Big data and artificial intelligence - Tools to be future ready?

The era of digitalization has dawned and with it, it has brought multiple opportunities and at the same time multiple new challenges too.

In the field of ophthalmic clinical record keeping, more and more hospitals are shifting toward electronic medical record software. As electronic data are comparatively easier to store and transfer, there already has been and in near future there will be an exponential increase in the sheer volume of data available for the researchers to make use of. This kind of humongous data with their multiple hierarchies, categories, subcategories, multiple types of variables and their complex interactions together constitute the "big data."

What is big data exactly? It can be defined as data sets whose size or type is beyond the ability of the traditional relational databases to capture, manage and process the data with low latency. Sources of data are becoming more complex than those for traditional data because they are being driven by artificial intelligence (AI), mobile devices, social media and the Internet of Things. For example, different types of data originate from sensors, devices, video/audio, networks, log files, transactional applications, web and social media – much of it is generated in real time and at a very large scale.[1]

Big data characteristics are comprehensively described with six Vs. "Volume" refers to the amount of data, "Velocity" refers to data in mobility as well as speed and frequency of data creation, processing and analysis. Complexity and heterogeneity of multiple datasets are referred to as "Variety." "Veracity" refers to the data quality, relevance, uncertainty, reliability and predictive value, whereas "Variability" depicts the consistency of the data over time. "Value" of the big data refers to the coherent analysis, which should be valuable to the patients and health care providers.[2]

Usually, the term *big data* is used in the context of business-related data. Medical record data by their inherent nature are more complex and need more skills for analysis. So, as the data volume increases, it will be productive to have advanced tools to make proper sense of the complex data and make sure that the best possible use is made of the available resources. In the field of ophthalmology, there are some large data collections such as The SMEYEDAT (Smart Eye Database), which is a web-based ophthalmic data warehouse that stores electronic records and helps in faster identification of patients with specific conditions.[3] The IRIS (Intelligent Research in Sight), which is a cloud-based ophthalmic data registry developed by the American Academy of Ophthalmology that aggregates clinical data and provides physicians with real-time analysis helping them compare the effectiveness of various available treatment options.[4]

Some important aspects that can be assessed in detail by using AI in big data analysis include demographic and socioeconomic factors. For example, few studies report gender bias in terms of women having a higher rate of blindness compared with men.[5,6] In many such situations, big data analysis has the capability of handling the records of millions of people together in relation to gender, cause of blindness, geographic location and so on and the sheer gargantuan size of the sample taken into consideration can provide us with statistically more accurate results.

Similarly, cause and effect associations, prevalence and association between various diseases can be better understood with big data. For example, Shen *et al*.[7] were able to analyze the association between refractive error and prevalence of glaucoma by race or ethnicity in the study that incorporated data of more than 400,000 patients.

Big data serves as a substrate on which multiple deep-learning algorithms can work providing with results like never before. For example, IDx-DR is the first AI algorithm approved by the U.S. Food and Drug Administration for the detection of diabetic retinopathy in the offices of non-ophthalmic health care practitioners.[8] It uses deep-learning techniques to compare patients' fundus photographs with the large data set and provides results with advice regarding the need for a referral.[8] Poplin *et al*.[9] developed a retinal photography–based deep-learning algorithm that was able to predict cardiovascular risk factors. Mitani *et al*.[10] further reported that retinal photographs could be used to predict anemia. This opens the possibility of a coveted future where a single fundus examination can help in the early diagnosis and treatment of multiple diseases with the help of big data analysis.

Big data can be made more universal if various medical records software used all over the country can pool their data in a uniform format allowing region-wise and country-wise analysis.

Big data comes with its own set of challenges. The initial setup for big data analysis requires sophisticated infrastructure and trained manpower. The data can only be as good as the skill with which it is entered. It is subject to bias and/or error at the point of entry because of misinterpretation of data, error in the selection of right spot for a particular data and so on by the entry operator that may lead to erroneous analysis. To a certain extent, attempts can be made toward automatic data transmission from device to device – for example, data from laboratory, imaging, billing, procedures and so on automatically getting updated in the electronic health records and vice versa to minimize the human errors.

