Editorial

How Machine Learning Models can Simplify Clinical and Public Health Decisions

Running Title: Machine Learning Models in Public Health

Arun Kumar Aggarwal[1], Er. Anubhav Aggarwal[2]

[1]Professor & Head, Department of Community Medicine & School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh-160012,

[2]MSPM Scholar, Carniege Mellon University, Pittusburgh, Pensylvania, USA

Corresponding Author: Dr. Arun Kumar Aggarwal

Email: **aggak63@gmail.com**

Abstract

This Editorial describes conceptual underpinning for use of Machine learning models for public health applications in order to compensate for skilled workforce shortage at the primary and secondary health care facilities. Such models have the potential to contribute towards Universal Health Care Coverage.

Artificial intelligence (AI) has been described as the "fourth industrial revolution", with transformative and global implications across almost every industry, including in healthcare, public health, and global health. AI algorithms can significantly improve health systems worldwide, as well as individual and population health outcomes. [1] Artificial intelligence holds great promise in significantly shifting the focus of medicine from curative to preventive measures by creating early warning and advanced "pre-detection" systems.

While AI has the potential for advancing health equity within and between countries, there are some ethical considerations in its deployment to reduce the risk and possibility of misuse of these systems, particularly for the most vulnerable. Common ethical concerns relate to privacy, trust, accountability and responsibility, and bias, particularly in the context of Low- and Middle-Income Countries (LMICs). [1]

There is now better awareness of the potential risks and harm that may be caused by unregulated development of AI. Guiding principles are being developed around the world to foster trustworthy development and application of artificial intelligence systems. These guidelines can support developers and governing authorities when making decisions about the use of artificial intelligence. The High-Level Expert Group on Artificial Intelligence set up by the European Commission launched the report 'Ethical guidelines for trustworthy artificial intelligence' in 2019. Authors argue that there is too much room for local, contextualized discretion to foster

trustworthy artificial intelligence globally. Some urgency has been shown in the shared globalized efforts to safeguard against the potential harms of artificial intelligence technologies in health care.[2]

In addition to ethics, there are some arguments to be made about the trust that can be placed on AI based models, and if explanations required by end-users to use these algorithm-based models for taking important decisions can be sufficiently provided. However, authors recommend that healthcare workers should exercise appropriate caution when using explanations from an AI system and urge regulators to be judicious in listing "explanations" among the requirements needed for clinical deployment of AI.[3]

There is drastic improvement in the performance of machine learning algorithms for pattern recognition. With the introduction of deep learning technology, the ability of AI technology to analyse data patterns has become similar to that of an average human ability for specific tasks (e.g., image recognition and speech recognition). [4] There are many studies that have used ML models to make predictions from images. AI has even beaten the best human chess player and Alpha Go players. In addition to the images, research to capture live physiological data is being used now on commercial scale to make clinical predictions.

AI based ML models are already a part of our everyday lives, imbibed in the products of many big corporates like Google, Facebook, Microsoft and Apple. Apple Watchs' health monitoring systems include a heart rate sensor, an ECG monitor that can watch for atrial fibrillation, blood pressure monitor, blood glucose levels monitor and a gyrometer that has the ability to identify falls. All of these together can detect all types of physical activity like walking and different types of workouts. In one example, Apple Watches are able to monitor cardiovascular patients waiting for treatment by assessing 'frailty' in both home and clinic – simply by measuring ability to walk a distance of 300 meters in less than 6 minutes.[5]

Apple Heart Study results done in collaboration with Stanford, suggested that atrial fibrillations alerts from the Watch app were rare, but fairly in line with paired readings from an ECG patch. The company doesn't seem content with limiting its ECG tech to Apple Watches alone. A patent published in the fall described a fabric-based piece of clothing that would be able to measure blood pressure, respiration and ECG, and then wirelessly communicate with external electronic equipment. While it is unclear what exactly this stretchable band would look like on the market, the patent gave examples of potential use cases including a headband, hat, undergarments, socks, pants, shorts and belt.[6]

