

The future is now: The Fifth Industrial Revolution has reached the biomedical and health sciences

El futuro es ahora: la Quinta Revolución Industrial ha llegado a las ciencias biomédicas y de la salud

To the Editor:

It is frequent to hear in academic circles and the media that we would go through a Fourth Industrial Revolution (4IR). This 4IR comprises intelligent factories, where production systems, components and people communicate through a network, and manufacturing is almost independent¹. However, the world is changing dizzyingly fast between one revolution and another. Global socioeconomic tensions, armed conflicts, scientific advances, the challenge of climate change and, especially, the recent COVID-19 pandemic² are catalysts for a rapid transition from the Fourth Industrial Revolution to the Fifth Industrial Revolution (*i.e.*, jump from 4IR to 5IR or Society 5.0). This revolution implies that humans and machines interact and discover ways of working together to improve resources and production efficiency¹, a collaboration involving a significant component of artificial intelligence (AI). This *Letter to the*

Editor highlights how this Fifth Industrial Revolution impacts the various fields of health sciences, biomedical engineering and healthcare.

The technological advances of the last few years, especially the technology based on 5G (*i.e.*, the fifth-generation mobile network as a global wireless standard designed to connect practically everyone and everything), will play a vital role in developing the digital society in the next five years³. COVID-19 pushed this change, a pandemic recognized as a determining factor for social and institutional development³. COVID-19 has been a true catalyst. Some authors² mention that the Fifth Industrial Revolution has already risen to the stage as a protagonist amidst this pandemic². The concept of a super-intelligent society comprises advanced information technologies, including AI, the internet of things and *cobots* (*i.e.*, collaborative robots) that manufacturers will use in industry, health and other sectors. Enormous data generation and availability can transform society into a human-centric society. Thus, these authors² mention that the fifth step in humanity's evolution can undoubtedly begin amidst a global health crisis like the one we observed in this pandemic².

What advances is this Fifth Industrial Revolution bringing to the medical field worldwide? (Figure 1) Industry 5.0 will generate a much more personalized

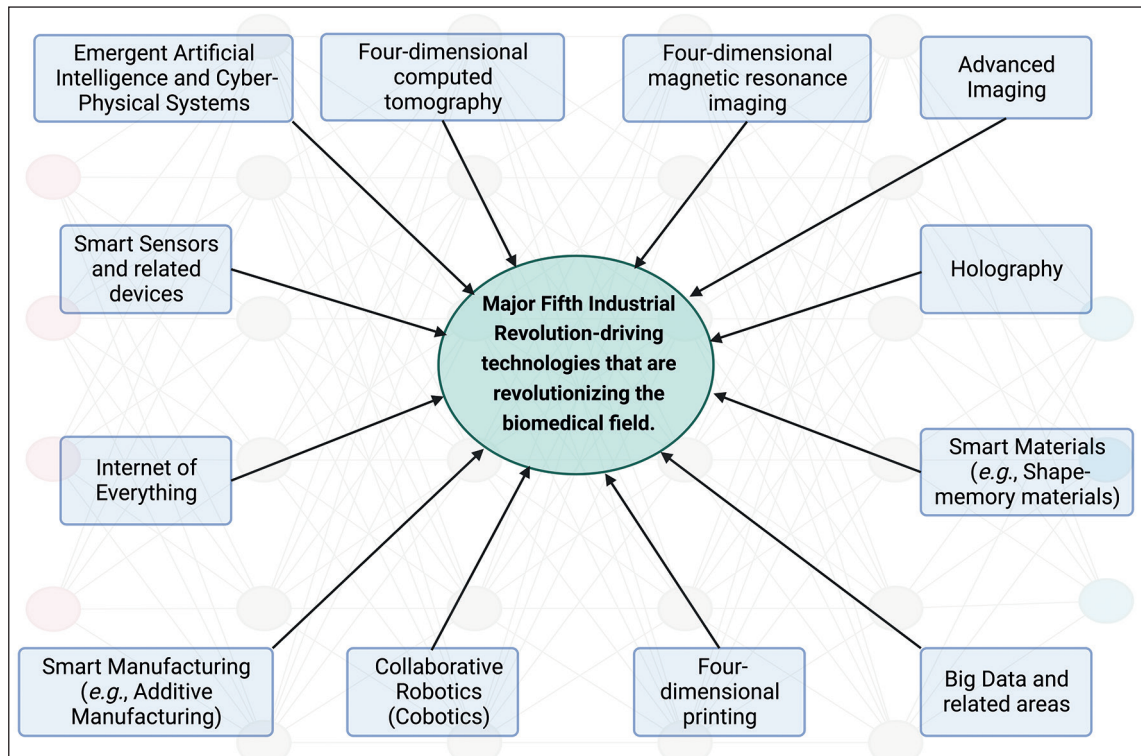


Figure 1. Industry 5.0 technologies in biomedicine. Adapted from Haleem and Javaid⁴. Created with BioRender.com.

medical provision with products and services specifically oriented to the requirements of patients and customers^{4,5}. Personalization includes devices that can meet specific requirements, *e.g.*, measuring multiple physiological variables⁴. Wearable technologies provide healthcare professionals with real-time patient health information, storable in individual or group medical record⁴. These smart devices can communicate, and physicians can provide the appropriate medication based on individual patient requirements⁴. This revolution involves *cobots*, used to perform complex surgeries⁴. The surgeon may benefit from this collaborative robotics technology. In particular, AI developments are the underpinning technology for AI-assisted image interpretation, AI-assisted diagnosis, and AI-assisted prediction and prognosis⁵.

What is being done in Chile regarding the transition from 4IR to 5IR, for example, in medical equipment? Implementing digital transformation has meant adopting measures that allow the integration of existing technologies in medical equipment with the rest of the institutional digital systems. It needs elaborating technical specifications for acquiring new equipment that includes communication standards, which allow them to be interoperable and secure, one of the critical characteristics that institutions recently acquired equipment want to have. This last feature represents an advantage in monitoring since it allows us to follow and display ventilatory and hemodynamic variables simultaneously. It also allows, for example, a neonatal patient to transfer to surgery without the need to disconnect the monitoring equipment from the patient's body, attach the module to the existing anaesthesia machines in the central wards of a hospital, allowing the patient's data to be uploaded to the latter without losing the traceability of their vital signs. In addition, some hospitals are moving towards a new electronic record where the patient data obtained from the monitoring centres will be integrated. Work is in progress regarding identifying clinical processes associated with medical equipment where through AI, the data retrieved from the equipment is used, for example, to streamline workflows, optimize the quality of diagnosis and help guarantee efficiency, reliability and sustainability of clinical services. Chile's future is promising in this area³.

In conclusion, we are going through the 5IR. This fact has substantial consequences since educational institutions in charge of healthcare providers' training shall have to carry out profound curricular innovations to promote the new skills required by the 5IR in this area, such as training using clinical simulation⁶, teaching big data in health, AI science, and collaborative

medical robotics, amongst other topics —*e.g.*, the One Health approach. Health institutions should train their employees. The Fifth Industrial Revolution poses many challenges^{1,3}, but positive developments can come with progressive adaptation to these changes. The future is now.

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