EDITORIAL COMMENT

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Clinical research and artificial intelligence

Technological evolution has enabled the exponential development of powerful algorithms for data search, filter, selection, and optimisation, among other applications. Rapidly, it was possible to realise that as long there is a sufficient amount of information, it is possible to improve the solutions of these algorithms heuristically. Furthermore, hardware and software developments and virtual computers also go along with this growth. Additionally, it provided researchers with material that potentiated and empowered the highly flexible computational change in many scientific areas in which clinical research stands out.

In this context, new concepts have emerged that have been improved over time due to the increase in computational capacity, the speed of reading data, and the constant downloading of information online. The evolution of the intelligent algorithms also had different durations over time, i.e., what in 30/40 years it took to create the "intelligent machine", the result of the Turing machine. In recent years, computational algorithms have evolved to high complexity levels of Artificial Intelligence (AI) (Figure 1).

Artificial Intelligence appears in the field of computer science. These algorithms become capable of recognising a problem in a clinical area of investigation, choosing variables, processing and analysing data, and making decisions. The connection to Machine Learning results from the recognition effect of certain variables associated with specific actions by the user/patient/object. Consequently, they started to confer autonomous decisions of the programs by learning the association between the action and the variable/information. Moreover, through the variable/patient association, the development of this logic increasingly conferred the concept of "intelligence" to these algorithms, which led to programs with exceptional outputs.

Suppose we add higher-level associations (at least more than three variables simultaneously) associated with an action/output/outcome. The learning effect described above becomes highly complex because we enter the sphere of combinations of variables associated with an action/outcome. In this sense, AI has evolved to Deep

