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Review Article

Big Data and Neural Network in Cardiology Health Prediction

Agustín Joison, N.[1*], Raul Barcudi, J.[2], Enrique Majul, A.[3], Sergio Ruffino, A.[4], Juan DE Mateo Rey, J.[5], Agustin Joison, M.[6] & Gustavo Baiardi[7]

[1]*Chairman of Biological Department, Faculty of Chemical Sciences, Catholic University of Córdoba, Avenida Armada Argentina*

[2]*Professor and Chairman of Coronary Unit, University Reina Fabiola Clinic, Córdoba, Argentina*

[3]*Chairman of Química III, Dean of Faculty of Health Sciences, Catholic University of Córdoba, Córdoba, Argentina*

[4]*Professor Assistant of Química III, Faculty of Health Sciences, Catholic University of Córdoba, Córdoba, Argentina*

[5]*Professor of Química III, Faculty of Health Sciences, Catholic University of Córdoba, Córdoba, Argentina*

[6]*Systems Engineer, Globant Business, Avenida Colón 610, Córdoba, Argentina*

[7]*Assistant professor, Institute of Biological and Technological Research (IIBYT-CONICET), National University of Córdoba, Faculty of Chemical Sciences, Catholic University of Córdoba, Avenida Armada Argentina 3555, Córdoba, Argentina*

[*]**Correspondence to:** Dr. Agustín Joison, N., Chairman of Biological Department, Faculty of Chemical Sciences, Catholic University of Córdoba, Avenida Armada Argentina.

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Abstract

In health as in other areas there is availability of information, which can be collected in digital and continuous format; this phenomenon that is currently called Big Data that includes four research themes in the current literature, namely: 1.information, 2. technology, 3. methods, 4. Impact. The term Big Data from 1990 began to be used as a synonym for the collection, automation and recording of large amounts of data, which introduced an innovation in the treatment of information improving decision-making in many areas of our society. In the area of cardiology health research, clinical diagnosis, prognosis and therapy of patients, accurate and orderly data are fundamental tools in the access and analysis of the right information. The current era of computer, systems and software enabled a better interpretation of Big Data, and improved deep learning and a successful advancement in machine learning algorithms. Big Data is now transformed into a tool that enables for healthcare stakeholders to implement three types of analysis techniques; 1: historical (descriptive study), 2: future results (predictive study), 3: current situation (prescriptive study). This technology, which was born with some uncertainty and Luke warmness of professionals to accept this revolution regarding the information it provides, ends as a new paradigm in health care by understanding of algorithms and machine learning importance.

Big Data Antecedents

In health as in other areas there is availability of information, which can be collected in digital and continuous format; this phenomenon that is currently called Big Data, that includes four research themes in the current literature, namely: 1.information, 2. technology, 3. methods, 4. Impact [1]. This first term appears whit the first work in business intelligence already to1958 [2]. The concept and application of Big Data has been developed with the advancement of the internet and new statistical software as well as digital communications. The study and analysis the information provided by Big Data allow an understanding of what happens in real time in many companies and research teams with the aim of increase the potential to understand the present and predict in the future responses and security [3]. The term Big Data from 1990 began to be used as a synonym for the collection, automation and recording of large amounts of data, which introduced an innovation in the treatment of information improving decision-making in many areas of our society [4]. Big Data also allows changes to formulate new hypotheses in a research process, with the recording of data unstructured improving the interpretation respect to classical hypotheses [5]. In 2004, Universities attempted to mass digitization more than 15 million volumes at universities as Harvard, Stanford and Oxford. That project called the Google Print Library Project3 was one of the first research in the use of Big Data. In cardiology, significant amounts of data exist and are collected, but the number of patients is site-dependent, and the most common type of practice [6].

Another research that used the advantages of Big Data from 1989 to 2001 was the human genome project, allowing a collaboration between large-scale research groups and as a result of it, was reflected in publications of the results faster and more efficiently [7]. Currently areas of knowledge such as education, health and economics are developed using Big Data. This new paradigm aims to gain a greater understanding of the results and application of artificial intelligence. Specifically Big Data and the increase of information it

produces more meeting people's needs, desires and behaviors. This flow of information and its analysis is compared to the development of the human experience [8].

Empirical science depends about what data is chosen, managed and analyzed, in this sense Big Data improves and benefits it applications. Possessing more data science increases the volume of discoveries in less time. Digital technology satisfies the work of researchers by learning more about technical details covering many areas of knowledge [9].

