

# ARTIFICIAL INTELLIGENCE: THE IMMEASURABLE LIMITS IN PEDIATRIC DENTISTRY

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**ABSTRACT**

The development of Artificial intelligence enables analysis of big data, provides reliable information, and improves the decision-making process. The field of artificial intelligence (AI) has achieved remarkable development and growth over the last two decades. Recent advances in digitized data acquisition, machine learning, and computing infrastructure have entered areas where AI applications were once thought to be reserved for human professionals. In medicine and dentistry, AI has great potential to improve patient care and revolutionize health care. In dentistry, AI is being studied for a variety of purposes, including identifying normal and abnormal structures, diagnosing diseases, and predicting treatment outcomes. This overview describes current and future applications of AI in pediatric dentistry.

**Keywords:** Big data , Artificial intelligence , machine learning, Pediatric Dentistry

## **INTRODUCTION**

Artificial Intelligence (AI) is the cognition displayed by robots in contrast to the necessary information represented by humans. An artificial neural network (ANN) is a computer formula that simulates human brain activity. In a traditional neural network, an input layer (or level) consists of one or more sub stages that communicate data via synapses to the two layers or intermediate 'hidden' level. A multi-layered architecture of neurons makes up this layer. Artificial neural networks that have been trained may recognise useful patterns in raw data and respond with an appropriate output.<sup>[1]</sup>

Because of their powerful data analysis capabilities, these virtual algorithms improve the accuracy and effectiveness of dental diagnosis and simulate visualization anatomical instructions for treatment.

Throughout the years, artificial intelligence has revolutionized dentistry, with computer-assisted diagnosis and radiography applications gaining significant popularity.<sup>[2]</sup>

It is extremely important for the health services to be computerized in order to reduce treatment inconsistency and improve treatment quality. One of the most convincing human components supporting this assertion is the mental and physical strain inflicted on pediatric dentists as a result of prolonged hours spent looking after children . This may endanger the quality of service offered<sup>[3]</sup>

Although advances in AI may not appear to have a significant impact on dentistry, specific areas such as image-based automatic detection of diseases and other specific diagnostic systems<sup>[15][16]</sup> image segmentation for automatic detection of oral traits<sup>[17] [18]</sup>and resolution enhancement of

dentistry-related images<sup>[19]</sup>are benefiting significantly from AI. <sup>[20]</sup> On the robotics front, various advancements are enabling the use of robotic assistance in dentistry. <sup>[21]</sup> In any case, AI techniques are still welcome in many fields of dentistry, all as part of the evolving digital dentistry paradigm.<sup>[17]</sup>

## **HISTORY OF ARTIFICIAL INTELLIGENCE**

According to history, In 400 BC Plato proposed a fundamental understanding of brain function .

<sup>[4]</sup> While Aristotle presented the concept (AI) for the first time in human history, he did not advocate that robots could substitute human thoughts in an emergency.

This, on the other hand, created a logic that may be used to replace human thinking systems.

<sup>[5]</sup>

Ramon Llull, a Catalan poet and great missionary theologian from the 14th century, devised logical principles to reconstruct the human mind.

<sup>[6]</sup> In 1950, British mathematician Alan Turing created a machine that deciphered encrypted messages. In 1955 The term "artificial intelligence" was coined by John McCarthy

## **APPLICATIONS OF ARTIFICIAL INTELLIGENCE**

AI is inspired by human intelligence, and helps us understand what we don't know. It learns from experience, adapts to unexpected situations, and gains a deeper understanding. It consists of the abilities of a conceptualist. It covers concepts defined as mental qualities, the use of knowledge to intervene in one's environment, reasoning, and the ability to learn large amounts of information.<sup>[9,10,12,13,]</sup>

The most potential field of research in this sector is undoubtedly the use of Deep learning in dentistry. Since these techniques allow the discovery of specific patterns from massive databases

of images, they can help with the construction of high-performance decision-making support systems<sup>[11]</sup>

AI has several potential uses in pediatric dentistry, which could change the face of behavioral pediatric practice in the future like on panoramic radiographs, the AI system proved successful in recognising and counting the primary teeth of children. AI is also useful in forensic identification, in addition to providing as a time-saving tool and a clinician's aid.<sup>[22]</sup> Machine learning algorithms will also get more complex over time as greater datasets are used. Early orthodontic tooth movement is also gaining traction, with personalized AI-driven appliances that are more acceptable to the younger generation.

