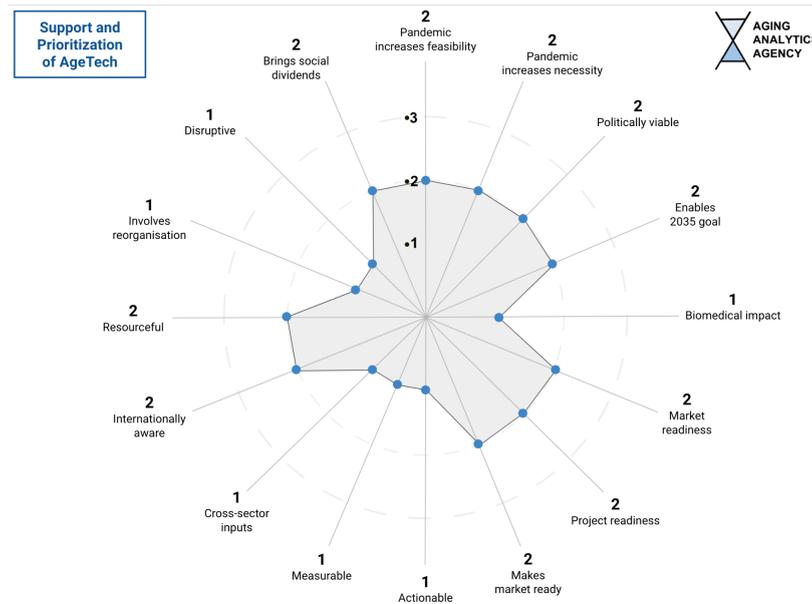
Point of comparison: The Committee's recommendation is in complete accordance with Aging Analytics Agency's belief that AgeTech is a necessary component in everything from reduction in loneliness to keeping the elderly demographic economically, socially and professionally active, and that UK funding and support of its domestic AgeTech Industry be prioritized considering it's already-substantial size, high degree of market-readiness, and potential to have accelerated and efficient short-term impacts on the quality of life of the UK's elderly population. However, it should be emphasised that the UK is already a world leader in AgeTech, and that forms of AgeTech may play a necessary early role in biomarker development.

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For a comprehensive overview of the UK AgeTech industry visit Aging Analytics Agency's [AgeTech UK IT Platform](#).



National Longevity Development Plan

Aging Analytics Agency's position is that solving the Aging Society Grand Challenge requires a breadth of coordination typical of an entire industrial strategy unto itself, rather than just a single pillar of one. The name we give to such a propositional strategy is "National Longevity Development Plan", which would consist of national and international initiatives. Aging Analytics Agency has spent time documenting the various elements of nascent "National Longevity Development Plans" across various countries, and their impacts on metrics such as HALE.

Score

- A1 (Feasibility increased by continuance of pandemic): +1
- A2 (Necessity increased by covid pandemic): 0
- A3 (Political viability): 0
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0
- B2 (Relevance to general goal of biomedical healthy life extension): +1
- C1 (Market readiness applicability): 0
- C2 (Project readiness): 0
- C3 (Move to market readiness): 0
- D1 (Actionability): +1
- D2 (Degree of measurability): 0

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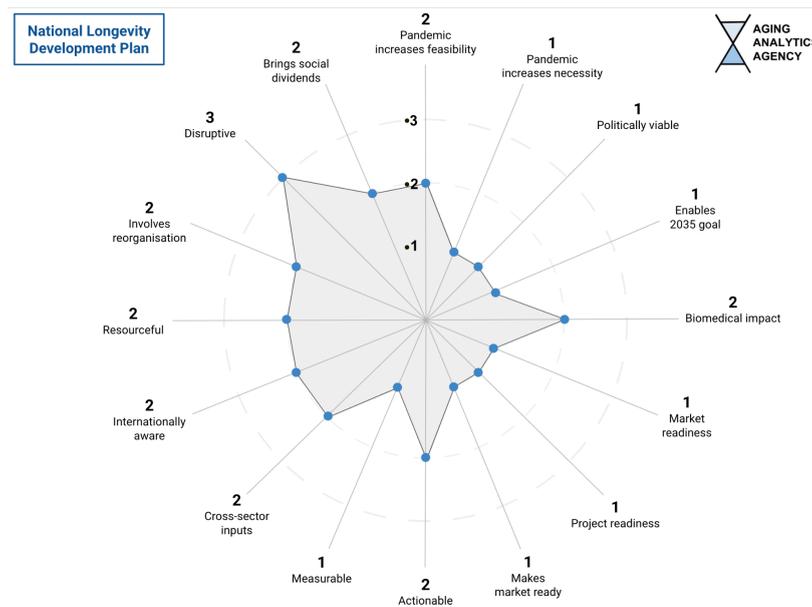


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- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): +2
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 10

Point of comparison: The Committee's document represents a point of view that recognises the need for a degree of coordination as far as is necessary to improve accountability and general coordination for "coping" with aging, but not the cross-sector coordination required to reach a future where Health Longevity can be categorised as an asset class in itself.



AI Centres for Human Longevity

We propose that the Government support the establishment of the first AI Centre for Longevity. Optimal locations for this purpose would *already* have dedicated divisions and resources both for AI and for Longevity -- constellations of both AI and Longevity expertise, divisions and resources. And a physical location suitable for engaging in cross-sector and industry-academic collaboration.

We also recommend that the UK Government use the first such centre as a case study to quantitatively assess the feasibility and practicality of using it as an example for the later

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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.

The Government should also take into consideration the possibility of using the 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.

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): -1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): +1

C2 (Project readiness): +1

C3 (Move to market readiness): +1

D1 (Actionability): +1

D2 (Degree of measurability): +1

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): 0

D5 (Resourcefulness): +1

D6 (Reorganisation): 0

E (Disruptiveness): +1

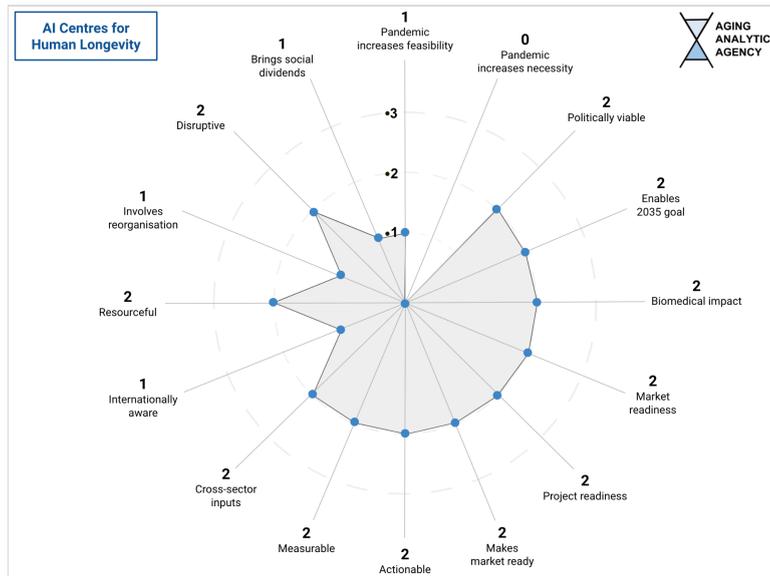
F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

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TOTAL SCORE: 10



Longevity Financial Instruments

Of all the factors and industry components that limit the ongoing growth of the Longevity Industry, and can enable the simultaneous acceleration of its developmental trajectory and the stabilization of its prospects as an industry, liquidity is the most important. While Longevity IPOs enable exposure to an increasing number of retail investors, there are many other mechanisms, systems and approaches to increasing the amount of institutional and retail investor exposure to the Longevity Industry, which have not yet been leveraged to their full potential.

There are enormous near term opportunities for liquid Longevity indices and derivatives focused at individual investors (and HNWI's in particular), that enable exposure to the rising tide of the global Longevity Industry. This is a key mechanism for matching wealthspans to rising healthspans. Such products are evolving to create liquidity in derivatives that have historically been illiquid or have had no liquidity. Existing InvestTech solutions have the potential to give investors exposure to relevant Longevity companies in a highly liquid and tradable manner, but are not being utilized sufficiently.

