E Journal of Cardiovascular Medicine

Editorial

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EJCM 2022;10(1):1-3

DOI: 10.32596/ejcm.galenos.2022.2022-01-04

The Digital (R)Evolution of Cardiac Surgery and Cardiology

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Evolution is unstoppable and it is the result of the survival of the fittest.

At the dawn of cardiac surgery in the 1960s, mortality was as high as 80% and every other patient died under the hands of the surgeons. Today in the 2020s mortality is as low as 1%-3% in elective patients. This drastic reduction was only possible with the (r)evolutionary invention of numerous diagnostic and operative tools, which have enabled the surgeons to plan and perform patient tailored surgeries without unpleasant intraoperative surprises resulting in high mortality. The digital revolution has already played a major role in the past evolution of modern medicine and improved patient care drastically.

With this in mind, I am certain that our future has no future without computers and artificial intelligence (AI).

However, many are strongly against this kind of evolution because of the fear of domination and enslavement by the digital world like many science fiction blockbusters already have demonstrated impressively.

As creatures of habit, it seems to be in our very human nature to automatically reject everything new and (r)evolutionary and to declare it as bad or harmful (the pandemic vaccine is a very good and rather sad example for this behavior).

On the one hand, this “natural” suspicion is certainly legitimate and everything new should be embraced with care and its superiority analyzed meticulously before introducing it in our everyday lives.

On the other hand, human history is studded with visionary new ideas and inventions, which have initially been declared as the devil’s work and the inventors were either ignored, imprisoned or even executed like Galilei, Tesla, Semmelweis, Mendel, etc, just to mention a few unfortunate souls. It took decades until they were recognized as ground-braking and evolutionary personalities whose thoughts, theories and inventions have improved everyday life of the entire human race ever since. Even Charles Darwin’s theory of evolution was discredited during his lifetime.

Unfortunately, history always repeats itself continuously and we can see it everywhere in our modern life: there are so many start-up inventions, which could stop and even

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Received: 12.02.2022 **Accepted:** 23.02.2022

Cite this article as: Reser D. The digital (R)Evolution of Cardiac Surgery and Cardiology. EJCM 2022;10(1):1-3. DOI: 10.32596/ejcm.galenos.2022.2022-01-04

reverse climate change using non-fossil fuels or recycled energy, but they are ignored and obstructed by those who influence our profit-driven economy.

I also know that there are numerous ground-braking medical devices and drugs available, which, however, have never been introduced into clinical use and got stored in a dusty drawer because they would immediately replace the very profitable current treatment options.

What a hypocritical and unethical world we live in!

But let's get back to the digital (r)evolution of cardiac surgery and cardiology.

With this Editorial, I would like to make physicians aware of the massive potential of the digital (r)evolution to improve patient care in the future, to give a few examples of what is already available today and what might the future holds in stock.

AI goes back to the 1950s and consists of any technique (intelligent programs, machines) which enables computers to mimic human behavior. Its further subset emerged in the 1990s as the so-called "Machine learning" (ML), which uses statistical methods to enable machines to improve with experience. It has an ability to learn without being programmed. The subset of ML is the so-called "Deep Learning" (DL), which emerged in the 2010s and in which learning is based on deep neural networks containing a massive amount of data (big data). A further possibility is the generative adversarial network (GAN) which is able to create images from data in order to learn from it.

These inventions have made it possible to use AI nowadays as an augmentation (and not as a replacement) of humans: it can be used for research methodology and facilitates our perception by enhancing image interpretation, recognition and data analysis (magnetic resonance imaging, echocardiography, electrocardiography interpretation, identifying new subtypes of diseases)[1-4].

It helps with problem solving and complex decision-making [congestive heart failure management, natural language processing with early prediction of disease based on medical records, multimodal AI helps with diagnostics and therapeutic decision making in fetal cardiology][5-7].

With the aid of AI, it is possible to identify cancer in tissue samples in the OR within 100 seconds whereas it normally takes 30 minutes, if it is sent to the pathologist (this is not merely an augmentation anymore, is it?).

AI is a massive resource to avoid "human factor" mistakes in medicine and thus to improve patient care but unfortunately, we are not yet able to use its full potential. The limiting factor at present is the lack of usable data for machine learning which has yet to be generated.