In the area of cardiology health research, clinical diagnosis, prognosis and therapy of patients, accurate and orderly data are fundamental tools in the access and analysis of the right information. This Big Data information has changed the paradigm in individual patient health and disease research. For example, Big Data in the cardiovascular area received collaboration from institutes such as NIH (e.g. the National Institute of Lung and Heart Blood (NHLBI) and the National Institute of General Medical Sciences (NIGMS), with many cohort studies by decades, with unlimited resources enabling future discoveries [10].

The contemporary health system Big Data helps to meet four basic objectives: quality and health satisfaction; improving the health of the population; reduce per capita costs; improve health care provider satisfaction. But there are challenges in the use of Big Data and its information, because of limitations and setbacks in health care, to meet the four objectives mentioned above [11].

In short, in this first part what we want to show is that Big Data does not correspond to a new computer technology, but want to see as a new way of thinking and analyzing data. In this sense it is important to understand that Big Data is related to the ability to obtain new knowledge more fully than was feasible before

Big Data and Bioinformatics

The current era of computer, systems and software enabled a better interpretation of Big Data, and improved deep learning and a successful advancement in machine learning algorithms [12]. Currently researchers and professionals of health use deep learning applied to biological study, analysis and development regarding molecular behavior prediction, interpretation of biomedical predictions, to improve diagnosis and biomolecular interaction [13]. There are some cases of pharmacologically-treated human diseases that are resistant to the activity of any single drug. At respect a drug combination consists of multiple drugs, each of which has generally been used as a single effective medication in a patient population. Since drugs combination can modulate the activity of distinct proteins, this can improve therapeutic efficacy by overcoming the redundancy in underlying biological processes. Big Data and bioinformatics associated to use the neuronal network may to help and predict the behavior of drugs [14-17]. Enzyme activity has a biological function in human beings and is essential in areas such as bio-technology process and medical diagnosis; the identification of enzymes and prediction their function by deep learning and bioinformatics can provide benefits in these fields [18].

Big Data and Clinical Medicine

The goal of using Big Data is often confused with automatic handling on computers, regardless of the fact that it is actually to generate learning to simulate expert systems of knowledge of the area, eliminating

in clinical scenarios, interactions and management of drugs or even in the convenient interpretation of radiological images. Big Data and deep learning associated with bioinformatics are associated as a learning system in algorithms, transferring experience in medicine, specifically in the students of residence, helping them to sift the large number of variables, fulfilled the objectives that a student would be: general principles about medical activity and applying them to new patients, looking for combinations that can predict the results of studies and diagnoses [19]. So depending on the type of variable analyzed prediction based on algorithms is not as productive. In this sense it is important in addition to the quality of the input data, the amount of it; for example when studying lactate as a predictor of risk of death, the disadvantage arises that few people the lactate is checked , therefore the size of the sample conditions the interpretation of the result [20]. The collection of data from patients' medical histories is critical to the development of public health and other medical research. In the implementation of EHRs (Electronic Health Records) the analysis of demographic data, biometrics, diagnosis, medicines and laboratory values of patients has been innovative. Big Data offers the ability to provide tools to predict numerous risks of disease that are useful for insurance, or in the case of public health epidemiological research, for health care and systems real-time health [21].

The usefulness in the management of big data and its application in machine learning has a high impact on people's health regarding disease risk prediction, thanks to the volume of information from EHRs stored in large databases. In this sense a nevus can be classified as benign or malignant, predicting cardiovascular risk by images of the retinal fundus image, predicting according to histopathology a lung cancer, automatic interpretation of electrocardiograms, determinations fractional left ventricle ejection, and more accurate analysis on calcium scans in coronary arteries [22].

Experience in the use of data for scientific purposes has enabled through analysis of neural networks, integrating variables in queries regarding genomics, proteomics, and predicting based on disease phenotypes, including clinical aspects, laboratory, electrocardiogram, echocardiogram, heart physiology, invasive hemodynamics, supporting a medicine more personalized [23].

In medical practice there are situations that need to make decisions based on precise responses, such as interventional cardiology, and in this case the analysis of a volume, variety and the veracity of the data can give important support to the clinical decision. In this regard, neural networks and the use of big data are more sensitive and effective with respect to the logistic regression model. When you want to keep track of practices such as cardiac catheterization and angioplasty in patients, it is sometimes not possible; at respect the use of big data and electronic registration (EHRs), can technically solve this problem, especially when it comes to clinical trials [24].