AI-enabled restorative dentistry with computer-aided design and computer-aided manufacturing technology is well-established, and it would be a time and aesthetic benefit for pediatric restorations. The new, better path to injection-free pedodontic practice is pain control with AI-enabled devices. AI can also be utilized to improve the teaching and learning process for both students and patients.<sup>[7]</sup> Some of the important applications of AI are illustrated in Figure 1.

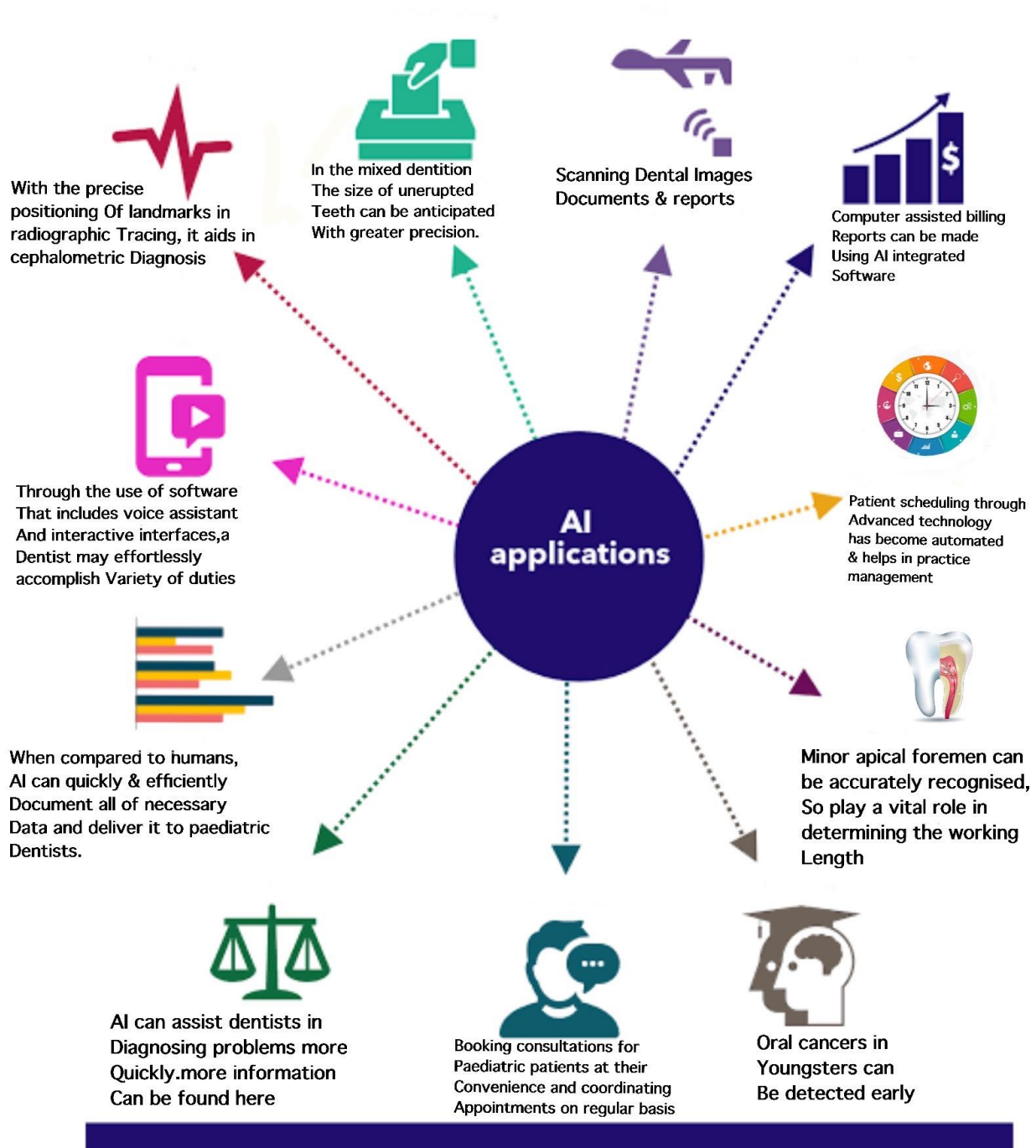


Figure 1 Applications of AI

## **INNOVATIONS THAT CAN TRANSFORM DENTISTRY IN FUTURE**

### ***USE OF SOFTWARE IN DENTISTRY***

Currently, software is used by dentists to gain insights on clinical decision-making. To help physicians choose the optimum modalities for their patients, these will grow further to incorporate A.I. algorithms. Dental medicine is moving towards a new phase of digitisation as a result of the exponential growth in clinical information and the development of healthcare A.I. These clever algorithms can be incorporated into the healthcare system to analyse patient information, scientific discoveries, and therapeutic approaches to provide diagnostic and therapeutic recommendations.

This one will be facilitated in part by the collecting of patient data, particularly genomic info, which might help researchers better understand each patient's unique system for providing care. The best alternative therapies and success prospects can be quickly provided to clinicians by A.I. programs with access to this data.

In addition to processing clinical information, A.I.-based algorithms can aid specialists in providing better care for dental issues. A machine learning technique was created in 2019 by researchers to precisely measure immune cells near oral cancer cells. This improves our understanding of how cancer spreads and how it is resistant, which helps us estimate the likelihood of survival. Others are improving periodontal disease and tooth decay detection from radiographs by employing neural networks. In the not too distant future, such methods might become commonplace.

### ***USE OF TOOTHBRUSHES WITH BRAIN***

An intelligent electric toothbrush ensures that you will be brushing your teeth properly and provides children with enjoyable games to maintain the healthy habit of brushing their teeth on a regular basis. The handle of smart toothbrush is jam-packed with sensors. These provide you immediate feedback through a companion app, alerting you if you're to use too much force, where you're brushing, and other factors.

