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Ideas and perspectives

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Respiratory Medicine of systems

Medicina respiratoria de sistemas

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In the late 1980s, I heard professors say: «90% of diagnoses are made with medical records». The challenge was, then, to integrate information. The information obtained in the medical record made sense after connecting the symptoms and signs, and the nosological diagnosis was establish. Currently, more than 30 years later, 90% of the diagnoses are established with additional studies, mainly imaging and often molecular. Technology has largely replaced clinical thought. That good medical record stopped being important and the Computer Tomography (CT) or the whole-body Positron Emission Tomography was introduced. There is no doubt that medicine has evolved, technology has allowed to practice more scientific medicine and less artistic; more precise, predictive, and even, personalized. Currently, in medicine as in science, we live the better times, but with an increasingly wide gap between what should be done and what is done in the social scope of medicine.

Medical practice has been based, for centuries, on the reductionist approach of science. Since Descartes, in the first half of the seventeenth century, science has been concerned with learning more about the components of the system. That is to say, that the individual elements have been the protagonists in the long and difficult path of reductionism. Although it was successful, reductionism felt short in the understanding of the biological systems. The Human Genome Project, probably far-reaching plan in the reductionist era of science, has failed to fully understand the functioning of the human body; and, yet again, the individual elements, even individual molecules do not explain the whole. Epigenetic is a good example of the importance of interactions. The medicine of systems is based on the interactions between its components, and not on the individual components. The system has emergent properties that derived from precisely the bidirectional, complex and simultaneous interaction between its elements. In axiomatic words; the system (the whole) is much more than the sum of its parts.

The opposite of reductionism is the approach that integrates; joins, interacts, connects. We are returning to see the macro, from a distance, through the integrative approach of science. The development of science has been a continuum. In other words, the path of reductionism has been necessary to understand that the molecular knowledge is not enough to understand the whole. The connectome is the map of connexions, of interactions.

Our brain works based on «reference frameworks». According to Jeff Hawkins,[1] those reference frameworks are used by our brains, by thousands or by hundreds of thousands, to construct the reality of our world. What we perceive as reality is a brain construct based on reference frameworks. In a simpler form, medicine is also based on reference frameworks or patterns. We recognize patterns to identify diseases. But, again, patterns or diseases are half-truth. In that recognition of patterns more and more subpatterns have been identified and we have created the phenotypes, endotypes, etiotypes of diseases. Supporting the concept of «patterns» might not be the best solution. We might have to understand and implement the model

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of interactions and make way for the medicine of systems where each variable (genetic or epigenetic) will have a specific and dynamic contribution in the pathophysiological process. How truth in that phrase: «there are sick people (systems), not diseases (patterns)». Let's leave behind the model in which a pattern was made fit to a subject; better let's analyze the way in which the variables (the elements) interact to create the biological reality of an individual.

Artificial Intelligence (AI), a technological process that aims to simulate human intelligence, has contributed in a significantly to the understanding of the biology of the systems. Nonetheless, AI requires being feed with information; in other words, the computer needs -to learn- to create predictive models. In its progressive and inexorable path towards improve its predictive ability, AI will be -or is it?- the primary provider of health services and eventually, it might replace clinical human reasoning with its almost infinite algorithms to generate diagnoses and to establish treatments and prognoses. Even more, robots with their intelligence -even if it is artificial- it will be the surgeons the ones who will flood the operating rooms around the world and, thus, the human reasoning could be less and less necessary. I do not doubt that human reasoning will be replaced by the, hopefully sufficiently intelligent, reasoning of machines. It is very likely that if we attend to the conclusions of AI, we will obtain better results for the common and individual good than those we would obtain from human reasoning. What I am not sure about whether the machines can deal with the absence of information; I mean, the models derived from AI work with what exists, with data, with evidence, with information; but, what if in the clinical exercise we must deal with what does not exist? For example, with the uncertainty? In AI, the total is equal to the sum of its parts; in natural intelligence, the total is not equal to the sum of its parts.

The artistic part of medicine is reduced today, I believe, to the management that we give with to the non-existent, to uncertainty. It is possible that human intelligence outweighs the artificial intelligence when there is no data that can provide certainty. AI works with data, not with an absence of data. On a smaller scale, this can be illustrated by the multivariate models that we frequently find in scientific publications. Let's say you build a mathematical model from certain variables to predict lung function. This model, when it takes into account the sex, height and age, will give us inevitably a prediction that will have a certain degree of imprecision, of error. The better the determinants of respiratory function are known, the grater the accuracy of the model. At the time, thanks to the contributions of Newton and others, the laws of classical mechanics were known and astronomical phenomena were predicted in seconds. On the contrary, if all the determinant factors of climate are not fully known, the models cannot be fed to generate sufficient accuracy in their predictions. That is, the prediction fails if there are gaps in the models. Clinical practice is full of gaps; of things that are missing. In terms of the symptoms, which are the most frequent reason why people go to the doctor, are, ultimately, sensations that each subject experiences differently. The symptoms derive from the effect of a stimulus on our consciousness; How many gaps can there be in this process so subjective as to be able to take it to a mathematical model for predictive purposes? How is the connection map (connectome) when aspects such as dyspnea, cough, precordial oppression, or even more subjective such as fear, anxiety, depression, quality of life, insomnia are included in the covariates?

I know little about the theories of education, but I witness that the medical student and residents are bombarded with diagnostic and therapeutic processes based on algorithms as if the implementing of algorithms were what makes the doctor. In the creation and implementation of algorithms, AI has a wide advantage. We cannot, nor should we train medical «algorithmologists»; they are going to be overtaken very soon (or they are being overtaken) by AI. For the doctors who pride to be one, AI will be a tool that allows them to make their work more efficient; for the rest, AI will be their substitute.

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