

Chatting with AI about AI Driven Longevity

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INTRODUCTION

This paper is an experiment with two generative AI tools: OpenAI's ChatGPT and Microsoft's Copilot, evaluating the responses from the same prompt between two systems.

The responses are edited for length and evaluated with actuarial commentary. The insights from the discussion will be used to inform a "prospective longevity risk analysis" designed by Gordon Woo et al.¹ The analysis attempts to parameterize improvements to mortality experience from five key drivers labelled as "vitagions": Lifestyle, Medical Intervention, and Health Environment, which drive mortality improvement today, plus Regenerative Medicine and Anti-Aging Processes that may exist in the future.

LIFESTYLE

Prompt: Provide a bullet list of the top three ways in which Artificial Intelligence could improve longevity by affecting lifestyle, where lifestyle is defined as: the principal individual lifestyle risk factors that affect health, such as smoking, obesity, and biometric risk factors.

CHATGPT

Personalized Health Recommendations

- Analyze individual health data to deliver tailored advice on diet, exercise, and sleep.
- Machine learning models can predict potential health risks and provide preventive strategies specific to the individual.
- Wearable devices with AI can offer real-time feedback to maintain healthy behaviors.

Behavioral Change Support

- AI-powered apps and virtual health coaches use behavioral psychology techniques, such as gamification and rewards, to help users modify lifestyle.
- Natural language processing (NLP) enables chatbots to offer empathetic, 24/7 support, addressing barriers to change.
- Predictive analytics can identify when users are at risk of lapsing into unhealthy behaviors.

¹ Woo G. et al. (2009) Prospective longevity risk analysis. *British Actuarial Journal*, 15, S1, pp.239-247.

Monitoring and Early Detection

- AI systems can track biometric risk factors, detecting early warning signs of disease.
- Continuous monitoring allows for proactive management of conditions like diabetes or hypertension, reducing their impact on longevity.

COPILLOT

- **Personalized health recommendations:** AI can analyze data from biometric sensors and health records to provide personalized recommendations for diet, exercise, and other lifestyle choices that can improve longevity.
- **Predictive analytics:** AI can analyze large datasets to identify patterns and predict individual health risks, allowing for targeted interventions to prevent chronic diseases associated with lifestyle factors.
- **Behavioral nudges:** AI-powered apps and devices can provide real-time feedback and reminders to encourage healthier habits, such as reminders to take medication, notifications to stand up and move around, or suggestions for healthier food choices.

ACTUARIAL REACTION

While biometrics have benefited from the increased proliferation of wearable devices like the Apple Watch and Fitbits, the degree to which they will have a meaningful impact on longevity is an open question.

First, it may be that there is a selection bias. Adopters of wearable health trackers may already be invested in optimal health.

Second, even with having information, there are barriers to lifestyle change. Diets, food habits, and exercise programs are hard to implement and maintain.

That said, it may be a “near-future” reality that doctors proscribe a virtual ‘longevity coach’ to monitor patient action and encourage healthy behavior between annual check-ups. Additionally, tailored education campaigns may be effective in combatting things like opioid addictions.

HEALTH ENVIRONMENT

Prompt: Provide a bullet list of the top three ways in which Artificial Intelligence could improve longevity by affecting the health environment, where the health environment is defined as: hygiene, sanitation, knowledge and awareness of health issues, access to healthcare, and other economic factors.

CHATGPT

Improved Access to Healthcare

- AI-powered telehealth platforms enable remote consultations, making healthcare accessible in underserved and rural areas.
- AI chatbots and virtual assistants provide 24/7 triage, reducing barriers to timely care.
- AI can optimize the distribution of medical resources in response to regional health needs.

Advancements in Hygiene and Sanitation

- AI-enabled sensors can detect water contamination, waste mismanagement, or air pollution, ensuring safer living environments.

- AI can predict failures in sanitation infrastructure and facilitate timely interventions to prevent disease outbreaks.
- AI tools can promote hygiene practices like handwashing through culturally tailored campaigns.

Enhanced Health Knowledge and Awareness

- AI analyzes demographic and social data to design effective, localized health awareness campaigns about diseases, nutrition, or preventive care.
- AI algorithms identify and counteract health-related misinformation.