Several major investment banks have introduced Longevity-themed baskets and portfolios tied to various sectors of the Longevity Industry. The objective is to give the massive global investment community exposure to the rapidly growing Longevity Industry. Some specific examples include AXA's WF Framlington Longevity Economy Fund, and Julius Baer's Longevity Basket Tracker Certificate. The only drawbacks of such companies and funds is that they are limited to publicly-traded companies when the vast majority of true Longevity companies are privately held,

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and they are only very weakly and superficially tied to the actual Longevity Industry partly as a result of being limited to public companies. Thankfully, there are existing InvestTech solutions and liquidity-generating approaches that can neutralise what we refer to as the Big Longevity Liquidity Gap.

During the past several years, a quite clear disproportion has emerged between various DeepTech sectors, in particular between the Longevity start-ups on the one hand, and the entire business model of venture capital funds on the other. There have also been big gaps and disruptions in the global financial system. There is a highly relevant big gap between progress in science and technology, and the outdated bureaucracy, in which most financial institutions remain mired, as though both exist in parallel universes.

This is happening for multiple reasons: At one end, DeepTech start-ups (including Longevity start-ups) have been suffering from a lack of access to relevant levels of seed investment. Although venture funds are by definition supposed to prioritise investments into the most disruptive technologies and start-ups, in reality, most of them prefer to specifically avoid DeepTech sectors, or to enter investment rounds at much later stages. As a consequence, the start-ups are forced to deal with angel investors. This creates a growth gap phenomenon known as the "Death Valley": 99% of DeepTech start-ups do not survive the stage of growth between seed financing and the beginning of revenue generation or even "A" rounds. Meanwhile, at the other end, there is an extreme abundance of significant assets being held and preserved in bank accounts or in comparatively stable derivatives on a scale of tens of trillions.

For instance, there is a tremendous volume of money on the scale of at least €1 trillion currently being stored in Swiss bank accounts with negative interest rates, which is an illogical phenomenon of a modern financial world. Yet the owners of these financial assets would nonetheless prefer to avoid investing them into venture funds, who are equally reluctant to invest into Longevity start-ups. Thus, the major source of these disparities comes down to the issue of illiquidity.

There are many thousands of HealthTech startups and hundreds of Longevity start-ups in the UK, EU, USA and Asia-Pacific region and 99% of them are not publicly traded, which means that they are limited to seeking funding from angel investors and venture investors, which represent a very small fraction of the available global wealth. This situation creates an extreme funding deficit and illiquidity problem. This is a problem facing almost all DeepTech sectors, but the negative repercussions are particularly bad for the Longevity Industry, as they lead on the individual level to reduced quality of life and unnecessary deaths, and threaten to inflict crippling economic effects on national healthcare systems, pension and social security systems, and economies.

Therefore, an extreme abundance of financial assets ends up preserved rather than invested. There are enormous amounts of financial assets being conserved within the umbrella of family offices (and we can estimate that there are around 5,000 of these) and hundreds of very

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conservative financial institutions, which hoard this capital simply due to a lack of safe, stably growing and predictable financial derivatives into which to invest. There is no relevant methodology to assess the amount of such assets, as they tend to keep this a secret. But this is at least several tens of trillions of dollars.

At the same time, many owners of these vast sums of wealth are nonetheless personally interested in Longevity, both as a prospective market with the capacity for unprecedented growth, and as a means to their own personal life extension. Even the most conservative investors, and the owners of the largest financial assets, now very clearly understand that the industries of AI and Longevity, separately, are two of the most prospective and relevant sectors to invest in, with full confidence that such investments will lead to relatively low-risk and stable profitability in the long term.

However, due to the lack of liquid tradable instruments related to the AI and Longevity industries, owners and managers of these assets still prefer to avoid any significant investments into these sectors. And in many cases, angel and venture investors are operating as sharks, exploiting this gross illiquidity for their own financial advantage, to the detriment of Longevity and other DeepTech start-ups. Therefore, financial innovations that can provide liquidity to Longevity companies and technologies, and form a bridge between the Longevity Industry and conservative financial markets, would inevitably enable the injection of something around 1% of the tens of trillions of dollars currently lying inert as "lazy money" within the global Longevity Industry.

In practice, this means that once such a liquidity bridge is established, it will have an immediate ability to attract around 300-500 billion dollars, pessimistically, just within the first few years and at least several trillions within a 5-7 years horizon. Currently, the typical approach of these family offices and large financial institutions is to allocate 10% into alternative investments. Our most pessimistic estimate is that 10% of that wealth could be reasonably invested into the Longevity Industry, but only under one very specific condition: that mechanisms exist to provide investors with enough liquidity to be able to withdraw at least some of their investment within more reasonable timeframes than the typical lock-in periods of venture capital firms.

Considering the current natural pace of innovation in the Longevity and Financial industries, even without any specific innovations in the InvestTech field, the current problem of illiquidity will likely be resolved naturally in 7 to 10 years, but with these new bridges in place, within 3 to 5 years. It is important that these solutions take into account the interests of both groups — start-ups wishing to acquire additional funding, and conservative investors wishing to keep their funds in secure tradable financial instruments.

In the meantime, one method of dealing with illiquidity is the creation of more modern hybrid investment funds, which would serve as the above-mentioned bridge between conservative investors and Longevity start-ups, and can provide more liquidity for investors (LP's) in comparison with the usual venture funds. Elements of such solutions are already present in other



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industries and can be returned and further improved using the modern tools of financial engineering and InvestTech.

Longevity based derivatives are going to be a preferred option for investors such as survivor bonds which pay a coupon based on the "survivorship" of a stated population group along with Longevity notes which reference a pool of pre-defined lives.

Due to the rise in such Longevity themed financial instruments and investment options, the government mortality Indices will be closely watched in the coming years. There will also be a significant increase in investment to adapt existing technologies and infrastructure to the aging population. Today, the majority of Longevity indices and derivatives are packaged as risk management solutions.

The current synthetic Longevity products are emerging Longevity indices, Longevity notes, Longevity swaps and other Longevity derivatives such as survivor bonds. The attraction of Longevity based financial products that take on Longevity risk is that they are standardized and tradable which allows massive liquidity to larger institutions that buy them such as pension funds and asset management companies.

Since the Longevity risk on insurance and annuity contracts are swappable the secondary insurance market might see minimal increases in liquidity although life insurance products and annuities might not necessarily be extremely liquid in the future. These kinds of practices are the simplest and least modern form of this general trend.

We can also envision the emergence of financial instruments and analytics tied to biomarkers of aging (which serve as proxies for measuring the current state of individuals' and populations' biological aging), and to the technological and scientific validation of Longevity companies' therapeutic pipelines, using the more modern and sophisticated approaches to safe human experimentation and validation described in the third article of this series.

More specifically, we envision the development of 3 types of analytical products. All of these products will be derived from sets of biomarkers of aging and Longevity, and panels of biomarkers which are off the shelf analytical dashboards:

An analytical panel will be launched for hedge funds and investment banks to predict success or failure of particular molecules in the later stages of clinical trials and provide investors with the signals to form long or shorting positions.

Technological due-diligence for venture investors to evaluate the claims of emerging companies whether their technologies can deliver actual results on humans will be made available in detailed formats. An analytical panel could also be launched for InsurTech-HealthTech companies focused on the retails clients. Currently we are aware of at least 6 companies working on similar types of solutions, and we can envision the emergence of another 10-20 such companies in the next 2-3 years.

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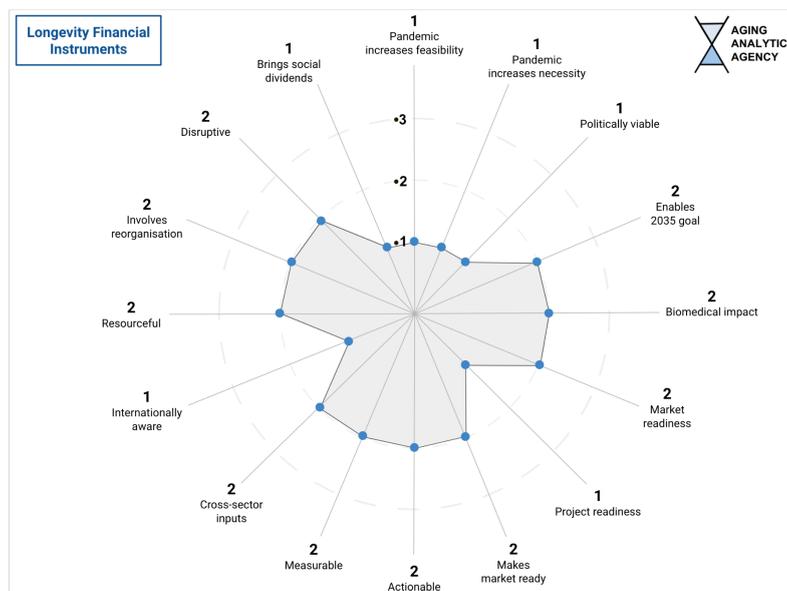
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Depending on the management, scientific team, and business executive team, we will see a variety of specific structuring of biomarker panels and actual analytical/financial products based on them.