### ***DESIGNING WITH COMPUTERS & 3D PRINTING***

Given the buzz that 3D printing created in the healthcare industry a while back due to the technology's potential to print drugs, prosthetics, and even organ replicas, it does not require an introduction. During the COVID-19 crisis, when hospitals needed to sidestep supply chains to satisfy demand, its significance was further underlined. The industry is already undergoing a revolution as a result of computer-aided designing (CAD) and CAM), such as 3D printing, which are transforming them into more affordable and productive digital labs. Traditionally, a dentist must create a mold of the patient's tooth and create a temporary crown before waiting for the dental facility to create a permanent one.

Using CAD/CAM technology, the tooth is drilled to prepare it for the crown, and a bitmap picture is then taken. Then, a device that receives and sends this image makes the crown in-office.

In fact, 3D printers may be used to make dental equipment more rapidly and precisely than traditional methods, including as orthodontic models, surgical implants, aligners, retainer, and other dental equipment. This helps in streamlining procedures and decreases errors and labour cost, which ultimately increases the technology's efficiency in terms of time and cost.



### ***USE OF AUGMENTED REALITY IN DENTISTRY***

In dentistry, the use of technology is more common during reconstructive and cosmetic surgeries to assist patients visualise how they will look after the procedure. These augmented reality (AR) apps, created by SmartTek and Kapanu, allow users to overlay virtual representations of their enhanced set of teeth before the treatment using their phone or tablet's camera. This enables patients and practitioners to customize dental characteristics like height and spacing before they have even enter the operating room.<sup>[29]</sup>

### **ADVANTAGES OF ARTIFICIAL INTELLIGENCE**

AI enables Diagnostic and treatment planning efficiency. It can be used for Program standardization. It is faster and takes less time.<sup>[1]</sup>

The use of ANNs, specifically CNNs, in dentistry has generated impressive findings in diagnosis and prognosis, particularly in diagnostic imaging and pathology, showcasing three possible applications: illness or injury recognition, image classification and their implementations, and image correction using Generative Adversarial Neural Networks.