COPILLOT

- **Early detection and diagnosis:** AI can analyze vast amounts of data to identify patterns and trends in disease outbreaks, allowing for early detection and response to prevent the spread of infectious diseases and improve overall public health.
- **Resource allocation:** AI can help optimize the allocation of healthcare resources by predicting demand for services, identifying areas with the greatest need for intervention, and streamlining processes to improve efficiency and access to care.
- **Health education and awareness:** AI-powered chatbots and virtual assistants can provide personalized health information, answer questions, and offer support to individuals seeking information about health issues, promoting awareness and empowering individuals to make informed decisions about their health.

ACTUARIAL REACTION

- Lack of access to healthcare is a known headwind for some populations. The possibility for AI based triage or even diagnostic services in underserved areas does seem to be a reasonable candidate to improve health outcomes.
- Copilot alluded to resource allocation. This could prove extremely helpful to monitor and control potential disease outbreaks. Being able to deliver early alerts and deploy needed providers and services to hot areas is something that could save a lot of lives.
- An area of concern may be allowing AI to develop “culturally tailored campaigns.” While there may be gains in effectiveness in increasing the relatability of education material to personal context, it seems as though this may present an area of risk relative to bias and discrimination.

MEDICAL INTERVENTION

Prompt: Provide a bullet list of the top three ways in which Artificial Intelligence could improve longevity by affecting medical intervention, where medical intervention is defined as: new medical treatments, including pharmaceuticals, biologics, and vaccines; improvements in diagnostics, surgical techniques, and the delivery of new or existing treatments.

CHATGPT

Accelerating Drug Discovery and Development

- Machine learning models can identify potential drug candidates and predict their efficacy and safety, significantly reducing the time and cost of drug development.
- AI can analyze large datasets to uncover new uses for existing pharmaceuticals, expediting treatments for emerging diseases.

- AI enables precision drug development by predicting how individual patients will respond to specific treatments based on genetic and molecular profiles.

Enhancing Diagnostics and Early Detection

- AI algorithms can analyze medical imaging with higher accuracy than traditional methods, enabling earlier detection of conditions like cancer or neurological diseases.
- AI systems can identify subtle patterns in health data to predict diseases before symptoms manifest.

Advancing Surgical Techniques and Treatment Delivery

- AI-powered robotic systems enhance precision and reduce human error in complex surgeries, minimizing recovery time and complications.
- AI can recommend the most effective treatment plans by analyzing patient data and comparing it with clinical guidelines and outcomes.
- AI accelerates the design of vaccines as demonstrated during the COVID-19 pandemic.

COPILLOT

- **Precision medicine:** AI can analyze genetic and clinical data to develop personalized treatment plans tailored to an individual's unique genetic makeup, increasing the effectiveness of treatments and reducing side effects.
- **Drug discovery and development:** AI can accelerate the drug discovery process by analyzing large datasets to identify potential drug candidates, predict their efficacy, and optimize their design, leading to the development of new and more effective treatments for various diseases.
- **Surgical assistance:** AI-powered surgical robots can assist surgeons in performing complex procedures with greater precision and accuracy, reducing the risk of complications and improving patient outcomes. AI can also analyze medical imaging data to assist in the early detection and diagnosis of diseases, improving the effectiveness of treatment and reducing the need for invasive procedures.

ACTUARIAL REACTION

The answers here are harmonious, and this area does seem to show the most promise for dramatically increasing longevity and improving health span. AI radically changes the possibility space and timetable for discovery and development, particularly in the pharmaceutical space.

[From a statement by Eli Lilly](#), *"The goal is to grow what Lilly calls its "digital worker-equivalent workforce," a concept that the company says helps quantify the hours saved by using technology instead of human labor. Lilly said that its efforts, which began in 2022 and now span more than 100 projects, are equivalent to around 1.4 million hours of human activity, or **around 160 years of 24/7 work**. Lilly told Insider **its goal is to bring this number to 2.4 million hours, or about 274 years.**" (Emphasis added)*

One area that may not have been directly called out is the reduction of medical errors, a known cause of fatalities in the healthcare system. Improvements in AI based diagnostics, coupled with doctor expertise could reduce the number of mortal mistakes that occur every year.

