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Editorial

Artificial Intelligence Applied to Evidence-based Surgery☆

Inteligencia artificial aplicada a la cirugía basada en la evidencia

Biomedical research production continues to grow exponentially. Each day, some 300 million pages are transferred online, representing 4 000 000 articles from 40 000 journals. It would take 5 years to read the information generated in 24 h. In this situation, attempting to process the never-ending flow of data could lead to mental block, threatening the expansion of scientific knowledge and acting as a ''biological limit''. However, the most powerful tool since the personal computer will soon make its debut: artificial intelligence (AI), developed with programs inspired by the human capabilities of feeling, learning, reasoning[1] and acting appropriately within a human environment.[2]

Thanks to the progressive increase in computing capacity, this ''neuromorphic'' type of computing is able to work with massive amounts of data, or ''big data'' (BD), promoting new capabilities like language processing or deep learning. As a result of this amazing development, research initiatives are underway, such as the ''one-hundred year study on AI'' by Stanford University since 2014,[3] or the Deep Patient project at Mount Sinai Hospital in New York using data from 704 587 patients to create diagnostic models with significantly better predictive results.[4] Researcher Katja Grace at the University of Oxford predicts that AI will outperform humans in about 45 years, conquering retail commerce by 2031, best-selling literature by 2049 and surgery by 2053.[5] In 2016, the Obama administration produced a thorough report to prepare for the future in an AI environment.[6,7]

Furthermore, the explosion of BD from digital platforms that generate biometric sensors and their applications (and soon the inexpensive sequencing of the human genome), promises new treatment options given the understanding of complex bioprocesses. In surgery, the Verb Robot combines automatic learning, robotics and augmented visualization.[8] ''Environmental biometrics'' promises to revolutionize patient follow-up and diagnosis, being the ideal substrate for ''quantum computing'' (QSC) as it is capable of working with qubits of 3 variables per unit of value: 0, 1, and indeterminate (thus breaking through the current limitations of digital calculation).[9] It also unlocks the possibility to improve patient health (basically, everyone who is connected to the Internet) and transform the healthcare sector according to the ''6D'' algorithm of the chain reaction of technological progress (Digitalized, Deceptive, Disruptive, Demonetized, Dematerialized, Democratized), according to which knowledge, when digitized, behaves like an information technology, acquiring exponential growth (with an initial Deceptive curve that later becomes Disruptive), and Demonetized, meaning reaching zero cost, thereby becoming Dematerialized and, by becoming virtual, Democratized as it is available to everyone.[10]

The pace of innovation will inevitably accelerate, forcing us to change our evidence-based surgery practices. As other digital platforms offer their services without offices, AI will be able to provide support for clinical decisions and management without a medical center, interacting directly with healthcare providers (virtual or in-person) and patients, who will be able to access their data like the medical staff. At this point, the recent related article by Fingerhut and Sarr should be mentioned, which refers to the need for normalization of the language used in scientific literature in order to systematize the degrees of evidence as well as the levels of recommendation used in conclusions.[11] Besides the fact that a consensus would lay the foundation for sustainable and systematized reporting in the literature, it would also facilitate the reading of texts by AI programs, which is a key point. It has been estimated that, in the next 10 years, the intersection of AI, BD and QSC will result in a disruptive jump in the capacity to store and process information (again, the 6D algorithm). This will inevitably lead to the appearance of a ''global doctor brain'' capable of collecting, storing and processing all biometric information in real time, and even

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combining it with clinical and bibliographic data, thereby having the power to make scientific-medical knowledge evolve on its own. We will probably stop creating databases to simply extract the answers to our questions directly from the network, even before asking them. The unlimited access to global knowledge in real time by the same users, not to mention practice in intelligent environments, will change surgical practice forever.

Our role as surgeons may not be immediately threatened, but we will have to provide the context to interpret AI decisions and recommendations while managing decision-making algorithms. Thus, our experience and ''intuition'' will continue to be critical and, since our judgment skills will continue to be more advanced than computers in the near future, we must be involved from the beginning to ensure the reliability of the systems and limit the ''black-box'' effect. The most important universities and technology companies are devoting more and more resources to AI research and development. We should work in coordination with them to develop applications, while managing risks and advantages. It is therefore imperative to equip ourselves with the protocols, human teams and technology necessary to face such a challenge.

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