From a patient's point of view, AI could help overcome the flaws in traditional dental care that have been widely criticized. Dentistry, and specifically dental academia, has a role to play in ensuring that AI improves dental treatment while lowering costs, benefiting patients, providers, and society as a whole.<sup>[23]</sup>

AI in dentistry is emerging as a benefit to clinicians in improving patients and simplifying complicated protocols by providing predictable outcomes. Significant Benefits of AI are mentioned in Figure 2.

## SIGNIFICANT BENEFITS OF AI

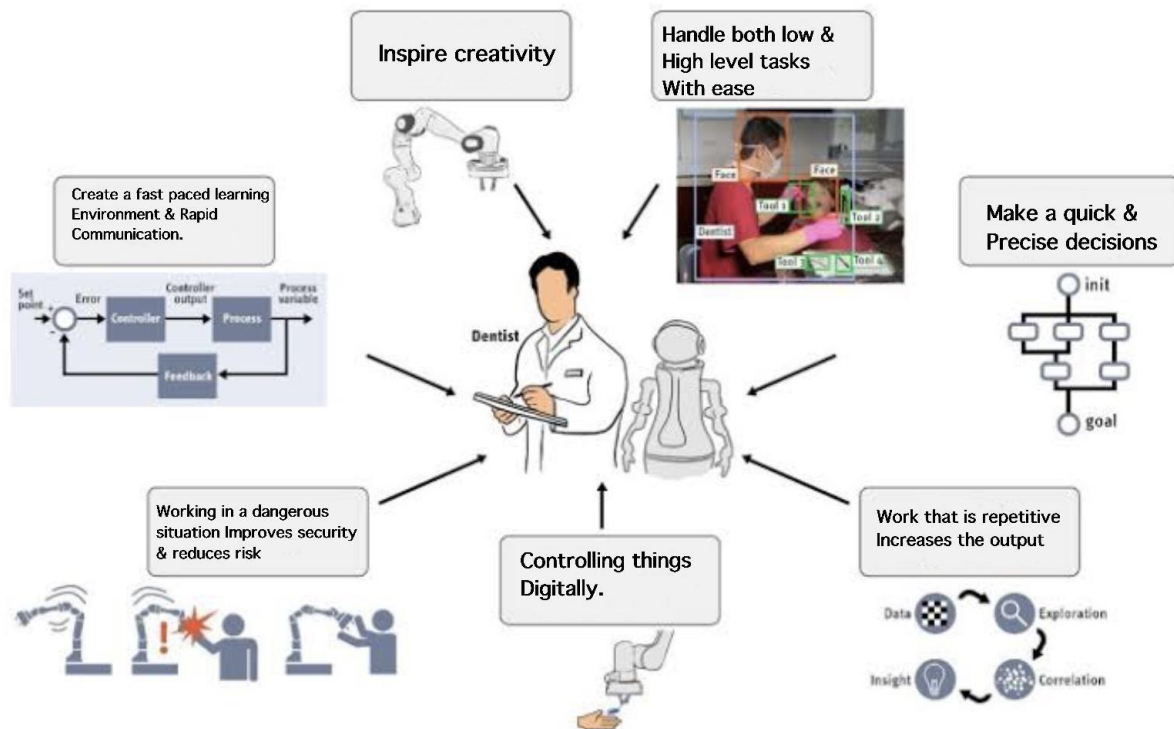


Figure 2 Benefits of AI

## DISADVANTAGES OF ARTIFICIAL INTELLIGENCE

One of the major disadvantage is that AI's mechanism is quite complicated. Costs of setup are high.<sup>[1]</sup> And due to the large amount of data required to train and precision, it is challenging to attain accuracy in rare disorders or diseases<sup>[25]</sup>