Score

- A1 (Feasibility increased by continuance of pandemic): 0
- A2 (Necessity increased by covid pandemic): 0
- A3 (Political viability): 0
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): +1
- C1 (Market readiness applicability): +1
- C2 (Project readiness): 0
- C3 (Move to market readiness): +1
- D1 (Actionability): +1
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): +1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 10



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Tier 3 Recommendations

Matching Funds for Research

Adopt the Australian policy of matching motor neuron disease research dollar for dollar but for relevant ageing research.

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): 0

C2 (Project readiness): 0

C3 (Move to market readiness): +1

D1 (Actionability): 0

D2 (Degree of measurability): 0

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): 0

D5 (Resourcefulness): +1

D6 (Reorganisation): 0

E (Disruptiveness): +1

F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 8

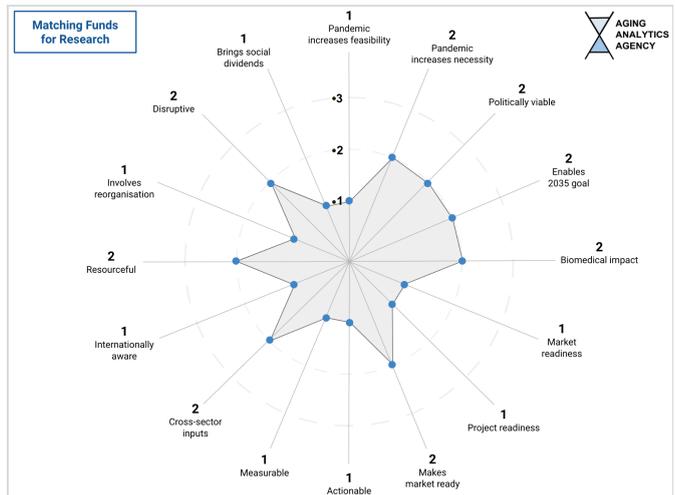
Point of comparison: The Committee's document correctly identifies the shortcomings of UK funding, but must explore more thoroughly lessons from other countries, not only countries with

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superior HALE to the UK, but also similar-sized democracies.



Longevity-AgeTech Banks

We recommend that the UK create financial incentives to develop the business models of UK banks and financial services companies with regard to the elderly, integrating AgeTech and WealthTech solutions in order to bring them into line with the propositional vision of the Longevity-AgeTech bank, described extensively in Aging Analytics Agency publications.

This process began in 2013, when the first AgeTech startups raised equity finance. Now AgeTech is a fast growing market that fosters technology to make Longevity accessible to everyone: digital, IT and mechanical technologies designed to support older adults and reduce the negative consequences of ageing in everyday life. Over the next few years, it is likely that all of these will come as complementary functions within a single product or service. As AgeTech and WealthTech converge, the financial industry is likely to see the emergence of what can be referred to as AgeTech banks, a novel future financial institution focused on simplifying banking for older people, resembling a traditional FinTech bank, but based on smartphones tailored for the older adults.

One side-benefit of age-friendly banking is that banks that provide good service for their oldest customers can provide similar services for all. The young and the middle-aged navigate the same systems as older people, but may have greater resilience in coping with poor design. A bank that improves its systems and services to assist its older customers also pleases the rest of its customers. It is by such means that the economy can be reinvigorated by the presence of the older demographics.

But it is the old, not the young, who hold most of the wealth. And in view of recent trends in the overall health of the elderly, the traditional approach is already outdated and will become

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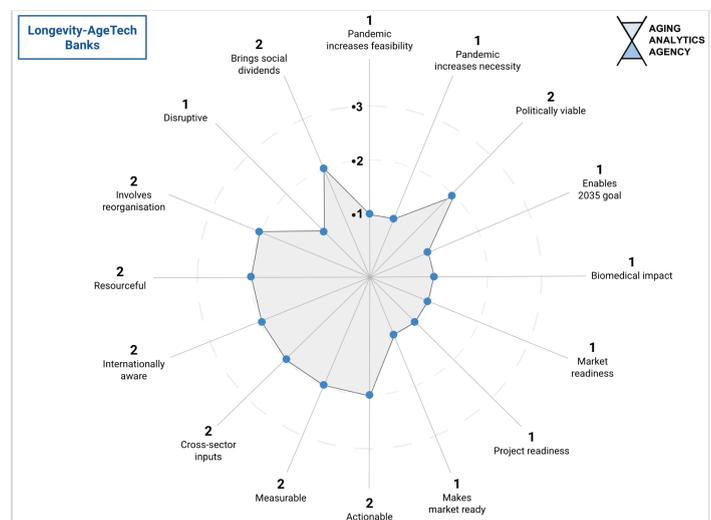
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increasingly obsolete over the next century. Even independent of any Longevity-related technologies, the number of elderly people staying active for longer is increasing. FinTech banks were made possible due to the interaction between bank and client that was made possible using smartphones and other portable devices on a massive scale. The only current obstacle to the creation of a Fintech bank for the elderly (i.e. an AgeTech bank) is the lack of a specific device tailored to their needs. But we should expect one to emerge in the next several years, given the continuing rate of progress in the IT sector in this regard.

Score

- A1 (Feasibility increased by continuance of pandemic): 0
- A2 (Necessity increased by covid pandemic): 0
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): 0
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): 0
- C2 (Project readiness): 0
- C3 (Move to market readiness): 0
- D1 (Actionability): +1
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 8



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Modern Approaches to Therapeutic Validation

Aging Analytics Agency recommends that the government create incentives for groups (companies, labs, etc.) that can demonstrate human efficacy in some form.

Progress in aging research has accelerated rapidly in recent decades, from the age of invertebrate testing in the 90s to the age of mouse testing in the early 00s. Now, as we prepare for an age of human clinical trials however, we find that aging research faces a unique difficulty: that unlike mice and invertebrates, aging takes decades to unfold in humans.

Fortunately, this same period has produced a range of more modern forms of human therapeutic validation, including the use of biomarkers of Longevity, in silico human modeling, in vitro tests using human cells and tissues, human-animal chimeras (e.g., human-mouse chimeras) for safety, toxicity and efficacy testing, and in vitro application of subtherapeutic doses using microfluidic chips ("chip-on-skin" technology). A specific task-force should be created, involving experts and industry stakeholders from both industry and academia, to roadmap and validate safe and effective approaches for human validation prior to the stage of clinical trials.

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): +1

A3 (Political viability): +1

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): 0

C2 (Project readiness): 0

C3 (Move to market readiness): +1

D1 (Actionability): 0

D2 (Degree of measurability): 0

D3 (Degree of leveraging cross-sector inputs): +1

D4 (Awareness of international context): 0

D5 (Resourcefulness): +1

D6 (Reorganisation): +1

E (Disruptiveness): +1

F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

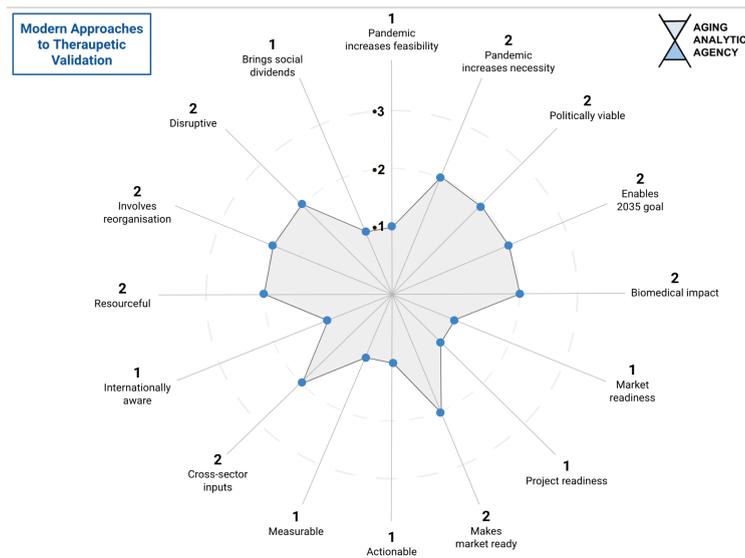
TOTAL SCORE: 9

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Point of comparison: Aging Analytics Agency agrees with the Committee, about fast-tracking human clinical translation, but has much more to add on the specifics of incentives and methods.



