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Usage of Predictive Analytics during COVID-19 Pandemic to Support Administrative Decision Making in Health Care

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Abstract: ***During the COVID-19 pandemic many researches have been done about the use of predictive analytic systems (PA) to take administrative decisions based on meaningful information and to help in limiting the spread of the virus and to manage hospitals resources to be able to treat the huge number of patients who increase rapidly every day. Research has shown that the usage of PA during COVID-19 pandemic has help in predicting some key indicators for decision making such as the beds allocation, residence time, rate of renewal, maximum daily rate of change. And, it helped the health care provider or hospital management to understand the short-term future demand for the healthcare equipment demand like medicine, ICU, ventilator, and also can get a clear understanding of managing the number of nurses and doctors. The usage of PA during covid-19 pandemic has proved its benefits that it can be widely used in healthcare due to its ability to support the decision making and its usage is not restricted to medical use and decision making.***

Keywords: Predictive analytics, healthcare, decision making, COVID-19

1. Introduction

Thus, Predictive analytics in general are used to detect the relationships and patterns in data to look forward, to predict the future, and discover the reason(Sunil. T et al, 2018) by analyzing the past and taking better preventive decisions(Hoda et al, 2016). This research is focusing on the usage of predictive analytics and especially during the COVID-19 and what are the benefits from its usage.

2. Review of Predictive Analytics Systems

Data mining is part of Business intelligence functionalities as defined by Gartner who described BI as a software platform delivering 14 capabilities divided into three groups of functionalities including integration, information delivery and analysis functionality which contain the data mining and predictive modeling. While data mining is considered as the automated process to detect the unknown patterns in the structured data of the organization (Martin et al, 2014) (Osama et al,2013). Another research (Mohammad.A et al, 2015) describes data mining as the process to collect, filter, prepare, analyze and store data that will be used to create useful knowledge and supporting the data analytics and predictive modelling. In fact, data analytics is divided into four types as follow:

- The descriptive analytics: which describe the current situation and answer the question what is happening now?
- The diagnostic analytics: which answer the question Why this is happening?
- The predictive analytics: which answer the question what will happen in the future?
- The prescriptive analytics: which answer the question what is the right choice or solution?

Thus, Predictive analytics in general are used to detect the relationships and patterns in data to look forward, to predict the future, and discover the reason(Sunil. T et al, 2018) by analyzing the past and taking better preventive decisions(Hoda et al, 2016).The classification of analytical methods starts by the descriptive analytics which look backward and deliver information that help in understanding what happened in the organization. Thus, business intelligence (BI) is considered as descriptive analytics and it had proven its efficiency in enhancing the quality and process of decision making (Lior, Nir, and Adir, 2017). Whereas, predictive analytics is a higher level than descriptive analytics due to its capability to create insight to know what can happen in the future which help decision makers to make fact-based decisions. Based on that, we can consider that predictive analytics have been developed to optimize the level of analytics and results of BI which are the precedent and preparatory stage for predictive analytics that can analyses the information delivered by BI to create insight and make future predictions and better decisions.

For the predictive analytics process it pass by five phases, the identification of the problem, the collection and preparation of the data, analysis of the data and the development of the model, the deployment, observation and control of the predictive model (Kosemani, Shaun, Pavol, 2016). Moreover, (Michael, Sule, and Dan, 2015) define predictive analytics as technologies and methods that allow organization to detect orientations and patterns in data, developing models, and testing a huge number of variables. The predictive analytics are used by organizations to achieve their desired goals and increase their profits. Predictive analytics are considered by(Hoda et al, 2016) as a prediction of the future by analyzing the past performance and studying the historical data to uncover the relationships and patterns in these data. While (Prasada, S.Hanumanth, 2014) add that

the predictive analytics help organizations' in predicting risk, tendency, and in attaining better revenues by enhancing their key metrics and making strategic corrections and this is by making accurate predictions from structured and unstructured information. Those predictions are done based on models. Thus, predictive models are creating during the predictive modelling process to discover the patterns between dependent variables and explanatory variables and predicting an outcome (Prasada, S.Hanumanth, 2014) (Meryem et al, 2016). Various algorithms are used:

Classification: decisive outcome, it's for predicting the value of decisive variable (class or target) by constructing a model based on one or multi decisive or numerical variables (attributes or predictors).

Clustering (unsupervised learning): assigning observations into clusters, each cluster contains the similar observations and data. This process helps in discovering the unknown relationships in a dataset.