REGENERATIVE MEDICINE AND ANTI-AGING PROCESSES

Prompt: Provide a bullet list of the top three ways in which Artificial Intelligence could improve longevity by affecting regenerative medicine and anti-aging processes. Regenerative medicine covers techniques for repairing and renewing cells and organs, including stem cell therapy and nanomedicine. Anti-aging processes cover discoveries that directly affect the human aging process and may decrease an individual's effective biological age below actual chronological age.

CHATGPT

Enhancing Regenerative Therapies

- AI can analyze cell differentiation processes to improve stem cell therapies for repairing damaged tissues and organs, including the heart, brain, and liver.
- AI designs nanoscale delivery systems that target specific cells for precision treatment, such as repairing cellular damage or regenerating tissues.
- AI facilitates the design and production of bio printed tissues and organs by analyzing biological structures and optimizing scaffold materials.

Advancing Anti-Aging Research

- AI algorithms analyze biomarkers, epigenetic changes, and physiological data to assess biological age, enabling targeted anti-aging interventions.
- AI accelerates the discovery of genes, molecules, and cellular pathways linked to aging, helping develop therapies to slow or reverse aging processes.
- AI simulates aging processes to predict the effectiveness of anti-aging drugs or therapies, reducing the time required for clinical trials.

Personalized Regenerative and Anti-Aging Protocols

- AI can design personalized anti-aging plans by integrating data from genomics, proteomics, and lifestyle factors, optimizing treatments for each individual.
- AI-powered tools track cellular damage and repair mechanisms in real-time, enabling proactive interventions to maintain youthfulness.
- AI can model how regenerative techniques (e.g., stem cells, CRISPR) and anti-aging drugs (e.g., senolytics) interact, maximizing their combined benefits for longevity.

COPILLOT

- **Personalized regenerative therapies:** AI can analyze individual genetic and health data to develop personalized regenerative medicine treatments, such as stem cell therapy or gene editing, tailored to address specific age-related conditions and promote tissue regeneration.
- **Drug discovery for anti-aging:** AI can accelerate the discovery of potential anti-aging compounds by analyzing large datasets to identify molecules that target key pathways involved in the aging process, leading to the development of new treatments that can slow down or reverse aging at a cellular level.
- **Predictive modeling for longevity:** AI can analyze biological markers, lifestyle data, and environmental factors to predict an individual's risk of age-related diseases and mortality, providing insights that can inform personalized interventions to extend healthy lifespan and improve overall longevity.

ACTUARIAL REACTION

Like drug discovery, the value of AI based techniques in these spaces comes from the ability to study large and complicated datasets (human genomes, biological pathways, etc.) as well as doing complicated calculations (predicting protein folds, etc.). In short, AI may be able to “do” and “see” what humans cannot.

Even with the discovery of a new pathway or protocol to address an aging pathway, it is yet to be shown to what extent the ability to replace or regenerate body parts can extend life. Likewise, accomplishing something like eliminating cellular senescence may only have a muted effect on aging. Improvements coming from these areas are quite speculative.

MODELLED OUTCOMES

The model for the prospective longevity risk analysis is a hybrid model that blends actuarial techniques for initial parameterization of mortality improvements with medically informed stochastic modeling of the underlying drivers of mortality improvement in the future.

Given the stochastic nature of medical advancements in geroscience, predicting future mortality trends faces significant uncertainty due to the unpredictable trajectory of medical science. This highlights the challenge for actuaries in forecasting mortality improvements amidst the inherent randomness in medical breakthroughs as well as societal progress.

The stochastic results can be sorted by exceedance probabilities of how likely an outcome is greater than a certain value. For this essay, the latest U.S. model was used, utilizing data through 2022. To supplement and contextualize the stochastic results, deterministic scenarios representing AI’s potential impact for each vitagion were selected and mapped on the stochastic distribution (Table 1).