As the area of dental medicine investigates the potentially advantageous uses of digital data for dental treatment and in research, digitalization is creating various unexpected and unforeseen ethical issues in the biomedical environment.<sup>[26]</sup>

## **CONCLUSION**

Despite the fact that AI has been found to have potential uses in dentistry in several studies, these systems are still far from being able to replace dentists. professionals in the dental field Rather, AI should be seen as a supplement to dentists and professionals. To guarantee that humans retain the ability to direct treatment and make educated decisions in dentistry, it is critical to ensure that AI is integrated in a safe and controlled manner.

The route to successful AI integration in dentistry will require dental and continuing education training, a challenge for which most institutions are now unprepared. Mixed reality is a novel phrase that combines features of generative AI, virtual reality, and augmented reality into computer-superimposed information overlays to improve learning and surgical planning. 32 As many AI systems for various dentistry disciplines are being created and first results have been encouraging, AI's future in the health care system cannot be dismissed. Artificial intelligence (AI) technologies show potential as a valuable tool for oral health practitioners.<sup>[8]</sup>

Despite the fact that artificial intelligence technologies are a huge help in the field of dentistry & dental hygiene,there's a lot more to education and biological systems.

AI and complicated systems will never be able to take the place of humans. Knowledge, skill, and decision-making ability are all attributes of humans.<sup>[28]</sup>

## **REFERENCE**

- [1] DentalReach - Leading Dental Magazine - Dentistry Journal, News & Events (February 21, 2022) Artificial Neural Network in Pediatric Dentistry. Retrieved from <https://dentalreach.today/dental-education/artificial-neural-network-in-pediatric-dentistry/>.
- [2] Baliga M. Artificial intelligence-The next frontier in pediatric dentistry. Journal of the Indian Society of Pedodontics and Preventive Dentistry. 2019 Oct 1;37(4):315
- [3] Baliga M. Artificial intelligence-The next frontier in pediatric dentistry. Journal of the Indian Society of Pedodontics and Preventive Dentistry. 2019 Oct 1;37(4):315-.
- [4] Brickley MR, Shepherd JP, Armstrong RA. Neural networks: a new technique for development of decision support systems in dentistry. Journal of dentistry. 1998 May 1;26(4):305-9.
- [5] Perlovsky LI. Neural mechanisms of the mind, aristotle, zadeh, and fMRI. IEEE Trans Neural Networks. 2010 May;21(5):718-33. doi: 10.1109/TNN.2010.2041250.
- [6] Park WJ, Park JB. History and application of artificial neural networks in dentistry. Eur J Dent. 2018 Oct-Dec;12(4):594-601. doi: 10.4103/ejd.ejd\_325\_18.
- [7] Baliga M S. Artificial intelligence - The next frontier in pediatric dentistry. J Indian Soc Pedod Prev Dent [serial online] 2019 [cited 2022 Feb 21];37:315. Available from: <https://www.jisppd.com/text.asp?2019/37/4/315/270481>

- [8]Ferro AS, Nicholson K, Koka S. Innovative trends in implant dentistry training and education: a narrative review. *J Clin Med.* 2019;8(10):1618.
- [9]Bindushree, V.; Sameen, R.J.; Vasudevan, V.; Shrihari, T.G.; Devaraju, D.; Mathew, N.S. Artificial intelligence: In modern dentistry. *J. Dent. Res. Rev.* 2020, 7, 27.
- [10]Hassani, H.; Silva, E.S.; Unger, S.; TajMazinani, M.; Mac Feely, S. Artificial Intelligence (AI) or Intelligence Augmentation (IA): What Is the Future? *AI* 2020, 1, 143–155.
- [11]Carrillo-Perez F, Pecho OE, Morales JC, Paravina RD, Della Bona A, Ghinea R, Pulgar R, Pérez MD, Herrera LJ. Applications of artificial intelligence in dentistry: A comprehensive review. *Journal of Esthetic and Restorative Dentistry.* 2021 Nov 29.
- [12]Sternberg, R.J. Human Intelligence. *Encyclopedia Britannica.* Available online: <https://www.britannica.com/science/human-intelligence-psychology> (accessed on 23 December 2020).
- [13]Chen, Y.W.; Stanley, K.; Att, W. Artificial intelligence in dentistry: Current applications and future perspectives. *Quintessence Int.* 2020, 51, 248–257.
- [14]Carrillo-Perez F, Pecho OE, Morales JC, Paravina RD, Della Bona A, Ghinea R, Pulgar R, Pérez MD, Herrera LJ. Applications of artificial intelligence in dentistry: A comprehensive review. *Journal of Esthetic and Restorative Dentistry.* 2021 Nov 29.
- [15] Lee JH, Kim DH, Jeong SN, Choi SH. Detection and diagnosis of dental caries using a deep learning-based convolutional neural network algorithm. *J Dent.* 2018; 77: 106- 111.