Coordination Among Municipalities

Aging Analytics Agency recommends seeking means for greater levels of *coordination* among municipalities rather than seeking to solve the problem through recentralisation. A one-solution-fits-the-whole-nation approach may not be a good idea, given the diversity of factors such as population density, and the fact that some municipalities such as Manchester have what amounts to their own partial, localised ageing industrial strategies. Also the nature of the Ageing Society Grand Challenge necessitates close coordination across the four Home Nations, as Industrial Strategy applies in its entirety only to England while the population it is concerned with circulates freely throughout the British isles.

Score

- A1 (Feasibility increased by continuance of pandemic): 0
- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): 0
- C1 (Market readiness applicability): 0
- C2 (Project readiness): 0
- C3 (Move to market readiness): 0
- D1 (Actionability): 0
- D2 (Degree of measurability): +1

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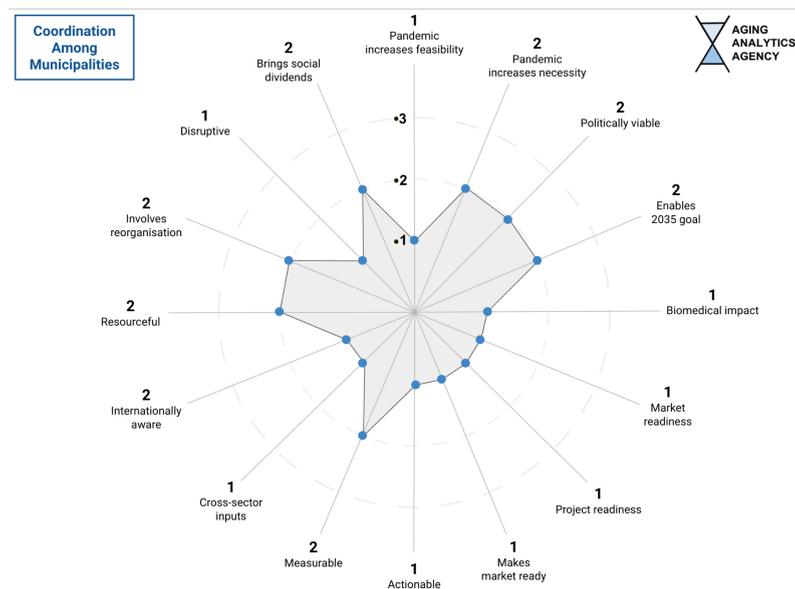
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- D3 (Degree of leveraging cross-sector inputs): 0
- D4 (Awareness of international context): +1
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 8

Point of comparison: The Committee is very specific about the need to better define local and national roles, which would be a necessary first step to greater coordination across municipalities.

However, the extent to which health metrics are a reflection on UK government strategy is reduced by the ability to circulate in and out of devolved jurisdictions such as Scotland and Wales where the applications of the strategy are curtailed - this question has been left out of the main document as though for the sake of simplicity but it directly influences the merits of recommendations pertaining to metrics.



AI Centres for Lifetime Wellness

We recommend that the Government 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

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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 utilise that data to create personalized recommendations for how citizens 60 years and older can optimise 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 optimise products and services aiming to improve the overall, lifetime wellness of elderly individuals in all aspects of life besides health.

We recommend that the government 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 optimise elderly wellbeing, financial wellness, overall activity, neuroplasticity and social Involvement.

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): 0

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

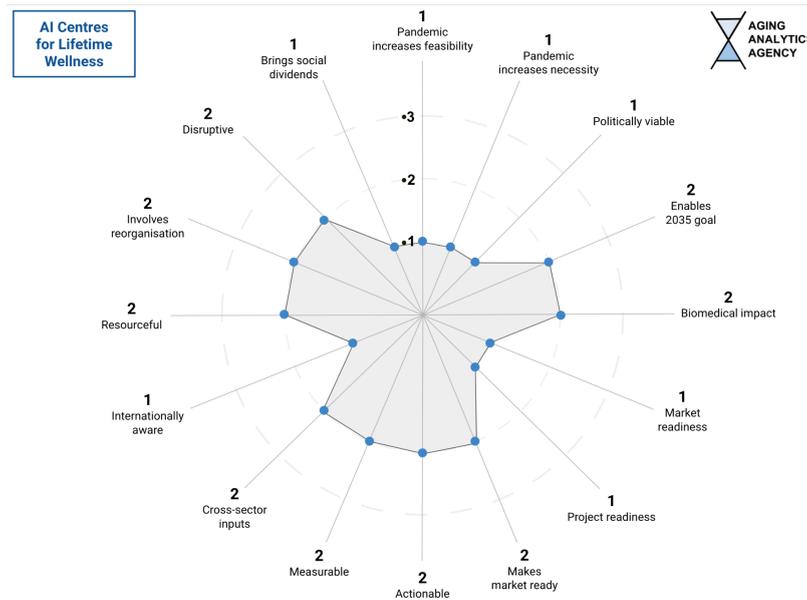
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- C1 (Market readiness applicability): 0
- C2 (Project readiness): 0
- C3 (Move to market readiness): +1
- D1 (Actionability): +1
- D2 (Degree of measurability): +1
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): +1
- E (Disruptiveness): +1
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 9



Longevity Startup Accelerators

We propose that the UK Government 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.

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- A working group to propose measures that the UK Government can take to provide enhanced and prioritized support for Longevity charities and nonprofits 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 the Government 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 organisations.

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

Score

A1 (Feasibility increased by continuance of pandemic): 0

A2 (Necessity increased by covid pandemic): 0

A3 (Political viability): 0

B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1

B2 (Relevance to general goal of biomedical healthy life extension): +1

C1 (Market readiness applicability): 0

C2 (Project readiness): 0

C3 (Move to market readiness): +1

D1 (Actionability): +1

D2 (Degree of measurability): +1

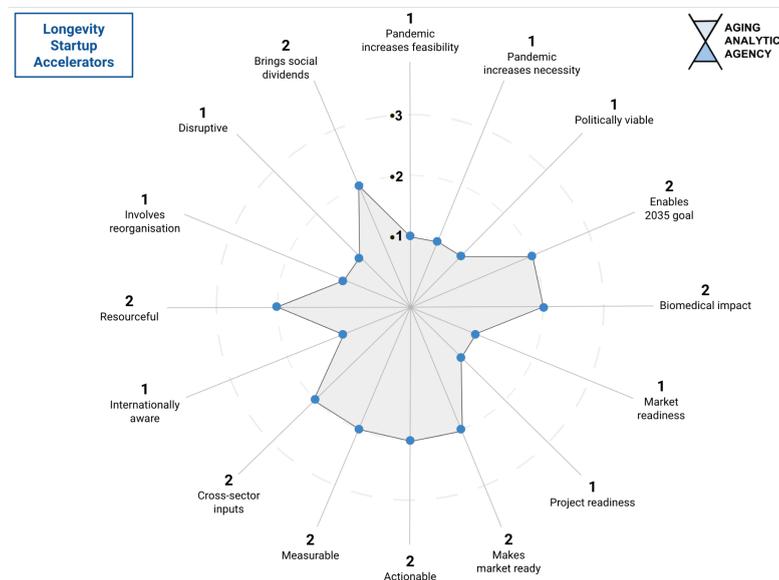
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- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): +1

TOTAL SCORE: 8



Counterparties for Healthy Ageing Strategy

- We propose that the UK Government 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 useful entities.