Association rules: to find important associations in the observations, which mean association rules find all item sets that have support greater than the minimum support and then using the large item sets to generate the desired rules that have confidence greater than the minimum confidence. An example of association rules application is market basket analysis which is a modelling technique that can be described simply as if a customer buys a specific set of items, he will probably buy another set of items.

Regression: numerical outcome, predicting the value of target (numerical variable) by constructing a model based on one or more predictors (numerical and categorical variables). There are different families of these algorithms and different ways of measuring the error.

Indeed, predictive analytics will be defined in this research as the analysis of past performance, structured and unstructured data by using predictive models, to discover new patterns and information to learn, to predict the future and make better and preventive decisions.

3. Usage of Predictive Analytics Systems in Healthcare

Healthcare predictive systems are analytic systems which aim to minimize the future medical cost and help to provide in hospital a high level of healthcare and preventive healthcare due to the early detection of risks and possibility to take better actions and decisions. In fact, those predictions are based on the historical patients' data including detailed information about the patient, his medical history and diagnoses.For instance, in one of hospitals in Texas due to predictive analytics the hospital could save more than half million dollars by implementing a predictive system that predict any complications of heart failure patients to prevent it. Thus, the predictive analytics use models which suggest algorithms to help in the medical treatment and disease detection; or it can be used beside the electronic health records systems (Mohammad et al, 2015). (Yichuan et al, 2016) highlight also that predictive analytics has been extensively used in healthcare to reduce preventable readmissions rates, to allow faster and better decision making by managers, and contribute in preventive healthcare. Moreover, it assists healthcare organizations to evaluate the situation of their current services, determining the best clinical practices, reduce healthcare costs, and understand the future trends in healthcare.

A research conducted to analyze types of analytics used in the healthcare literature has shown that the most analytics used are descriptive, predictive, and prescriptive. Moreover, most of the articles applied the analytics for the decision making in healthcare. The highest application area of predictive analytics was for the clinical decision support as shown in the figure below followed by a high percentage of its use in the healthcare administration such as for reducing costs, improving quality, and resource allocation (Md S.I et al, 2018).

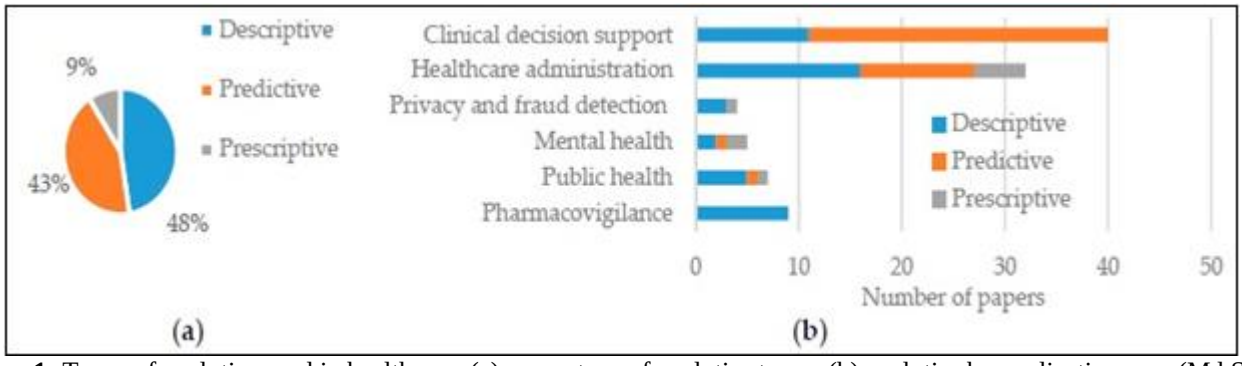

Figure 1: Types of analytics used in healthcare, (a) percentage of analytics types, (b) analytics by application area (Md S.I et al, 2018)

Moreover, to be able to make those analysis many tools and techniques are used to support the predictive analytics in the analysis of healthcare data such as Hadoop which is an open-source distributed data processing platform from Apache. Hadoop can have two functions as a data analytics tool and a data organizer tool with an ability to process huge amount of data due to its two components which are the Map/Reduce and the Distributed File System. Thus, the Map/Reduce is based on programming models to handle huge datasets by their division to small blocks of functions thus its able to fragment tasks into subtasks and combining its outputs, it also allows to perform operational calculations effectively in a huge number of data and it save time due to parallelism technique which enable to run multiple task in