- [16] Hung M, Voss MW, Rosales MN, Li W, Su W, Xu J, Bounsanga J, Ruiz-Negrón B, Lauren E, Licari FW. Application of machine learning for diagnostic prediction of root caries. *Gerodontology*. 2019 Dec;36(4):395-404.
- [17] Xu X, Liu C, Zheng Y. 3D tooth segmentation and labeling using deep convolutional neural networks. *IEEE Trans Vis Comput Graph*. 2018; 25(7): 2336- 2348.
- [18] Tian S, Dai N, Zhang B, Yuan F, Yu Q, Cheng X. Automatic classification and segmentation of teeth on 3D dental model using hierarchical deep learning networks. *IEEE Access*. 2019; 7: 84817- 84828.
- [19] Hatvani J, Horváth A, Michetti J, et al. Deep learning-based super-resolution applied to dental computed tomography. *IEEE Trans Radiat Plasma Med Sci*. 2018; 3(2): 120- 128.
- [20] Schwendicke F, Singh T, Lee JH, et al. Artificial intelligence in dental research: checklist for authors, reviewers, readers. *J Dent*. 2021; 107:103610.
- [21] Grischke J, Johannsmeier L, Eich L, Griga L, Haddadin S. Dentronics: towards robotics and artificial intelligence in dentistry. *Dent Mater*. 2020; 36(6): 765- 778.
- [22] Kılıc MC, Bayrakdar IS, Çelik Ö, Bilgir E, Orhan K, Aydın OB, Kaplan FA, Sağlam H, Odabaş A, Aslan AF, Yılmaz AB. Artificial intelligence system for automatic deciduous tooth detection and numbering in panoramic radiographs. *Dentomaxillofacial Radiology*. 2021 Sep 1;50(6):20200172.
- [23] Shan T, Tay FR, Gu L. Application of artificial intelligence in dentistry. *Journal of Dental Research*. 2021 Mar;100(3):232-44.
- [24] Chen YW, Stanley K, Att W. Artificial intelligence in dentistry: current applications and future perspectives. *Quintessence Int*. 2020 Mar 1;51(3):248-57.

[25] Jose AA, Sawhney H, Jose CM, Center GD. Artificial intelligence and its applications: Transforming today's Dentistry.

[26] Javaid M, Haleem A, Khan IH, Vaishya R, Vaish A. Extending capabilities of artificial intelligence for decision-making and healthcare education. *Apollo Medicine*. 2020 Jan 1;17(1):53.

[27] Khanna SS, Dhaimade PA. Artificial intelligence: transforming dentistry today. *Indian J Basic Appl Med Res*. 2017 Jun;6(3):161-7.

[28] Shan T, Tay FR, Gu L. Application of artificial intelligence in dentistry. *Journal of Dental Research*. 2021 Mar;100(3):232-44.

[29] Thurzo A, Kočíš F, Novák B, Czako L, Varga I. Three-dimensional modeling and 3D printing of biocompatible orthodontic power-arm design with clinical application. *Applied Sciences*. 2021 Oct 18;11(20):9693.

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