We propose that the UK Government 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 is the formulation of a large database of potentially relevant partners and counterparties including government ministries, departments and agencies, laboratories, R&D

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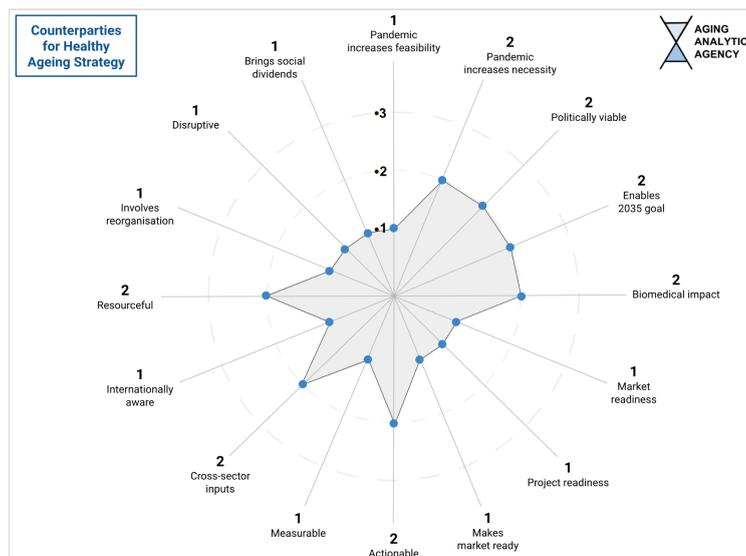
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hubs, AgeTech hubs, and relevant start-ups, corporations and NGOs. An early and proactive approach to the creation of this database is essential to the formulation of a maximally relevant and effective list of partners and institutional collaborators,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

Score

- A1 (Feasibility increased by continuance of pandemic): 0
- A2 (Necessity increased by covid pandemic): +1
- A3 (Political viability): +1
- B1 (Relevance to the specific goal of increasing HALE by 5 years by 2035): +1
- B2 (Relevance to general goal of biomedical healthy life extension): +1
- C1 (Market readiness applicability): 0
- C2 (Project readiness): 0
- C3 (Move to market readiness): 0
- D1 (Actionability): +1
- D2 (Degree of measurability): 0
- D3 (Degree of leveraging cross-sector inputs): +1
- D4 (Awareness of international context): 0
- D5 (Resourcefulness): +1
- D6 (Reorganisation): 0
- E (Disruptiveness): 0
- F (Dividends - does the recommendation aid in social activity and inclusivity?): 0

TOTAL SCORE: 7



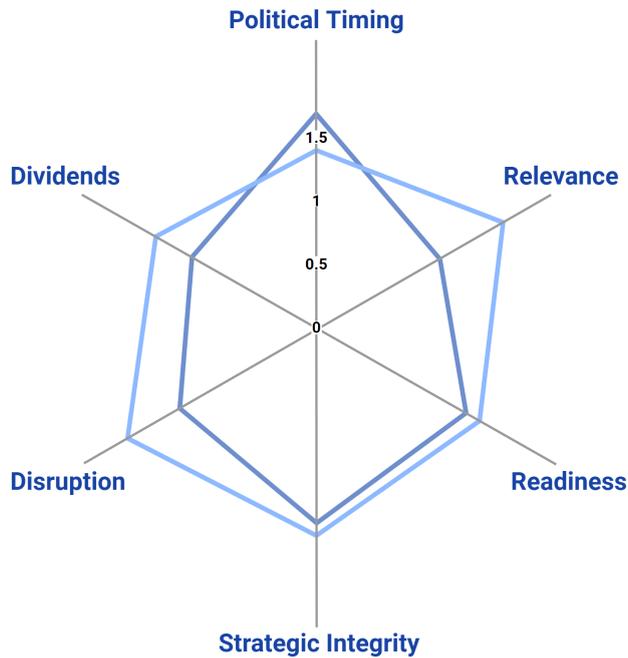
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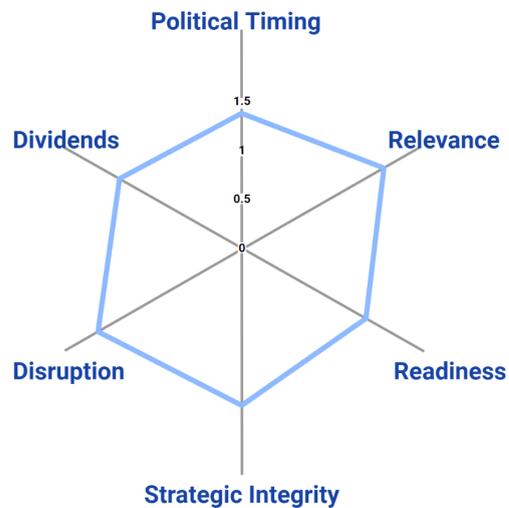
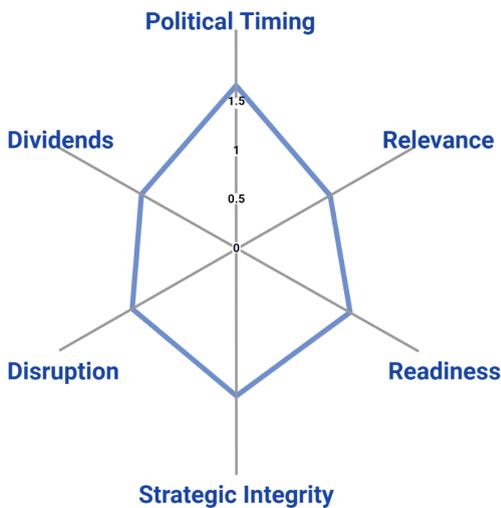
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Comparison of Aging Analytics Agency Recommendations vs. Those Made by House of Lords Science and Technology Select Committee

■ House of Lords ■ Aging Analytics Agency



■ House of Lords ■ Aging Analytics Agency



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The most significant overall point of comparison between the Committee's and Aging Analytics Agency's independent visions for government strategy might be as follows:

Aging Analytics Agency strategises for the attainment of greater national Healthy Longevity as though this were an industrial strategy in itself, in the sense that no cross-sector synergies are off limits, and all national assets are of potential use. In doing so we invoke the concept of a National Longevity Development Plan, a propositional form of industrial strategy that seeks to make an asset of Longevity.

As a consequence:

- Aging Analytics Agency and the Committee frequently agree on the deployment of specific technologies, but only Aging Analytics Agency regards as essential certain synergies between them. For example, AgeTech, mHealth, biomarkers and drug discovery are mentioned, but never is it suggested they be harnessed together.
- A complete industrial-scale strategy for aging would recognise the importance of seeking existing assets as a basis for future strategy, e.g. would have specifically noticed and cited today's AI centres for health as assets that can be repurposed specifically as AI centres for Longevity and the rapid biomarker development.
- An industrial-scale strategy for aging would be informed by the experience of other countries. For example, studying the example of Singapore reveals that HALE can be increased rapidly enough to meet the 2035 target using existing assets, and the Australian experience of funding motor neuron disease research could prove instructive.
- Finally, a complete industrial-scale strategy for aging would have the breadth to take into account the financial industry and see the evolution of novel financial systems are essential for the industrialisation of Longevity.

A main crux of the government's long-term concern regarding the demographic challenge is the threat of financial devastation. And yet the solutions provided by the current industrial strategy consist overwhelmingly of non-financial technologies, and together they amount to a coping strategy to withstand the impact of the "grey tsunami" when it hits, rather than a strategy for making an asset of Healthy Longevity.

In fact addressing the demographic challenge will involve firing on all four cylinders of the nascent Longevity Industry: geroscience (including regenerative medicine for aging), P4 medicine, AgeTech and novel financial systems.

