



International Center  
for Scientific Debate  
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## Synopsis

# BIOENGINEERING FOR HEALTHY AGEING

## ADDING LIFE TO YEARS

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# BIOENGINEERING FOR HEALTHY AGEING. ADDING LIFE TO YEARS

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On November 9, 2017, researchers from around the world met for a B-Debate session to debate the role of bioengineering in active ageing. The World Health Organization (WHO) estimates the number of people over 60 will double between 2000 and 2050. In addition, that, by 2050, one in five people on the planet will be over 60 years old.

Seniors have more illnesses than the rest of the population. And, furthermore, they often have chronic diseases that can be very incapacitating. In this context, bioengineering can offer many solutions in various areas, like mobile apps, care robots, new diagnostic tools and regenerative medicine solutions.

However, many questions remain unanswered and experts tried to do so in this latest edition of **B-Debate**, [Bioengineering for Healthy Ageing. Adding Life to Years](#), an initiative of [Biocat](#) and the ["la Caixa" Foundation](#) to promote scientific debate, organized jointly with the [Institute for Bioengineering of Catalonia \(IBEC\)](#).

## CONCLUSIONS

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- The ageing population is a proven trend, which will mean that, **by 2060, one in three Europeans will be over 60**. Among other implications, the total spending on long-term care will double.
- Among the new approaches that are being used to tackle this challenge, healthy ageing stands out. This aims to allow **citizens to live independently and self-sufficiently for many years**, preferably in their own surroundings.
- Another increasingly important concept is **high-definition medicine**, which focuses on health, patients and prevention instead of disease.
- **Bioengineering has many solutions to offer in a variety of areas**, like biosensors and devices, mobiles, care robots, new diagnostic tools and cardiac and organ regenerative medicine, among other areas.
- There are many challenges to tackle, like **ethics, getting various stakeholders involved and open science**. And barriers, like privacy, trust, functionality and value added, cost, and suitability and ease of daily use.

- The values underlying responsible research and innovation could be a good guide for the self-reflection process to make **research and innovation in health more open and transparent.**

## 1. CHALLENGES AND OPPORTUNITIES FOR AN AGEING POPULATION

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Kicking off the event, [Josep Samitier](#), of IBEC, highlighted that **one in three Europeans will be over 65 by 2060**. This figure will mean the ratio of people working to the unemployed will go from 4:1 to 2:1. Another noteworthy fact is that, between 2010 and 2060, total government spending on pensions, healthcare, long-term care and unemployment benefits will rise by more than four percent of the GDP. And, as he stressed, total spending on long-term care will double.

“There are many questions to answer. What is a healthy lifestyle? What is your definition of health? Do we need more technology? Is it better to have more technology? How do you want to age well? To what extent are diagnosis and treatment tied? What is the value of diagnostics on its own?,” he asked.

For [Carol Brayne](#), of the Cambridge Institute of Public Health of the University of Cambridge, the debate starts with the concept of healthy ageing. And this, sometimes, is also known as successful or active ageing.

“A generation shift is occurring in health, with expectations that are always constantly changing within the cohorts. And the evidence is still not particularly well integrated into fields like gerontology, demography, neuropsychiatry and neurology, neuroscience, epidemiology, etc.,” she listed.

This is why, she believes, the role of population-based studies is gaining ground, “as research is being done to see how different disciplines, and their findings, are associated with the population from neutral, non-filtered points of view, ensure representation in evidence and test new and old concepts, including healthy/active/successful/satisfied/full ageing. Plus, they are a test of the true change over time and of how new concepts are incorporated into old ones. And, finally, they provide updated basic knowledge to develop policies and set up services. The controversy focuses on the changes in ageing, the context, future generations and sustainability, among other issues.”

[Somnath Chatterji](#) of the WHO reviewed this body's global strategy: a commitment to monitoring ageing and health on a national and global level to focus research on the implications of public health on ageing. In terms of the impact of disease, we need better strategies to quantify life expectation in the elderly to measure progress.

