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EDITORIAL

NATURAL AND ARTIFICIAL INTELLIGENCE IN BONE MARROW TRANSPLANTATION AND CELL THERAPY

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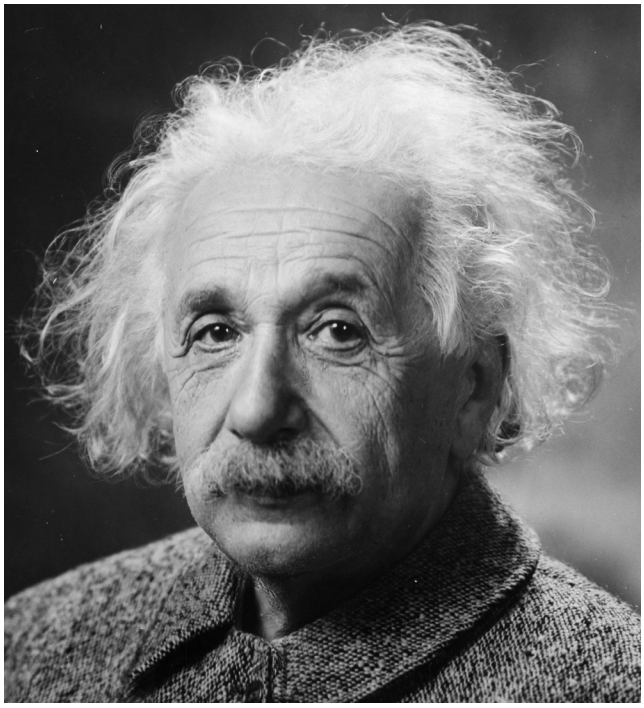
"The human spirit must prevail over technology"
Albert Einstein

Much has been said about the importance of artificial intelligence (AI) in our lives. What seemed to be the future is already present in our daily lives. Discussions on the subject permeate forums in all areas such as administration, IT, mathematics, law, engineering, science in general and as far as medicine and hematology are concerned.

We can divide AI into subsections: statistical models, machine learning (ML), simulation, and deep learning. In HCT, the most important utility of this is the ability to predict outcomes and better select donors, estimating the possibility of relapse, which is the main cause overall. Unfortunately, in Brazil, we must consider infection as the leading cause of death within 100 days post-HCT[1].

Another important concept that has emerged recently is Explainable Artificial Intelligence (XAI): a framework and tools to reveal predictions. All these tools together could improve the quality of patient care. This tool is especially important in predicting the efficacy of HCT in children, and we could use a dataset of statistical analysis using the "jamoving" application. ML to predict the efficacy of HCT in adult and pediatric patients and early death post-HCT. In the era of precision and personalized medicine, the use of AI methods, clinical support tools can improve patient care in complex clinical situations such as pediatric HCT. Donor and recipient age are crucial in HCT. The best chance of success is when the donor's age is between 18 and 35 years old, with 95% accuracy after using a chi-square test for feature selection. Optimization of Harris Hank appears to be the best technique. Additionally, four XAI techniques: SHAP, LIME, Qlattice, and Eli5, were used to make the models more accurate and interpretable. According to them, the most important parameters were relapse, donor age, recipient age, platelet recovery time, and presence of lymphoma[1].

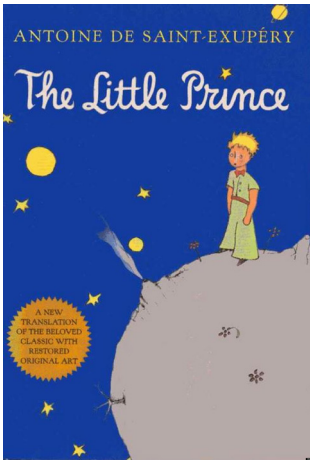


Albert Einstein, *German: (14 March 1879 – 18 April 1955) was a German-born theoretical physicist who is widely held to be one of the greatest and most influential scientists of all time. Best known for developing the theory of relativity,*

The concept of accumulating information to help solve and prevent complex problems is also part of the so-called natural intelligence (NI). It is common to discuss that older professionals are more experienced, perhaps due to the accumulation of important information in their memory that can eventually help resolve difficult situations. Often in discussions of clinical cases among health professionals, we ob-

serve examples of cases and situations experienced in the past resolving today's complex patients. On the other hand, we also witness the natural intelligence among some very gifted young professionals capable of not only citing articles they have read, but also the author, institution, scientific journal and, it would not be absurd, the publication page[2].

Artificial Intelligence (AI) has been developed for many years. Alan Turing wrote an incredible article in 1950 "Computing Machinery and Intelligency"[3]. AI is the ability of technological solutions to simulate human intelligence, carrying out certain activities autonomously and learning for themselves, thanks to the processing of a large volume of data they receive from their users.