And this in turn will involve a degree of strategic breadth and coordination similar to that currently afforded to the existing four-pillar industrial strategy as defined by BEIS in 2017. (A more comprehensive overview of how and why the United Kingdom is already leading the world toward

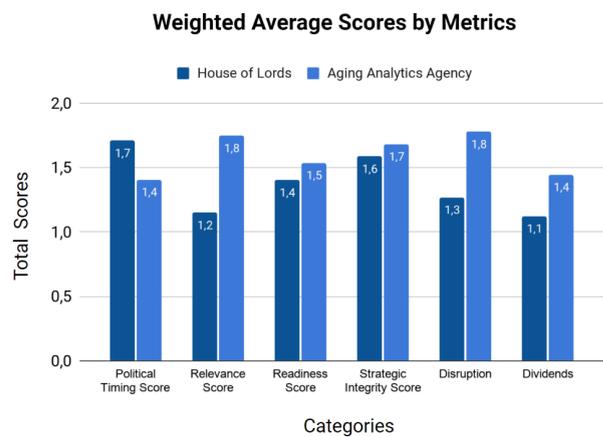
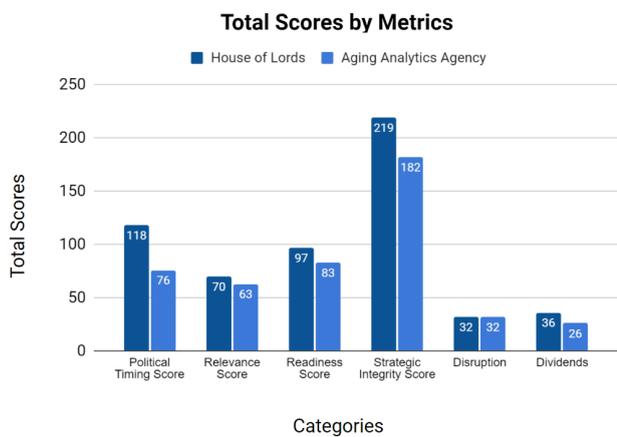
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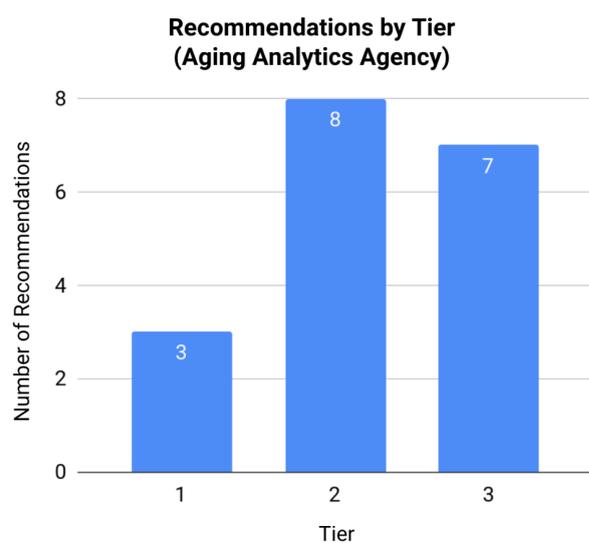
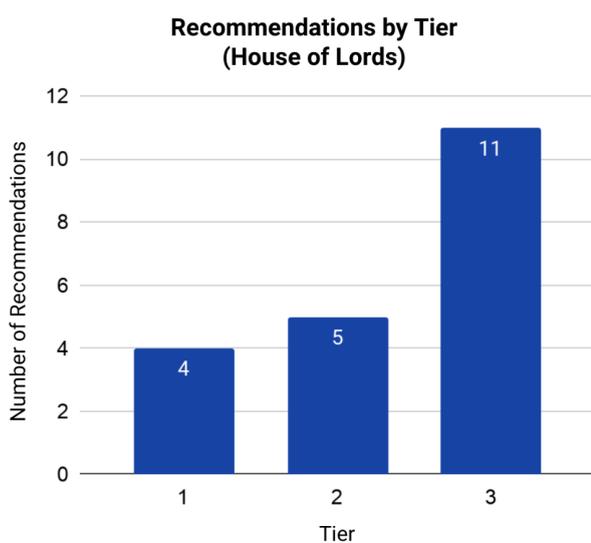
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this vision can be reviewed in Aging Analytics Agency's [National Longevity Development Plans Global Overview](#) special analytical case study).

The following set of charts depict the relative scores, tiers, and themes of recommendations from both Aging Analytics Agency and the House of Lords Science and Technology Select Committee.



Aging Analytics Agency recommendations shows a similar pattern of merits to the House of Lords recommendations, but only Aging Analytics Agency gives active consideration to the factor of political timing in relation to the covid pandemic, which impacts everything from various forms of political capital ranging from the public's familiarity with telehealth to demand for preventive measures.



Aging Analytics Agency has a higher number of recommendations specifically in tier 2 (related to the 2035 goal), and fewer in tier 3 ("no major strategic ramifications"). This is partly because

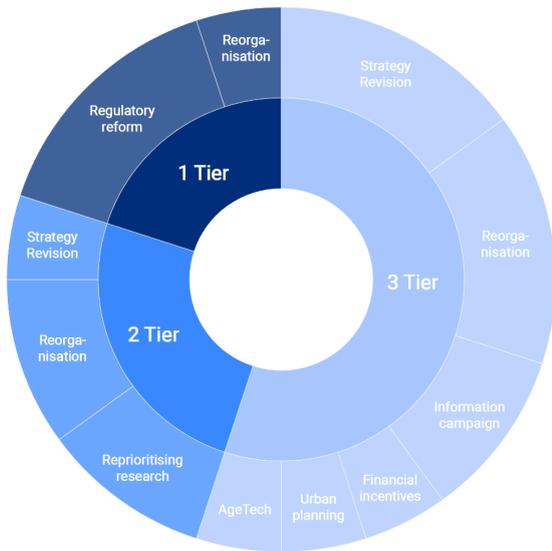
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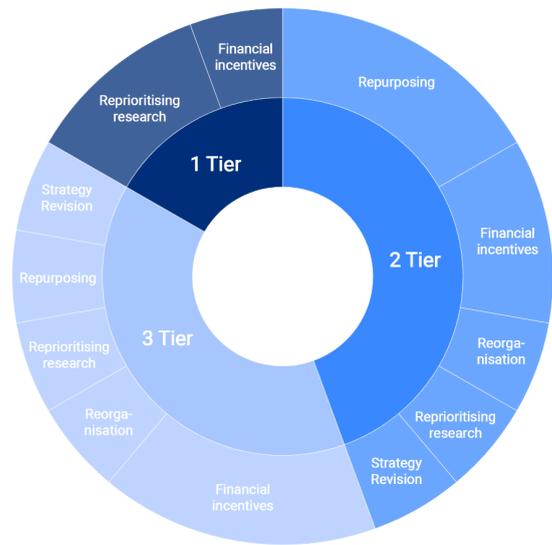
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Aging Analytics Agency views some of the Lords' recommendations such as mHealth development as having a greater long-term strategic significance than originally conceived of, e.g. having some bearing on biomarker development.

Recommendations by Theme (House of Lords)



Recommendations by Theme (Aging Analytics Agency)



Aging Analytics Agency is first to introduce financial incentives. Both the House of Lords and Aging Analytics Agency give similar priority to reprioritising research. But in lieu of mass reorganisation favoured by the Lords, Aging Analytics Agency prioritises the reform of existing assets. This reflects Aging Analytics Agency's position, based on the experience of countries such as Singapore, that biomedical breakthroughs are not necessary merely in order to meet the 2035 goal.

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Major Conclusions and Key Take-Aways

The Longevity Industry has reached a point where politics has become one of the most important factors on which its future depends. The political, economic, and industrial capital that municipal and national government control and dispense is larger than any other industry stake-holder, and the stakes are proportionately higher, given that they are tasked with maintaining and optimising the wellbeing and quality of life of their national population, and the size, integrity and stability of their national economy - or, in other words, the health and wealth of their nation.

The future of both the Longevity Industry and the state of the UK's National Healthy Longevity must begin with the government using its powers of coordination to emulate the experience of countries such as Singapore, which have the smallest gaps between life expectancy and HALE. Only then will there become apparent a need for biomedical innovation in order to progress past this point.

If the government fully invests its resources and political will into this approach - utilizing its many existing strengths and resources in synergy rather than isolation, utilizing sophisticated and modern approaches for analytics and benchmarking to adopt best-case examples internationally, and using modern, market-ready technologies to both execute and track progress on its mission towards adding 5 extra years of HALE by 2035 - it may find it has not hit a speed limit after all.

There are many low hanging fruits to be found. With a more discerning approach to biomarkers and network of labs set up to formulate an actionable, easily-implementable panel of ageing biomarkers, the UK can take its first steps toward bootstrapping our way to a fully fledged Longevity Industry and make health the new wealth.

