

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

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.

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

- **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.

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

- 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.

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

- 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

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

- 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.

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

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.

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

- **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.

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

- **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.

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

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).

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

- **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.

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

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

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

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

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

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)

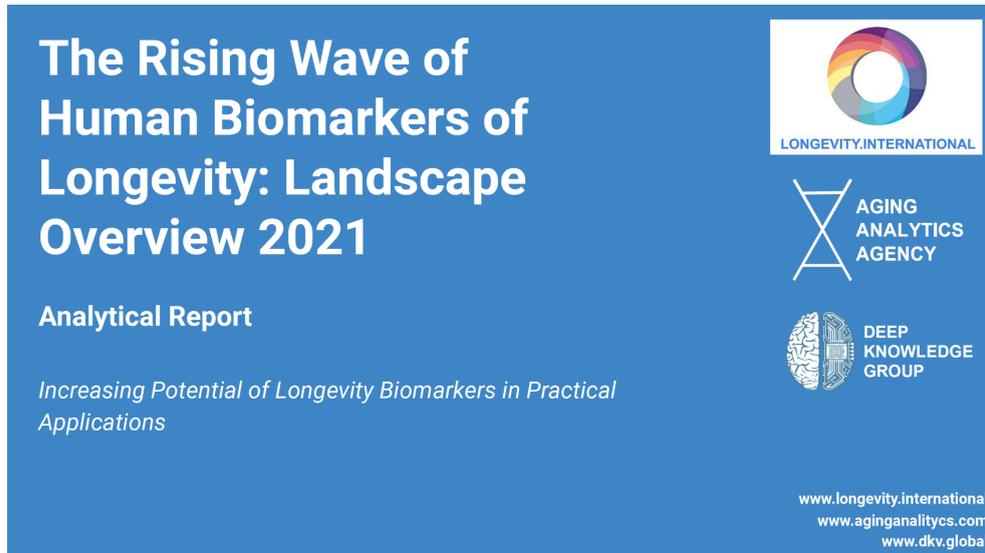
Response and Analysis of UK House of Lords' Science and Technology Committee's 'Ageing: Science, Technology and Healthy Living' Report



Official Response, Analysis of Report & Benchmarking of Recommendations

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.

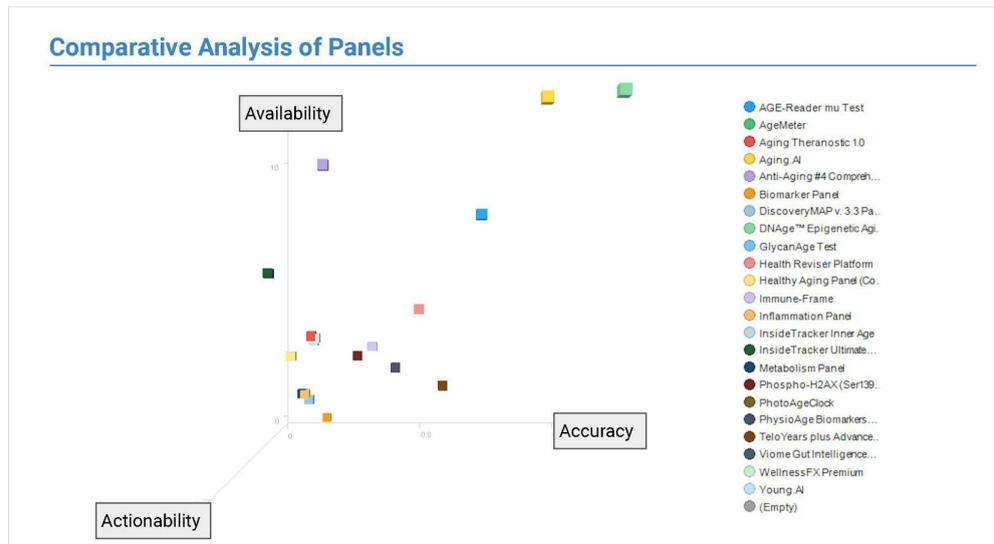
We now have biomarkers and biomarker panels that are market-ready; actionable enough (i.e., with comparatively low cost and invasiveness) to be developed, applied and used at scale; and accurate enough to prove useful in validating the safety and effectiveness of lifestyle, behavioural and Precision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

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

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.