Table 1
SELECTED DETERMINISTIC SCENARIOS REPRESENTING THE POTENTIAL IMPACT OF AI ON EACH DRIVER OF MORTALITY IMPROVEMENTS (“VITAGIONS”)

Vitagion	Deterministic scenario	Description
Lifestyle	Obesity declines faster than expected	Obesity declines at a level calibrated to match a 1-in-100 scenario of obesity decline. This path supports the calibration of lifestyle long-duration trend volatility within the model.
Health environment	Pandemic response improves outlook for mortality improvement	The COVID-19 vaccines provide a highly visible proof-of-concept for the use of mRNA techniques. This success results in improving the outlook for the treatment of infectious diseases and applying the technology to chronic diseases.
Medical intervention	Medical Breakthroughs: Improvement shock for medical intervention for all causes of death	Medical breakthroughs for all causes of death driven by advances in medicine, a decrease drug development time, and streamlined clinical trials.
Regenerative medicine + anti-aging processes	Regenerative Medicine and Anti-Aging Processes Shocks (2 scenarios)	The annualized 1-in-200 liability impact of Regenerative Medicine and Anti-Aging on the model’s central view. Given the vitagion’s volatility parameter, this translates to the expected progress happening in 37 years instead of 50 years.

Next, the stochastic model was updated based on the parameters of the selected deterministic scenarios to estimate the impact of AI on all vitagions simultaneously. The stochastic models run 100,000 simulations with valuation year set to 2024 and base mortality set to “Pri2012_Total_Employee” rolled forward to 2019 (see Appendix). The outcome was life expectancies for a 50-year-old male and female.

The median life expectancy (p50) for a 50-year-old male and female was 33.7 and 35.2 years, respectively, under the model. Table 2 provides the deterministic scenarios quantified isolating AI impacts by vitagion.

Table 2
LIFE EXPECTANCY AT AGE 50 ACCORDING TO THE STOCHASTIC MODEL AND AI-IMPACTED VITAGION DETERMINISTIC SCENARIOS

Deterministic Scenario	Male	Female
Median Life Expectancy	33.7 (p>50)	35.2 (p>50)
Medical Intervention	36.2 (p>97)	38.2 (p>98)
Health Environment	34.3 (p>77)	35.9 (p>80)
Lifestyle	34.1 (p>73)	35.7 (p>76)
Regenerative Medicine	34.1 (p>72)	35.6 (p>75)
Anti-Aging Processes	34.0 (p>65)	35.5 (p>69)

Figures 1 and 2 present the life expectancy distributions of the original and updated model. The updated model representing AI’s impact on all vitagions simultaneously increased the median life expectancy to 35.9 and 37.4 years for males and females, respectively. These represent the 97th percentile on the original stochastic distribution. The greater spread of the updated distribution indicates that some individuals will benefit from AI more than others and experience greater mortality improvements.