At the same time, the European Innovation Partnership on Active and Healthy Ageing has kicked off. This initiative aims to increase healthy life expectancy of EU citizens by two years by 2020. The plan has three focal points: improving health and quality of life, supporting long-term sustainability of healthcare and social systems, and promoting growth and improvement in the industry.

From his point of view, future trends will focus on the environment's impact on functionality, incorporating additional biomarkers, improving methods for analyzing and measuring, and identifying interventions to change the path of ageing.

## 2. TOWARDS HIGH-DEFINITION MEDICINE?

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Another recent concept that will be key in the future is **high-definition medicine**, reminded [Josep Roca](#), of Hospital Clínic Barcelona. This is defined as **adopting technology that can measure multilevel health parameters longitudinally at high resolution**. They are paired with dynamic repositories of knowledge and sophisticated analyses to feed support systems for decision making among citizens and professionals.

This approach comes with challenges in terms of implementation. Among others, these include developing an infrastructure that can sustain a digital health framework (DHF), generating evidence and implementing it in science, generating value, financial incentives for innovative business models, novel regulatory and approval frameworks, and empowering people and putting together multidisciplinary teams.

"We'll go from focusing on disease to focusing on health; from basing our work on organs to basing it on a system; from dealing with disease to focusing on patients and prevention; from reactive to proactive care; and from a universal approach to a personalized one. And we'll have to review the taxonomies of disease. Another relevant change is that we need healthcare that is predictive, instead of reactive: we will prevent, or limit the impact of the illness by evaluating health risks. This will allow for early detection, with cost-effective interventions. We're in for a long, exciting ride," he predicted.

### 3. GROWING ROLE OF ROBOTICS

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Robots have huge potential to improve quality of life in the final years, as explained [Tony Prescott](#), of the University of Sheffield. "The future will be an ecosystem of connected care: robotics, along with telehealth, will provide care at home, in residences and at hospitals. Home is key, people prefer to age in their own surroundings according to our data. People over 65 spend more than 80% of their time at home. This goes up to more than 90% in people over 85," he highlighted.

Prescott stressed that we must remember that robot care isn't a substitute for human care. But robots, among other activities, can provide additional physical and social support, help people live longer at home, help the elderly help others or make care-givers more efficient.

"They will also allow these professionals to focus on the more human aspects of their job, creating a profession with more skills and that will allow care-giving to be more enriching. And they will lower the number of cases of injury care-givers suffer as a result of some of the physical aspects of their job. I also think that it will help because there is a shortage of skills-trained professional care-givers," he summed up.

Finally, he insisted that the robots of the future don't necessarily have to look human-like, as can be seen in some of the help robots already on the market.

In this field, a new paradigm of 'soft' robotics is coming to dominate, explained Cecilia Laschi, of Sant'Anna School of Advanced Studies in Pisa. While the traditional approach to personified intelligence focused on the brain and central processing, the current approach looks to interact with the environment and for cognition to emerge from interaction between the system and its surroundings.<sup>3</sup>

"Robotics can make behavior adapt to do its job better: greater safety, efficiency, effectiveness, robustness and flexibility, among other characteristics, doing more than is possible today," she said.

Plus, the expectations are very promising: sales of service robots between 2016 and 2019, are expected to hit \$45 billion. According to the International Federation of Robotics (IFR), over this same period, 1.4 million industrial robots will be installed in factories and an estimated 333,000 service robots will be sold in both manufacturing and non-manufacturing sectors. And 42 million of this type of robot will be sold for personal and domestic use in our private lives.



## 4. REGENERATIVE TREATMENTS APPLIED TO AGEING

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**Regenerative treatments applied to ageing is a very promising field.** Elena Martínez, of the IBEC, reviewed the development of human heart builds that work like tissue, allowing for cardiac regeneration.

