# Longevity medicine: upskilling the physicians of tomorrow

Longevity medicine is advanced personalised preventive medicine powered by deep biomarkers of aging and longevity, and is a fast-emerging field. The field encompasses the likewise rapidly evolving areas of biogerontology, geroscience, and precision, preventive, and functional medicine.

With modern advances in artificial intelligence and machine learning, biomarker research and drug development have produced numerous tools for early diagnostics and prevention of communicable and non-communicable diseases, which remain largely unknown to the global medical community.[1–4] This unawareness is mainly due to a complete absence of structured, pedagogically-concepted educational resources tailored to specific audiences, primarily consisting of physicians, biotechnologists, and public health professionals. The notion of longevity and healthy aging as a major priority for healthcare will undoubtedly substantially impact primary, secondary, and tertiary prevention. Therefore, it is essential that practicing doctors have access to the appropriate education through a credible curriculum in longevity medicine.

The development of longevity-focused medical practices greatly depends on bridging the gap between health-care providers and interdisciplinary experts, such as academic biogerontologists, artificial intelligence experts, computer scientists, and informaticians. Health-care providers require customised courses on the most recent advances in longevity medicine and on how this knowledge can be implemented in the practice. Patients have insufficient access to the health-care providers who have been adequately trained in longevity medicine and can manage a patient from a longevity medicine standpoint. Viable longevity education with practical translation will thus ultimately improve health-care systems worldwide and decrease disease occurrence by training health-care providers to tackle the most common and strongest contributor of disease—unhealthy aging. Longevity medicine combines best practices from various fields and uses leading-edge innovations, such as deep learning and artificial intelligence to evaluate the patient's biological age throughout the course of life. Longevity physicians are looking for ways to reduce the gap between the current parameters (current biological age) and the parameters of optimal maximum physical performance (the ideal biological age, predicted by deep learning).

Aging is a complex multifactorial process leading to loss of function, rendering people prone to most diseases.[5] Many genetic and epigenetic changes implicated in aging and longevity are associated with aging in model organisms.[6] Even though their mechanisms in human aging are not fully understood, many of these changes are also associated with non-communicable, mostly chronic diseases in humans.[7,8] The unprecedented increase in the proportion of people over 65 years across the global population and the increase in illness, and social and economic burden associated with aging require educated physicians who are knowledgeable about the multifaceted healthy longevity approaches, commencing with fundamentals of biogerontology and artificial intelligence-based technologies that are applicable in individualised patient care. Adequate curricula on aging and longevity biotechnology encompassing and explaining the complexities of those fields are an essential foundation to differentiate the burgeoning longevity medicine from anti-aging and prolonging life. Equipping health-care providers with tools of obtaining and utilising an individualised precision dataset of each patient not only reduces the risks of the patient developing diseases, but mitigates and even eliminate diseases, and customises optimal preventive and therapeutic approaches.[9]

The rapid deployment and development of artificial intelligence-based medicine demand a response from global interdisciplinary consortia to develop longevity medicine curricula. Interest in aging research among the medical and drug discovery community has rapidly increased. The popular non-profit free conference Aging Research for Drug Discovery saw record physician attendance in 2020 with over 2000 delegates.[10] Academia is now actively seeking collaborations with artificial intelligence experts who engaged in creating educational content. Several universities implemented extracurricular webinars series. However, it was not until 2020 when the first curriculum for physicians was created by a team of scientists and clinicians led by the artificial intelligence and longevity scientist and entrepreneur, Alex Zhavoronkov. This translational medicine course allowed physicians interested in both theoretical and practical aspects of

longevity to gain the fundamentals in the field, including theories of aging, biomarkers of aging, molecular mechanisms, and geroprotector regimens. Courses such as this course serve to close the detrimental knowledge gap and provide an overview of clinical applications of recent advances in aging research, skills to evaluate the validity of biomarkers of aging and other biological age testing systems, and knowledge of the available longevity therapies to tackle diseases related to senescence-related processes in the organisms. It implies bridging biogerontology, machine learning, differential diagnosis, omics, geroprotective interventions, drug design, and health-care organisations informing advances in these research areas while giving examples of their implementation into clinical practice.

Aging is the greatest risk factor for most acute and chronic diseases. Previous decades have shown that we are now on the cusp of being able to intervene in the aging process, probably allowing us to decrease overall mortality and morbidity rates in elderly individuals. Although this progress has mostly occurred at the academic level, there is now a great need for expanding this knowledge into the realm of clinical practice. With this Comment, we hope to encourage this necessary step towards implementation of longevity education for health-care providers worldwide.

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