In line with the above concept, a study in 11,709 patients with myocardial infarction admitted to the Mayo Clinic between the years 2004 to 2013 showed mortality at 30 days, rehospitalization at 30 days for heart failure and followed by cardiovascular death within 180 days after intervention process, it could be better predicted with the algorithm of neural networks than logistic regression models [25].

Big Data Analytics and Artificial Intelligence: A New Healthcare

Health care efficiency not only contemplates medical action itself, but also data and information are crucial in decision making [26]. Big Data is now transformed into a tool that enables for healthcare stakeholders to

implement three types of analysis techniques; 1: historical (descriptive study), 2: future results (predictive study), 3: current situation (prescriptive study). In this regard, when it is possible to complement all of the three analyses mentioned in health care, decision making is more efficient at preventing death or improving quality of life [27]. The use of Big Data in deep learning and neural networks has the advantage of automatically performing analysis of variables from raw data. In this sense scientific research is focused on predicting over time certain diagnoses from relationships between variables that are explanatory to a certain disease. For example, events recorded in the EHR of 3,884 cases of heart failure by incident and 28,903 controls to predict the initial diagnosis of heart failure [28].

Another application of Big Data is related to the field of phenotype analysis and screening. In the specific case of cardiology, it refers to the study of a set of biomarkers and cardiovascular imaging. In this regard there are cases such as heterogeneous syndrome called HFpEF, which can be more easily diagnosed by applying neural networks, using algorithms to the correct decision making in this cardiovascular disease [29]. Normally to analyze the risk of an event using some data, logistic regression models are used, with results that reflect the situation at any given time. But using algorithms and neural networks particularly with large-scale data offers the advantage of improve prediction performance [30].

Artificial Neural Network and Risk Stratification of Cardiac Events

Although doubts remain regarding the negative values of cardiac markers such as troponin and non ST elevation electrocardiograms, increasing uncertainty regarding coronary heart disease, images and clinical evaluation guidelines support the presence of coronary syndrome. In this regard, the use of neural networks allows a better prediction and stratification of risk not to interpret with unnecessary mistakes and expenses unnecessary testing, to reduce uncertainty and make a better prediction of MPI results and angiographic results [31]. Prediction models are based on logistical and linear regression analysis, probabilities using odds ratio (OD), risk relative (RR), and multivariate analysis. However, neural network models and algorithms provide greater accuracy with respect to ACS ANN improve diagnosis of MI in non-ST elevation ASC [32].

Our Experiences and Conclusions

Prediction of results is a health tool not only to confirm a particular diagnosis, but also a safety for medical professionals to repeat and confirm over time in future patients, increasing the effectiveness in treatment and disease prevention. The application of neural networks in big data has the advantage of identifying variables that could alter the course and interpretation of expected signs and results. Our experience using Big Data and neural networks (perceptron multilayer) in cardiology specifically in acute coronary syndromes, in the study, analysis and interpretation of the predictor variables of cardiovascular risk we observe that certain markers of myocardial ischemia did not agree with the clinic of patients at admission to the coronary unit.

Regarding the use and analysis of big data by neural networks, our group conducted a study about to behavior of cardiac markers Creatine kinase MB and cardiac troponin (cTnI) in diabetic and hypertensive patients admitted to the coronary unit with acute coronary syndrome with non ST-segment elevation. Results showed that in these patients the activity and concentration of both markers decreased at 8 and 12

hours respectively. Based on these results, neuronal networks were used to predict the behavior of cardiac markers in future diabetic and hypertensive patients admitted to the coronary unit with acute coronary syndrome with non ST - segment elevation. Subsequent analysis showed a higher likelihood (72%) that markers values of patients were lower or normal [33,34].

It is very important to develop algorithms with Big Data, using artificial intelligence from the explanatory variables for the process that leads to the disease increasing the prediction of the event. Interest in the application of ANNs (artificial neuronal network) in medicine over the past 10 years has only increased, as reflected in the progressively increasing number of publications that include this methodology. The areas they have been developing are image recognition, wave analysis, pharmacology procedures, epidemiology, prediction of results and diagnostic processes.

This technology, which was born with some uncertainty and Luke warmness of professionals to accept this revolution regarding the information it provides, ends as a new paradigm in health care by understanding of algorithms and machine learning importance. It is our hope that elucidating these connections will demystify these techniques and provide a set of reasonable expectations for the role of machine learning and big data in health care. It is essential that all areas of the Health System have trust in computer systems specifically in deep learning, not only because the concrete and objective information that derives from it but also because the possibility of predicting future events, providing high certainty regarding the diagnosis and treatment of diseases.

Conflict of Interest

The authors declare that there is not financial interest or any conflict of interest.

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