The health record of a patient is very sensitive data and the analytics software should use advanced encryption algorithms, pseudo-anonymization of the personal data and other available methods to guarantee privacy and security of the data.[2]

At certain times, the results obtained by such observational and retrospective studies may not be confirmed by randomized prospective studies and we need to continue to be vigilant while interpreting the results.[11]

To conclude, use of AI is the new big thing in the field of medical records and big data associated with it. It can analyze the existing data in multiple new ways and provide new perspectives, find new correlations, provide cause–effect associations and modify treatment regimes and all this can be done with minimal time and effort consumption compared with the traditional ways.

More studies on this line will help in better utilization of available resources as the treatment plans and schemes can be personalized to a particular area and specific problems pertaining to people there and in a greater sense will help us to be "future ready."

Shrinivas Joshi, Giriraj Vibhute, Apoorva Ayachit, Guruprasad Ayachit

Department of Vitreoretina. M M Joshi Eye Institute, Hosur, Hubli, Karnataka, India.
E-mail: shrinivasmjoshi@gmail.com

References

1. Available from https://www.ibm.com/analytics/hadoop/big-data-analytics. [Last accessed on 2021 Jun 01].
2. Ristevski B, Chen M. Big data analytics in medicine and healthcare. J Integr Bioinform 2018;15:20170030. doi: 10.1515/jib-2017-0030.
3. Kortüm KU, Müller M, Kern C, Babenko A, Mayer WJ, Kampik A, *et al*. Using electronic health records to build an ophthalmologic data warehouse and visualize patients' data. Am J Ophthalmol 2017;178:84-93.
4. Cheng CY, Da Soh Z, Majithia S, Thakur S, Rim TH, Tham YC, *et al*. Big data in ophthalmology. Asia Pac J Ophthalmol 2020;9:291-8.
5. Kaur K. Cataract blindness: Socioeconomic factors associated with treatment barriers and high blindness rates for women in rural regions of Andhra Pradesh, 2018. Available from https://scholarscompass.vcu.edu/auctus/61. [Last accessed on 2021 Jun 01].
6. Khanna R, Raman U, Rao GN. Blindness and poverty in India: The way forward. Clin Exp Optom 2007;90:406-14.
7. Shen L, Melles RB, Metlapally R, Barcellos L, Schaefer C, Risch N, *et al*. The association of refractive error with glaucoma in a multiethnic population. Ophthalmology 2016;123:92-101.
8. Padhy SK, Takkar B, Chawla R, Kumar A. Artificial intelligence in diabetic retinopathy: A natural step to the future. Indian J Ophthalmol 2019;67:1004-9.
9. Poplin R, Varadarajan AV, Blumer K, Liu Y, McConnell MV, Corrado GS, *et al*. Prediction of cardiovascular risk factors from retinal fundus photographs via deep learning. Nat Biomed Eng 2018;2:158-64.
10. Mitani A, Huang A, Venugopalan S, Corrado GS, Peng L, Webster DR, *et al*. Detection of anaemia from retinal fundus images via deep learning. Nat Biomed Eng 2020;4:18-27.
11. Boland MV. Big data, big challenges. Ophthalmology 2016;123:7-8.

Access this article online

Quick Response Code:

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_514_21

Cite this article as: Joshi S, Vibhute G, Ayachit A, Ayachit G. Big data and artificial intelligence - Tools to be future ready? Indian J Ophthalmol 2021;69:1652-3.

About the author

Dr Shrinivas Joshi

Dr Joshi completed his clinical fellowship in Vitreoretinal Surgery from the University of Toronto, Canada, and was trained in pediatric retinal surgeries at the Sick Kids Hospital, Toronto. He is one of the first Indians to be trained in artificial retinal implantation surgery under Dr Robert Devenyi at Toronto Western Hospital. He is the recipient of Senior Honor Award by American Society of Retina Specialists. He has been awarded the prestigious Rhett Buckler award by the American Society of Retina Specialists for four consecutive years, which is a record in itself. He has been honored with the International Hero award by All India Ophthalmological Society in 2018, 2019 and 2020. Dr Joshi has keen interest in digital technologies, artificial intelligence and is also one of the pioneers of 3D surgery in India.