Machine Learning takes analytics to the extreme by exploring hidden information in data. Disease diagnosis is a major intention of medical decision support systems which will assist the physicians to quickly reach the right decision. Many ML algorithms: K-Nearest Neighbors, Decision Tree, Artificial neural networks, Radial Basis Function neural networks and Support Vector Machine are now easily available for use of amateurs without any knowledge of coding required. Performance of these techniques can be compared through various performance measures such as sensitivity, specificity, accuracy, F measure, and Kappa statistics, True Positive Rate, False Positive Rate and ROC curves through cross-validation method to evaluate the fair estimate of prediction techniques. [7]

Machine learning models work by predicting a certain "class value" (what is to be predicted, for e.g. – does the patient have a certain disease?) by examining the

similarity of the given case with past cases with a given result. The process to develop a model with good results requires (i) Algorithm Selection with hyperparameters tuning for picking the most appropriate learning approach, and (ii) Feature Selection and Error Analysis to optimise for best possible results (iii) Packaging the trained model into a user-friendly (mobile) application to support clinical practices.

In a study authors concluded that it is utmost important to optimize medical processes and to have regular experts' workflows to support healthcare services. The had experimented with standard ML model development and experimentation techniques using different types of ML models to select the best performing model, validate that and use that for development of mobile app.[8]

As public health practitioner if you want to use ML models, it is important to understand the basics to collect and organise your data. In Public health, we collect both quantitative as well as qualitative data ranging from numeric data, nominal, ordinal, binary and even text data, when we capture "Why" part of our research questions and try to capture the sentiments of our patients or the population in various surveys. We tend to use various commonly used softwares like EpiInfo, SPSS, Stata or R for various quantitative analysis and softwares like "NVIVO" for qualitative analysis. However, many softwares that are used in ML domain, allow to use both the quantitative as well as text data at one time to make predictions in both cases when the outcome is numeric and if the outcome is nominal or binary. The choice of models depends on the type of the data and its distribution. There are different models if the data is normally distributed and outcome is numeric, or if there is skewness in the data and there are outliers, or if the variables are interrelated etc. If you want your prediction decision in the form of flowchart or tree, then there are different models for it. On can calculate the validity of the predictions through these models.

Public health practitioners should now add this next level of skill to collect and organize their data sets, to use ML based softwares so as to make predictions and develop AI products useful to enhance to scope of health care products at the peripheral level, with intersectoral coordination with product managers.

References

1. Murphy K, di Ruggiero E, Upshur R, Willison DJ, Malhotra N, Cai JC, et al. Artificial intelligence for good health: a scoping review of the ethics literature. BMC Medical Ethics. 2021;22(1).
2. Bærøe K, Miyata-Sturm A, Henden E. How to achieve trustworthy artificial intelligence for health. Bulletin of the World Health Organization. 2020;98(4).
3. Ghassemi M, Oakden-Rayner L, Beam AL. The false hope of current approaches to explainable artificial intelligence in health care. The Lancet Digital Health [Internet]. 2021;3(11):e745–50. Available from: https://doi.org/10.1016/S2589-7500(21)00208-9
4. Erickson BJ, Korfiatis P, Akkus Z, Kline TL. Machine learning for medical imaging. Radiographics. 2017;37(2).
5. The Study Concludes that the Apple Watch can Accurately assess Fraility in patient with Cardiovascular Disease using Activity Data. Digital Information World. https://www.digitalinformationworld.com/2021/03/the-study-concludes-that-apple-watch.html#.

6. Dave Muoio. Apple's 2019 in review: Research programs, health records, patents and features. Global Edition Digital Health. https://www.mobihealthnews.com/news/apples-2019-review-research-programs-health-records-patents-and-features. 2019.
7. Godara S, Singh R. Evaluation of predictive Machine Learning techniques as expert systems in medical diagnosis. Indian Journal of Science and Technology. 2016;9(10).
8. Duong-Trung N, Tang NQT, Ha XS. Interpretation of machine learning models for medical diagnosis. Advances in Science, Technology and Engineering Systems. 2020;5(5).

-----*-----