the same time. It utilizes the distributed algorithms on a set of computers in a cluster to handle these huge data sets. While, the Hadoop Distributed File System (HDFS) to ensure accuracy will copy the data blocks which remain on other computers in the data center and it will manage the transfer of data to different part of the distributed system. It helps in portioning the huge amounts of healthcare data to small cluster and disseminate it to other systems and its able to eliminate the redundancy in data, another similar system to the HDFS is Casandra File System (CFS). Another tool is JAQL which is a functional query language it can support and function with the MapReduce ; Hive is also able to address a huge number of data but with slow process and it can does all the excel functions which does not require the real time performance; Presto engine is characterized by its ability to analyze a great amount of data in a very fast and rapid time of performance; Vertica can also analyze huge amount of data rapidly but with less cost and known by its scalability; Complex Event Processing(CEP) it allow to link events in data to the real time; Mahout which help in producing application that assist Hadoop systems for Healthcare analytics (Mohammad et al, 2015).

The usage of predictive analytics in healthcare was mainly for the clinical decision support and its used in the healthcare administration such as for reducing costs, improving quality, and resource allocation. The table below show some of researches conducted on the use of predictive analytics to overcome many healthcare challenges.

Table 1: Review of previous research of predictive analytics use in healthcare

Usage Purpose	*Comments*	*Reference*
predicting future hospital visits and hospital costs to enhance the clinical decision making	This research has highlighted the significant role that predictive analytics can play to make enhanced administrative decisions and reducing costs. Moreover, two methods were proposed to predict the number of future visits for a patient to the hospital and the total future charges for each patient and based on those two methods an assessment of patients' risk level will be predicted and identification of patients with high risk to better provide health care services and treatment.	(Archana. C, 2017)
Predicting chronic kidney diseases	In this research the right choice of the classification algorithm used has result a low error rate and prove a good performance in term of time and accuracy of predictions. Moreover, this research emphasizes on the importance of using predictive analytics to have a preventive health care and to help in decision making.	Basma. B et al, 2016)
Early detection of liver disease and testing the accuracy of different classifications algorithms	The results of this research emphasis on the necessity to choose the right variables, models, and algorithms when using predictive analytics in order to get accurate predictions	(Tapas, and Subhendu, 2016)
Complex model to support decision making in treatment of acute coronary syndrome, and predicting the risk, and unwanted events such as clinical death	This research strength for better usage of predictive analytics to use a combination and integration of various models in a complex predictive model which increase accuracy of predictions and decrease the biased decisions	(Alexey V et al, 2016)
To predict the Chronic obstructive pulmonary disease (COPD) aggravation risks before it happens to prevent it	The limitation of this research is the use of a limited number of data which decrease the accuracy and correctness of results. Thus, data availability affects the usage and results of predictive analytics	(Riad Alharbey, 2016).
Developing predictive models to define the factors affecting the death anxiety.	The predictive models were tested on the HER nursing system and it results a high accuracy prediction which can contribute to minimize the healthcare costs and improving the quality of care and services	(Muhammad. K et al, 2015)
predicting types of diabetes diffuse, complications, and identifying possible treatment	The system developed in this research target to detect earlier diabetes which will cure diabetes patients and decrease the costs of the treatment, but the efficiency of this research can be affected by depending solely in Hadoop as a tool especially that it does not give the query functionality and it run slower than other database management systems	(Saravana.K et al, 2015)
Predict the disease risk in short term for the patients of heart failure in the tele-health environment. The goal of this system is to improve the decision making and minimizing the cost and time for patients	The system needs to be improved to reduce more the workload of patients and more tests. And experiments on larger number of patients might be made to ensure of the accuracy and ability of the system	(Raid et al, 2015)
to predict the need to transfer a stroke-in-patients to the intensive care unit	This research had a contradictor results with many other researches by finding that the artificial neural network algorithm has less accuracy in comparison with other tested algorithms in this research. But to approve this result there is a need to make the test with larger and diverse amount of data	(Nawal N, Sreela, 2015)
predicting number of hospitalization days by using data of health insurance claims	this kind of research help hospital to provide better quality of care, lower the costs and well allocation of hospital resources, but the use of more detailed information about patient medical history will lead to higher accuracy in the prediction especially with the incompleteness and low data quality and missing values in the insurance especially the clinical data such as the codes of diagnoses	(Yang et al, 2014).
Predicting mortality rates in the intensive care units	The results were positive, and this kind of research encourage the healthcare organizations to use the predictive models to enhance the quality of healthcare and services provided to patients.	(Yun, Hui, 2014).
To predict the readmission of patients	In this research also, there is a confirmation through the results that the multiple	(Mohammad et al,