At some point however, this will require a "National Longevity Development Plan" involving cross-departmental coordination across ministries of health, social welfare, finance, economy, industry and trade, which starts with but extends beyond the UK's Healthy Ageing Industrial Strategy, and which positions the goals and mandates of that Industrial Strategy as its central concern.

This is more politically viable than it may sound at first. The general public is suffering from "covid fatigue", and are afraid that future unprepared governments may react to future pandemics with more lockdowns. Accusations of "lack of coordination" are now standard forms of political attack from opposition parties around the world. The public are in a mood which is very tolerant of extreme, expensive, preventive measures to ensure the nation and the economy are never caught off guard in such a way again. To sum up:

- **The public is now very aware of the link between health and wealth.**

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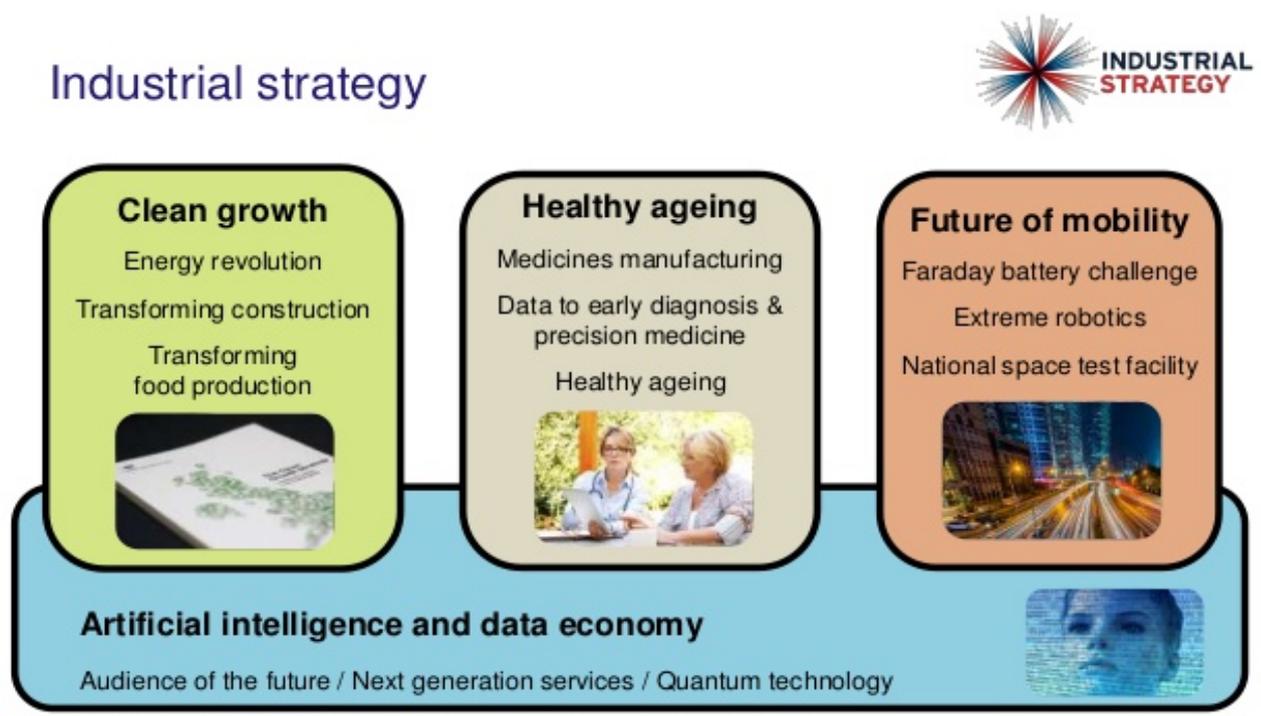
- **Coordination, sacrifice, and investment in preventive measures, are now all perceived virtues among the electorate.**

As such , the government has renewed political capital to make amazing things happen. We would urge the government to take full advantage of the various facts and advice listed in this document, and **go further and faster** in tackling the Ageing Society Grand Challenge head-on.

As documented in Aging Analytics Agency's document *National Longevity Development Plans: Global Overview*, the UK has one of the most ambitious industrial strategies in the world - at least on paper - and the one most closely approximating a fully fledged National Longevity Development Plan. But having drawn such an ambitious roadmap, the UK government appears too willing to continue down its chosen route "in 2nd gear". The UK has updated its vision, but has not updated its methods.

The UK government and it advisory bodies need to develop an understanding of when and how progress in one sector can help shorten the road ahead in another sector. More than brute technological innovation in one particular sector or another, what is needed is harmonisation and deeper analytics to identify best and worst case approaches and track developments and milestones.

On paper, the UK Industrial Strategy *already* appears to be conceived with all the relevant synergies in mind, as this graphic from the official literature illustrates:



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But this kind of thinking needs to be *applied* to the Aging Society Grand Challenge. The government must give itself permission to take the obvious steps in applying this form of strategic thinking to the Ageing Society, before they can legitimately claim to be at any kind of impasse. The ambitions, sophistication and rigour of the tools they use to execute and track progress in their strategy needs to match the ambitions, sophistication and rigour of the strategy itself.

This should involve:

- Utilizing the UK's existing strengths and resources to their full extent, in synergy rather than in isolation.
- Prioritise funding, support and development-to-scale of market-ready approaches and solutions to alleviate the 'market readiness' problem that constitutes the largest and foremost bottleneck on progress towards the attainment of the government's 2035 goal, while simultaneously supporting the development of a more optimal industry, academic, legal, regulatory and financial infrastructure to support longer-term R&D stage projects to keep their momentum going past the 2035 goal.
- Prioritise funding, support and investment into AgeTech, Preventive Medicine, AI for Longevity.
- Prioritise funding, support and investment into actionable biomarkers of Longevity and the development of a consensus framework of actionable, market-ready panels of biomarkers of ageing and Longevity that can be used to more precisely implement the early diagnostic tools and preventive medicine technologies and approaches that will constitute the nation's largest short-term gains in optimizing population-level HALE, and which can be used to quantitatively track progress towards their 2035 goal.
- Utilise, in a cross-sector manner, the NIH's existing prioritisation of mHealth to maximise synergy. The UK government already recognizes mHealth as a major method of preventing NCDs in the UK population. The same commitment and recognition should hold for Ageing Society.
- Synergies between the UK Ageing Society and AI Industrial Strategies, rather than isolation.
- Explore and leverage the UK's existing strength in banking, finance and financial services to support the development of financial sectors of the Longevity Industry so as to optimise socially inclusive financial wellness among the elderly.

The House of Lords Science and Technology Select Committee's recommendations help to optimise the government's existing efforts, but a greater focus is needed on identifying the paths of greatest market readiness and project readiness. At each stage it must be asked: are we utilising existing assets most effectively? If developing a clinical program, what are the

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biomarkers we need and why? If developing biomarkers, what is the minimum viable panel of biomarkers needed? When identifying that panel, it should be asked, is there a potential for digital biomarkers?

As the Committee's diligent critique of government policy demonstrates, the UK has the will to succeed in this arena. But the UK is the first democracy of its large size to attempt to increase HALE on such a timescale, and this makes coordination and an ability to effectively identify and allocate relevant existing assets an unprecedented challenge - albeit one that the UK has both the political will and the resources to face and to surpass, provided that it adopts a more sophisticated, modern and ambitious approach to the management, coordination and execution of those resources.

The specific set of recommendations provided by Aging Analytics Agency in this document and associated IT-Platform, as well as the analytical frameworks used to conduct Longevity Policy recommendation benchmarking and comparative analysis, have been partially informed by the ongoing development of Aging Analytics Agency's [Longevity Policy and Governance Dashboard](#).