Figure 1
LIFE EXPECTANCY DISTRIBUTION FOR A 50-YEAR-OLD MALE

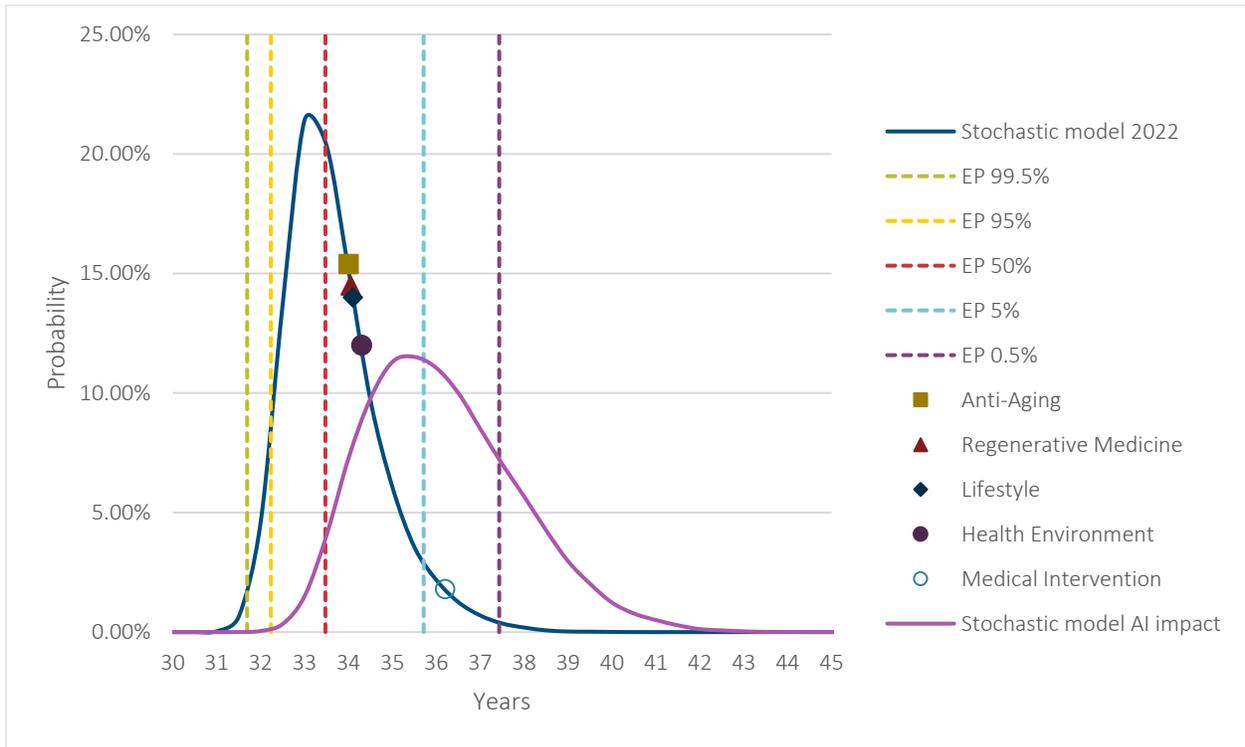
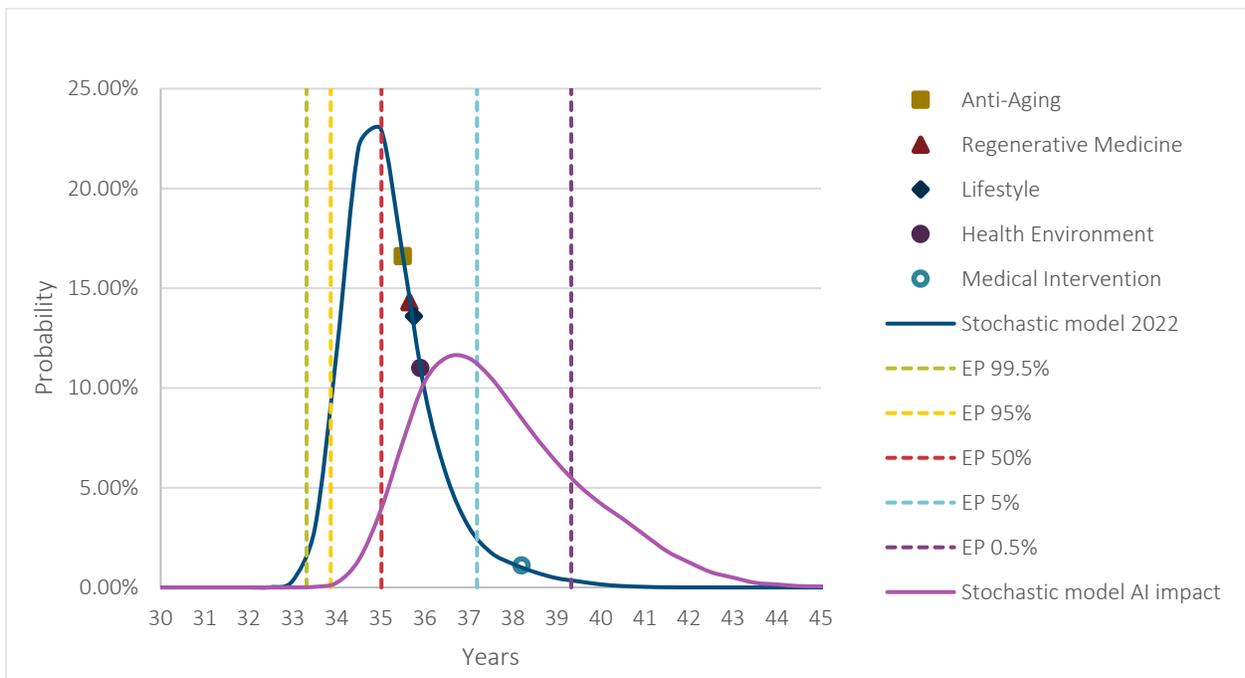