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

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

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

- 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.

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

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

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

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.

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

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

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

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

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

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)
- 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

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

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.

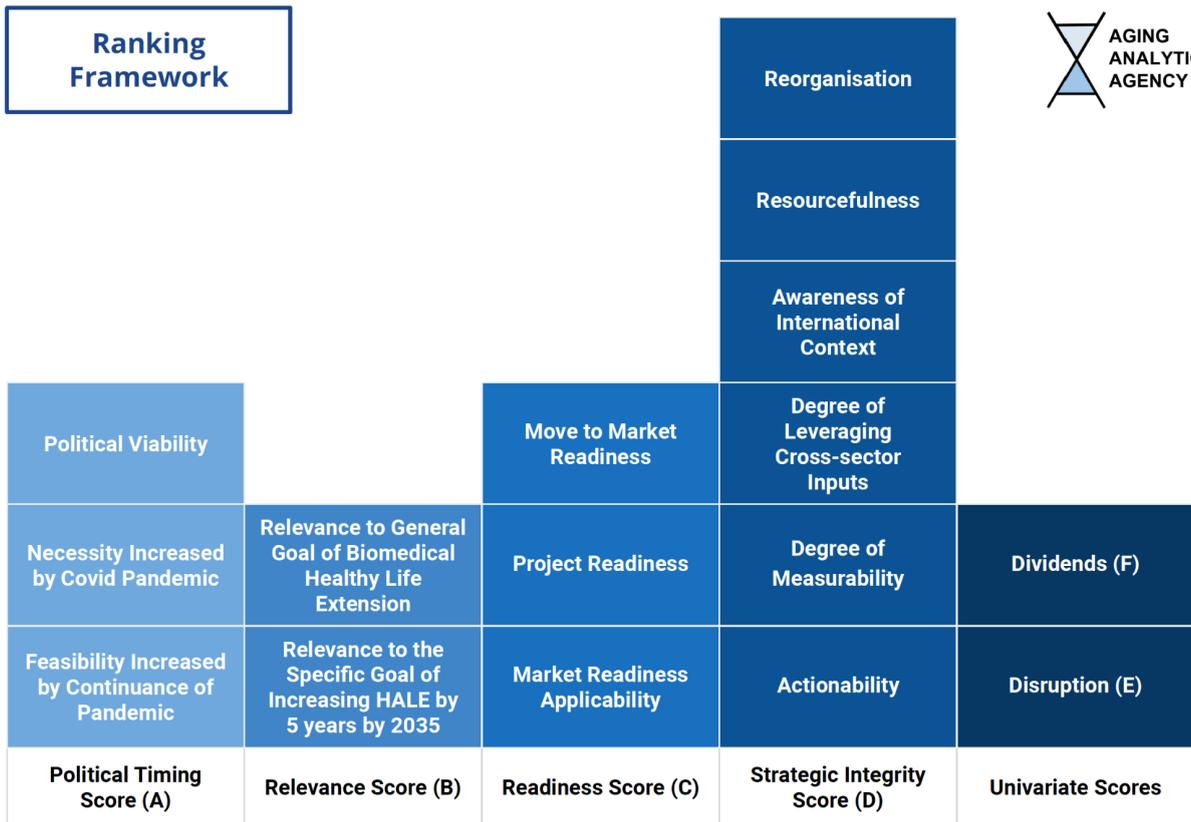
And in future documents, proposals from various world regions and municipalities will be subject to the same framework, with a view to benchmarking global governance / HALE ranking, finding correlations between positive and negative rankings in (1) actual national health and economy parameters and rankings, 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

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

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.

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

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?

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

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*

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

- *-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*

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

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*

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

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