For diagnostics, therapy and chronic disease management (evidence-based medicine), there is a knowledge and information gap which can only be overcome with intelligence-based medicine (computer has all the information and knowledge)[8].

Nobody knows what the future holds but I would like to list some plausible possibilities here:

Teaching residents how to perform surgery might be performed through "real time deep learning" where the computer shows a video and gives comments about the optimal step by step performance.

"Edge computing" will transfer data to wearable devices which creates different realities: "Virtual Reality" is already in use today where we immerse completely into a simulation with the aid of high-tech goggles. In the "Augmented Reality", digital information is added to and overlaps the real-world view. In the "Mixed Reality", the virtual world is imposed on the real-world view and the user is even capable to interact with both. These realities will allow us to perform oriented surgery and learning with image augmentation.

"Multimodal AI" will allow us to use every information available (images, genetic data, medical reports, research data) and facilitate optimal patient tailored decision making.

"Collective intelligence" and "swarm learning" will become the ultimate Heart Team where artificial experts and networked human specialist groups will discuss the patient and decide about the optimal treatment option.

And hopefully, even animal research might be entirely replaced by virtual twins and simulation.

There is a lot of research going on worldwide, which will enable AI to become a part of everyday life and clinical practice. However, it will take some more time until this goal is reached, due to the complexity of this agenda.

For some, the introduction of AI into modern medicine seems to be too slow but that has a good reason: we are "only" physicians who have no idea about the digital world and what it might be capable of. Therefore, we need to team up with "AI specialists" and I would like to strongly encourage every physician to get involved with them in order to help develop the AI of the future!

If artificial intelligence will remain a pure augmentation of humans in the future is currently unknown – honestly, I doubt it.

But one thing is certain: evolution is unstoppable. Nothing is able to hide from it. And there is one consoling thing about it: it will always be the fittest which will survive eventually or unfortunately… for the good or the bad…

Acknowledgment

I would like to thank Anthony C. Chang (MD, MBA, MPH, MS, chief intelligence and innovation officer of the Children's Hospital of Orange County, Chair of the American Board of AI in Medicine) for his excellent talk about "Artificial Intelligence in Cardiology and Cardiac Surgery" at the 17th International Congress of Update in Cardiology and Cardiovascular Surgery. His presentation inspired me to write this editorial and enabled me to use and understand all the technical terms.

Ethics

Peer-review: Externally peer-reviewed.

Conflict of Interest: No conflict of interest was declared by the author.

Financial Disclosure: The author declared that this paper did not received any financial support.

References

1. Arafati A, Hu P, Finn JP, et al. Artificial intelligence in pediatric and adult congenital cardiac MRI: an unmet clinical need. Cardiovasc Diagn Ther 2019;9(Suppl 2):S310-25.
2. Schneider M, Bartko P, Geller W, et al. A machine learning algorithm supports ultrasound-naïve novices in the acquisition of diagnostic echocardiography loops and provides accurate estimation of LVEF. Int J Cardiovasc Imaging 2021;37:577-86.
3. Feeny AK, Chung MK, Madabhushi A, et al. Artificial Intelligence and Machine Learning in Arrhythmias and Cardiac Electrophysiology. Circ Arrhythm Electrophysiol 2020;13:e007952.
4. Sweatt AJ, Hedlin HK, Balasubramanian V, et al. Discovery of Distinct Immune Phenotypes Using Machine Learning in Pulmonary Arterial Hypertension. Circ Res 2019;124:904-19.
5. Barrett M, Boyne J, Brandts J, et al. Artificial intelligence supported patient self-care in chronic heart failure: a paradigm shift from reactive to predictive, preventive and personalised care. EPMA J 2019;10:445-64.
6. Tohira H, Finn J, Ball S, Brink D, Buzzacott P. Machine learning and natural language processing to identify falls in electronic patient care records from ambulance attendances. Inform Health Soc Care 2021:1-11.
7. Nurmaini S, Rachmatullah MN, Sapitri AI, et al. Deep Learning-Based Computer-Aided Fetal Echocardiography: Application to Heart Standard View Segmentation for Congenital Heart Defects Detection. Sensors (Basel) 2021;21:8007.
8. Anthony Chang Intelligence-Based Medicine. Artificial Intelligence and Human Cognition in Clinical Medicine and Healthcare. First published on June 27, 2020. Hardcover ISBN: 9780128233375. eBook ISBN: 9780128233382