Figure 2
LIFE EXPECTANCY DISTRIBUTION FOR A 50-YEAR-OLD FEMALE





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APPENDIX

SOA Mortality Table	Pri2012_Total_Employee	Pri2012_Total_Employee
Rolled forward to 2019	Pri_2012_2019_F	Pri_2012_2019_M
Sex	Female	Male
20	0.0002	0.0006
21	0.0002	0.0006
22	0.0002	0.0006
23	0.0002	0.0006
24	0.0002	0.0006
25	0.0002	0.0006
26	0.0002	0.0007
27	0.0002	0.0007
28	0.0003	0.0007
29	0.0003	0.0007
30	0.0003	0.0007
31	0.0003	0.0007
32	0.0003	0.0008
33	0.0003	0.0008
34	0.0003	0.0008
35	0.0004	0.0008
36	0.0004	0.0008

SOA Mortality Table	Pri2012_Total_Employee	Pri2012_Total_Employee
Rolled forward to 2019	Pri_2012_2019_F	Pri_2012_2019_M
37	0.0004	0.0009
38	0.0004	0.0009
39	0.0005	0.0009
40	0.0005	0.0009
41	0.0005	0.0009
42	0.0006	0.0009
43	0.0006	0.001
44	0.0006	0.001
45	0.0007	0.001
46	0.0007	0.0011
47	0.0008	0.0011
48	0.0008	0.0012
49	0.0009	0.0013
50	0.0026	0.0047
51	0.0029	0.0049
52	0.0031	0.0052
53	0.0034	0.0055
54	0.0037	0.0059
55	0.0041	0.0063
56	0.0045	0.0068
57	0.0049	0.0073
58	0.0053	0.0078
59	0.0057	0.0083
60	0.0061	0.0088
61	0.0065	0.0092
62	0.007	0.0095
63	0.0074	0.01
64	0.0078	0.0104
65	0.0083	0.0111
66	0.0088	0.0119
67	0.0095	0.0128
68	0.0102	0.0139
69	0.0111	0.0152
70	0.0122	0.0166
71	0.0135	0.0183

SOA Mortality Table	Pri2012_Total_Employee	Pri2012_Total_Employee
Rolled forward to 2019	Pri_2012_2019_F	Pri_2012_2019_M
72	0.015	0.0201
73	0.0168	0.0223
74	0.0189	0.0247
75	0.0213	0.0274
76	0.0241	0.0305
77	0.0273	0.034
78	0.0308	0.0381
79	0.0348	0.0427
80	0.0392	0.0479
81	0.044	0.0539
82	0.0493	0.0605
83	0.0552	0.068
84	0.0618	0.0764
85	0.0692	0.0859
86	0.0776	0.0965
87	0.0869	0.1084
88	0.0973	0.1216
89	0.1089	0.136
90	0.1219	0.1517
91	0.1352	0.168
92	0.149	0.1848
93	0.1634	0.2016
94	0.1781	0.2185
95	0.1933	0.2354
96	0.2095	0.2536
97	0.2264	0.2721
98	0.2441	0.2909
99	0.2623	0.31
100	0.2811	0.3292
101	0.3004	0.3485
102	0.3197	0.3676
103	0.3391	0.3863
104	0.3583	0.4045
105	0.3772	0.4222
106	0.3957	0.4392

SOA Mortality Table	Pri2012_Total_Employee	Pri2012_Total_Employee
Rolled forward to 2019	Pri_2012_2019_F	Pri_2012_2019_M
107	0.4137	0.4554
108	0.431	0.471
109	0.4477	0.4855
110	0.4635	0.4947
111	0.4786	0.4958
112	0.4927	0.4969
113	0.4987	0.4978
114	0.4993	0.499
115	0.5	0.5
116	0.5	0.5
117	0.5	0.5
118	0.5	0.5
119	0.5	0.5
120	1	1