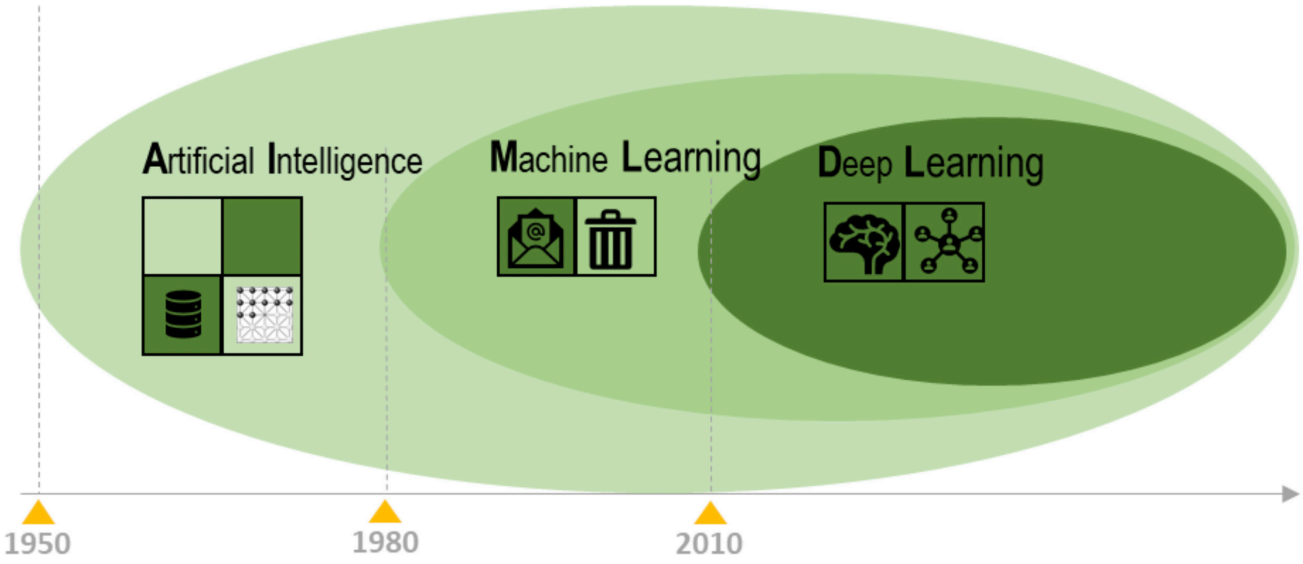

Figure 1 *General view of the chronology of intelligent algorithms.*

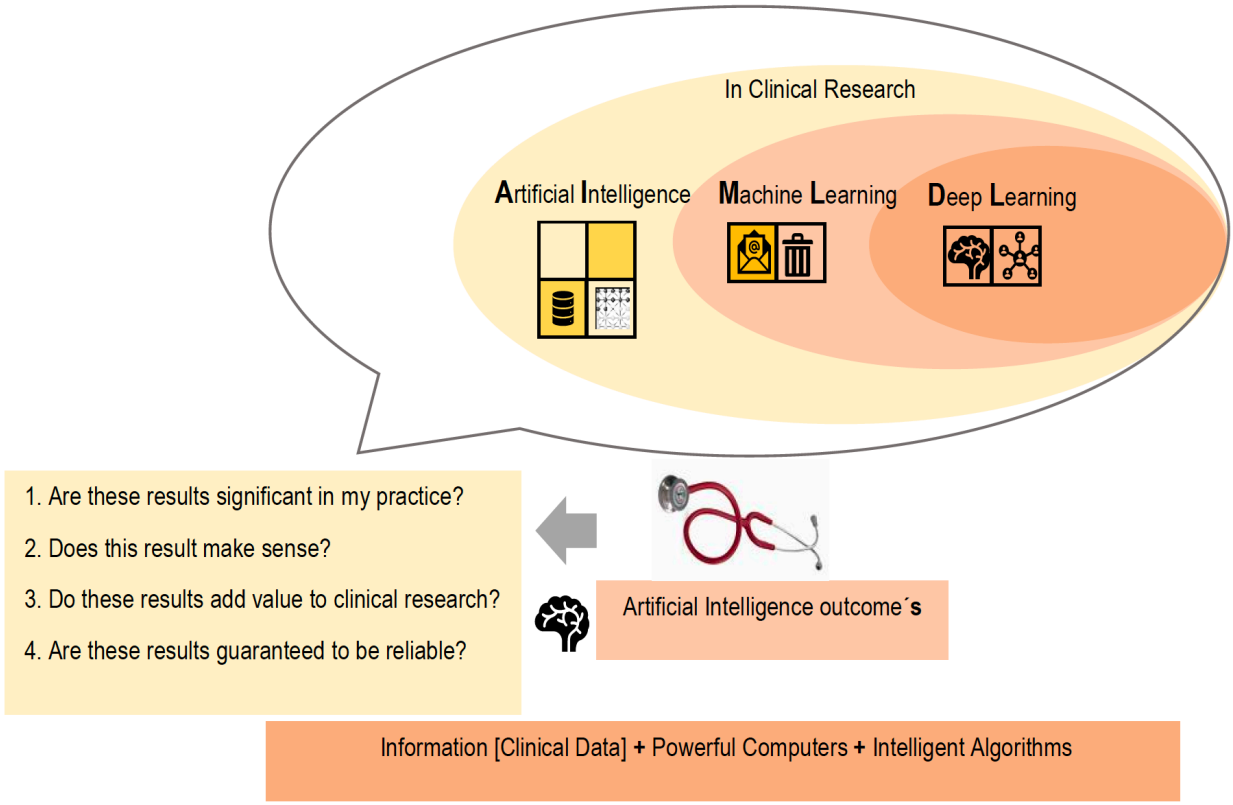

Figure 2 *Infographics of the clinician's role in AI outcomes.*

Learning where latent associations, never perceptible to humans and straightforward understanding, become visible and treated very refinedly.

However, AI by itself is no silver bullet. It combines computer programming, databases, algorithms, and other subjects from computer science, with other scientific fields such as mathematics, statistics, and operations research, with the main domain, medicine. Therefore, the requirement of specific knowledge in Mathematics, Statistics, Computer Programming, Linear Algebra, Medicine, and other fields is essential for multidisciplinary teams to answer complex questions in medicine successfully.

Now it remains the question – Must we rely on algorithms that read, process, classify, analyse, and model data that explain/characterise pathologies?

All this reflection is important because we are aware that decisions based on data evidence are advantageous but must be carefully examined. However, we must be equally aware that no statistical-mathematical result obtained from intelligent modelling can not speak for itself without the proper validation from a clinician. Whatever the outcome is from the application of AI, even for ethical reasons, it should always be unveiled and validated by clinical judgement, performed by an accredited professional, such as a clinician (Figure 2).

At this stage, the evolution of the management and intelligent treatment of clinical data should be an object of careful analysis. This process must be supervised by clinicians and the researchers part of the multidisciplinary team. If one fails, these intelligent algorithms are worthless and false conclusions can be drawn.