- **Brave New World** *is a dystopian novel by English author Aldous Huxley, written in 1931 and published in 1932.[2] Largely set in a futuristic World State.*

- **The Little Prince** *is a novella written and illustrated by French writer, and military pilot, Antoine de Saint-Exupéry.*

In our opinion, natural and artificial intelligence are complementary and each benefits from the other. They are not competitive and artificial intelligence should not be frightening. It's here to stay. It's up to us to know how to make the most of it. In our area of Hematology, bone marrow transplantation and cell therapy, important resources and tools have already emerged that will certainly benefit our patients.

It is almost impossible for all of us health professionals to accumulate the scientific information published on a daily basis, medication leaflets, important lectures, data accumulated in patient records and decision support tools.

In the past, when the first computer resources appeared, one of the most heard phrases was "a good doctor is no longer the one who accumulates information, but the one who knows how to search for it". Today with artificial intelligence this has become easier[4].

One of the most interesting examples, for those who don't know, is "Isabel Active Intelligence". (www.isabelhealthcare.com). We learned from our teachers that one of the most assertive ways to correctly diagnose oneself is through the consideration of differential diagnoses. Well, this tool allows the professional to list, in order of probability, differential diagnoses from the most common to the rarest, based on signs, symptoms, laboratory and imaging test results. We also have other examples, such as image analysis through visual systems that help identify tumors and cell images for hematological diagnosis, among other applications.

Decision support tools and therapeutic guidance for diseases and treatment complications based on information from medical records, literature and genetic and environmental factors should also be mentioned. We know that people of different races can respond differently to the same treatments. How can we accumulate this information and properly treat our patients without assistance tools? All this without mentioning the increasing advent of robots that can assist in the handling of exams, diseases and patients[4,5].

Today tools sometimes contained in your smartphone can monitor patients remotely. Recently, we were introduced to one that monitors signs of cytokine release syndrome after cell therapy in outpatient treatment or even after discharge, such as temperature, blood pressure and oxygenation measurements, sending information to the medical team. Monitoring of this type is already widely used in geriatrics and cardiology with measurements of heart rate and rhythm [4].

In hematopoietic stem cell transplantation and cell therapy, numerous publications and initiatives have been taken. We highlight the so-called precision medicine defined as an emerging approach to the treatment and prevention of diseases that takes into account the individual variability in genes, environment and lifestyle of each person that influences several steps of the transplant from the selection of patients and donor, type of conditioning regimen, prevention and treatment of GVHD, VOD and infections. In this sense, artificial intelligence and "machine learning" initiatives permeate our day-to-day activities, helping us make decisions. Predictive models of death, viral infections, graft-versus-host disease and other complications as well as relapses are being widely used [6,7,8,9].

Fernando Pessoa *(13 June 1888 – 30 November 1935) was a Portuguese poet, writer, literary critic, translator, publisher, and philosopher, described as one of the most significant literary figures of the 20th century and one of the greatest poets in the Portuguese language.*

Charles Spencer Chaplin *(16 April 1889 – 25 December 1977) was an English comic actor, filmmaker, and composer who rose to fame in the era of silent film. He became a worldwide icon through his screen persona, the Tramp, and is considered one of the film industry's most important figures.*

In recent decades, humans have learned that emotional intelligence (EI) is crucial. We have seen psychologists, doctors, and the media all echoing the same truth: "This person is brilliant, but lacks EI, and that is the problem." At the same time, technological growth has been exponential, leading to innovations like electric cars, cloud-based information, numerous actions directly on smartphones, robotic surgeons, and precision medicine. Some actions are faster and more precise than humans can achieve.

We have many options and solutions, and perhaps we can do anything we set our minds to. However, all these possibilities bring the challenge of understanding where exactly humans and machines stand. It's impossible not to think of Charles Chaplin in "Modern Times," Aldous Huxley's "Brave New World," George Orwell's "1984," and even Antoine de Saint-Exupéry's "The Little Prince." We should value a quote from this classic of literature: "You can only understand the world after you have experienced it," or from the master of Portuguese literature, Fernando Pessoa, who said in "The Book of Disquiet" that "we cannot eat a piece of cake without losing it."

This is why we must improve our accessibility to everything that can make life better, such as AI. However, we must not forget that EI and the need to feel the wind on our faces or see the sun after the storm are essential. Nothing can separate us from our soul and breath.

Finally, but not exhausting the subject, instruments for patient education and real-time assistance have been developed. It's an incredible world and we, healthcare professionals, have to know how to make the most of this moment. This is not a competition between our practice and artificial intelligence. We will not be efficient if we do not know how to take advantage of it. To paraphrase Albert Einstein, "no matter how much technology advances, the human spirit will prevail"

PS. This text in Nelson Hamersclak part was originally written in Portuguese. It was translated into English by AI and then corrected by NI.

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