The dashboard uses Big Data analytics, AI, and deep learning algorithms for the profiling, comparative analysis, benchmarking, automated SWOT analysis and semi-automated practical recommendations for national and municipal Longevity Policy strategies and initiatives tuned to the specifics of individual territories in order to provide public policy-focused insights, identification of growth opportunities, and other forms of competitive intelligence for use by government agencies, healthcare, economy & industrial development ministries, & international

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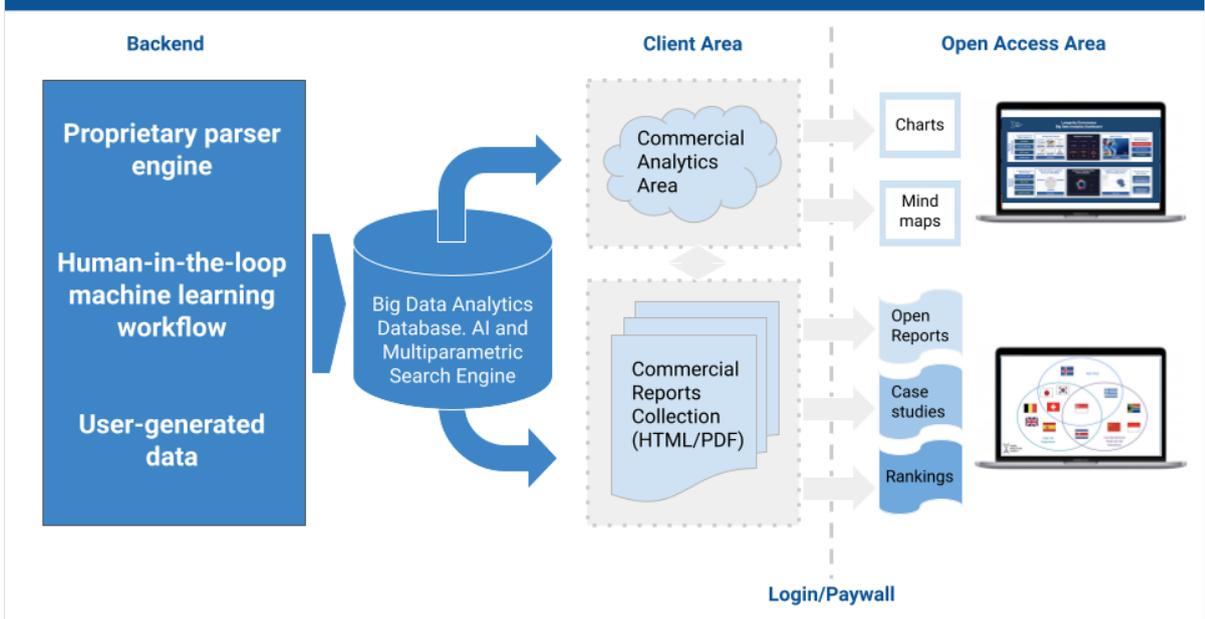
policy organizations, private and public companies related to the Longevity industry, research institutions, universities, technology vendors and contract research organizations, startup hubs and accelerators, and consulting companies and agencies.

Longevity Policy & Governance Big Data Analytical Dashboard Features & Technologies

SWOT analysis	Data aggregation	Model creation
Polynomial formulas, multidimensional vector spaces	Data extrapolation through regressions	Factor analysis of LE-HALE gap determinants (multiple regression)
Mathematical transformations: logarithmic, exponential, parabolic, multiplicative	Data extrapolation through deep neural networks	Analysis of variance of major longevity parameters across groups of countries (ANOVA)
Business development harmonization analysis: definite integrals, standard deviation	Natural language processing for tag cloud creation	Defining leading countries in longevity governance (ranking)
Variance-covariance analysis of the parameters of the countries	Data parsing	Estimation of relationships between metrics (intra-class correlation)
Linear algebra	Deep neural networks for data structuring	Assessment of effectiveness of healthcare systems

The ultimate aim of the dashboard is to provide the necessary set of modern analytical tools to enable national governments, individual economy, healthcare and industrial development industries, international policy organizations and other responsible stakeholders to formulate and implement policies and development strategies capable of transforming the challenge of ageing into the opportunity of Healthy Longevity for the mutual benefit of their citizens and their economy.

Longevity Policy & Governance Big Data Analytics Platform at a Glance

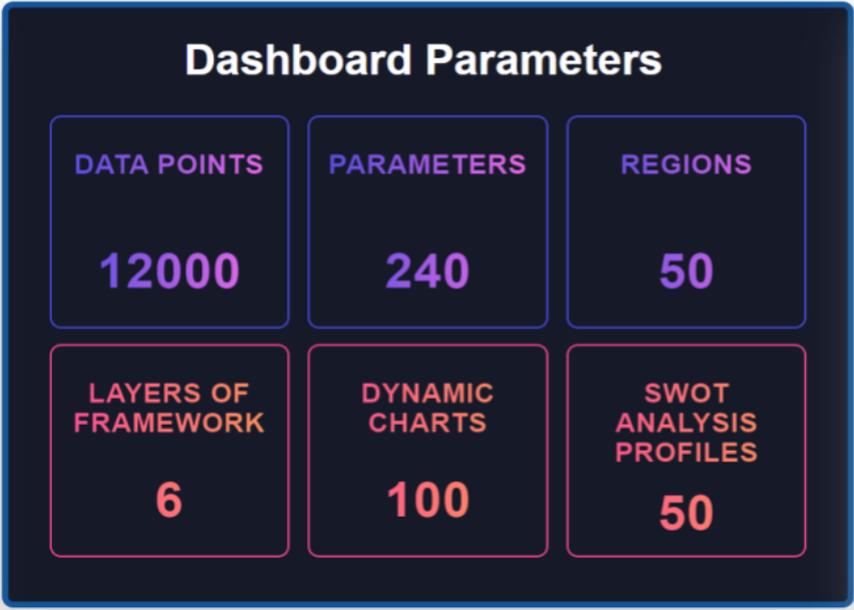


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While the project is still in development (and the dashboard currently available in alpha format), several more advanced features will be rolled out as part of the dashboard Beta release, scheduled for release in Q3-Q4 2021, including reinforcement learning for comparative Longevity Policy analysis, automated Longevity policy initiative and development plan benchmarking (ranking), automated SWOT analysis on region-specific Longevity governance and policy projects and semi-automated Practical recommendations to optimize Longevity policy and governance strategy.



Category	Count
DATA POINTS	12000
PARAMETERS	240
REGIONS	50
LAYERS OF FRAMEWORK	6
DYNAMIC CHARTS	100
SWOT ANALYSIS PROFILES	50

- Reinforcement learning for comparative Longevity Policy analysis
- Longevity policy initiative and development plan benchmarking (ranking)
- Semi-automated SWOT analysis on region-specific Longevity governance and policy projects
- Semi-automated Practical recommendations to optimize Longevity policy and governance strategy

As this and other projects clearly demonstrate, governments now have all required technologies and tools available to improve the health of their citizens and optimize public health and industrial strategy development and execution via the use of modern analytical approaches, and a failure to do so is entirely the result of a lack of will, responsibility and foresight, rather than sheer capacity, technology or resources. However, only those governments willing to embrace the integral use of modern technologies and deep AI-driven comparative analytics to optimize their political and industrial Longevity strategies will be likely to succeed.

The need for more sophisticated, data-driven and transparent approaches to Longevity Policy formulation, optimization, progress-tracking and execution becomes even more apparent considering that Longevity Policy is beginning to be embraced in the UK on a municipal level as well. Aging Analytics Agency was [recently appointed by MIDAS](#), the inward investment arm of the Greater Manchester Combined Authority, to conduct an analytical survey and profiling of the municipality's healthy ageing assets (companies, investors, R&D Hubs, etc), to strengthen and help the local Manchester government to meet the goals set out in their Local Healthy Ageing

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Industrial Strategy, evidencing the development of committed *local* Healthy Ageing Industrial Strategies in the UK as well. And while Manchester appears to be the first, it is likely that others will soon follow.

If national and municipal governments (including the UK) fully invest their resources and political will into this approach - utilizing their many existing strengths and resources in synergy rather than isolation, utilizing sophisticated and modern approaches for analytics and benchmarking to adopt best-case examples internationally, prioritizing support and development-to-scale of maximally market-ready technologies with the greatest short-term practical impact on society, and the use of modern technologies and more sophisticated, quantitative, data-driven analytical systems and approaches to both execute and track progress on their goals - they are likely not only to neutralize some of the most dangerous sources of economic and societal instability on the horizon, but to reap the full economic and societal benefits of transforming the challenge and deficit of an ageing population into the opportunity and asset of National Healthy Longevity.