“We have to remember that cardiac diseases are the number one cause of death and morbidity in the world. And that heart tissue has minimal capacity to repair itself, so we need technology that promotes either repair or regeneration: engineering heart tissue allows us to generate 3D myocardial tissue to repair damaged areas,” she summed up.

As for [Núria Montserrat](#), of the IBEC, she went over the state of organ regeneration, which may have hope for regenerative medicine. Research is focused on combining pluripotent stem cells in animal models for in vivo reprogramming and regeneration and on tissue engineering.

## 5. WHAT WILL 2.0 IMMEDIATE DIAGNOSTICS BE LIKE?

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[Emmanuel Delamarche](#), of IBM Research, broke down the results of a report on 1,300 seniors. The most noteworthy conclusions are that more technology is needed for immediate diagnosis (“at point of care”), with more tests in doctors’ offices and fewer done at hospitals, given the mobility difficulties of these individuals.

Furthermore, more precise, detailed diagnostic tests are needed, specifically for chronic diseases, and technology to improve adherence to medication schedules. **“We should add a patient contextual model to the psychological data, using cognitive technology,”** he added.

Mobile diagnostic devices and sensors that help with healthy ageing are another great business opportunity, explained [Anthony Turner](#) of the University of Linköping, Sweden: the Wearable Technology report puts figures for this sector at one million billion<sup>5</sup>.

“These devices empower users, who can efficiently manage their health anywhere, anytime, giving them the confidence that their data and any automatized actions are totally secure,” he highlighted.

An implicit part of this vision is the ability to provide advanced information management with real-time measurements regarding individuals and their environment. And, as

Professor Turner noted, the recent boom in wearable sensors has highlighted the potential of ongoing measurement and users' desire for personalized information.

In his opinion, the main bottleneck today in this area is the availability of reliable sensors that directly measure key biochemical parameters, which are essential for high-level algorithms for personalized health management.

"It is clear that biosensors for personalized health management will be important in the future. This is why we need to attract engineers, clinicians, managers and companies with new business models to implement and drive effective paths together," he concluded.

## 6. DESIGNING THE FUTURE

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The ethical aspects were covered by [Ignasi López](#), of the "la Caixa" Foundation. "There are many challenges to tackle. Ethics is important in a health-based citizen approach but it isn't the only challenge. We can't forget about involving other stakeholders or open science," he reminded.

He believes the values underlying responsible research and innovation "seem to be a good guide for the self-reflection process to make research and innovation in health more open and transparent." Other pending challenges are the many barriers to the acceptance of advanced technology for healthy ageing. [Tony Prescott](#), of the University of Sheffield, named privacy, trust, functionality and value added, cost, and suitability and ease for daily use, among others.

**"If we're talking about the elderly's perception of technology, the relationship is complicated and ambivalent:** technology can help promote participation in society, but it can also exclude and stigmatize them. The reason is that, generally, technology isn't neutral and exists within complicated social relationships," he warned.

Finally, [Totti Könnöla](#), of the Insight Foresight Institute in Madrid, went over three possible scenarios for 2030. As he indicated, the perfect situation would be for the government to move into a supervisory role, overseeing healthcare results and enforcing compliance with soft methods. Their direct intervention in healthcare (and funding it) would be significantly reduced, except in the case of acute illnesses.

In the second scenario, considered transitional, **social gaps in terms of access and trust remain**. And the role of healthcare-related governmental institutions and basic

funding mechanisms haven't changed, but rising costs are, de facto, eroding universal public coverage.

**The third and final scenario would be one in which the responsibility for a healthy society is shared.** In this case, although healthy attitudes and behaviors are predominant, the acute management crisis would lead the government to retain, increase control, directly fund and produce all healthcare services. This helps reach high levels of public funding for healthcare expenditure with little or no trust in the private sector.

"Governance in personal healthcare ecosystems is transforming: all stakeholders have a role to play. To grow the ecosystems, we have to think in terms of platforms and accept the disruption. And federate and coordinate them," he concluded.