with heart failure based on a multiple model	model lead to higher and better predictive results which is consensus with the results of many other researches in predictive analytics in healthcare	2014).
Developing a parallel predictive modeling (PARAMO) based on HER to make the process of health data simple and faster	This platform has been to allow the independent tasks to work in parallel in a cluster computing environment. the results of the research have shown an important improvement of speed of research workflow and reutilization of health information compared to standard approaches of running sequentially. The weakness in this research is their focus on the scalability of PARAMO and the have forget the quality and accuracy of predictions. Moreover, the development of predictive models based on EHR data have improve its success during its application on several targets' disease.	(Kenney et al, 2014).
Predicting risk of readmission for patients with congestive heart failure	In this research they have use the operational data to make predictions, which might be incomplete. Moreover, the accuracy was acceptable, but the data number was small and lack of diversity which decrease the validity and accuracy of results.	(Samir.E et al, 2014)
To predict diabetes patients' conditions and improving decision making	The results of this research were not satisfactory regarding the prediction of wellness where the accuracy was low, but the results for predicting diabetes occurrence was higher and more accurate.	(Ravi.S et al, 2014)
Predicting readmission of patients with (pneumonia, acute myocardial infarction, or chronic obstructive pulmonary, and heart failure disease.	This study had weaknesses such as the use of homogeneous data which lack of diversity, and the data was only from administrative data which make the predictions inaccurate and this was proved by research before that administrative data is not enough to efficiently identify and differentiate between the preventable and non-preventable readmissions	(Issac, Saeede, Kai, 2014) (Elizabeth et al, 2013)
Predicting 30-day- readmission risk of congestive heart failure patients	In this research they have use multi-algorithm which lead to the satisfactory results of the research with high accuracy.	(Kiyana et al, 2013)
Multiple predictive model to predict the physiological status of patients	This research has integrated four different algorithms to take benefit of the strength of each one in addition to their combination with multiple schemas which increase the accuracy of prediction results	(Peter K, Kailash C, 2013)
To predict the hospital length of stay (PHLOS) andto recognize which patients require fast and early interventions or normal interference to prevent any complication that may lead to length of stay	The results of this research show that the use of clustering algorithms with classification algorithms lead to have results with higher accuracy but the results of this research were approved only by one expert of emergency medicine thus the results of the research need to be tested and validated to be approved.	(Ali, Vandana P, Alex, 2012)

Indeed, from the table above we can see that the previous research in predictive analytics use in healthcare sector was focusing mainly in technical perspective and in the development of algorithms and models to help to overcome clinical challenges; chronic diseases; and enhancing clinical decisions. Those researches have shown that there is a consensus that the use of multiple models or the integration of various algorithms together can help significantly in improving the accuracy of predictions. And, the right choice of the algorithm and of the data to be used is also very important to get efficient results with high accuracy. Moreover, the integration of predictive analytics with other hospital systems improve the results of predictions. Although, data quality and availability still a challenge in predictive analytics application where many studies show the issue of lack of data and it's not available to be able to test and train the predictive models developed. In addition to problems in data quality such as the incomplete data. Moreover, in some cases the Unavailability of right data for the right model to get right predictions affect the quality of results. However, despite those challenges, predictive analytics had proven its ability to bring many benefits to healthcare by its use in solving medical problems,reducing costs, High quality of healthcare, better services, better resource management and allocation, better clinical decisions, saving people lives, and preventing diseases.

In addition to researches focusing on clinical application of predictive analytics a research was handling the costs and resource planning of healthcare sector. Thus, it focuses on demand prediction to know the places that need the healthcare services and include it in the future plans which will organize the demand and supply of healthcare services. While, the aim is to develop a model to predict the demand for healthcare services in Emirate especially Abu Dhabi. This is by combining four predictive models which are known by its high accuracy results K Nearest Neighbor (KNN), Naïve Bayes (NB) algorithm, Support Vector Machine (SVM), and C4.5 algorithms which are an extension of ID3 of decision tree algorithm. The tool of analysis used is WEKA due to its great ability to process the used models. The results of this research show a high demand on some places for the healthcare services. But this result is not enough and accurate which require more research with more descriptive attributes to enhance the accuracy of the results (Noura Al Nuaimi, 2014).

Indeed, this research give the ability to ministry of health, and hospitals managers to be able to coordinate together firstly to know more about the prioritization list of places that need more healthcare services, secondly, they can allocate the needed resources to be able to deliver those services. In addition, they can use it to distribute and manage hospitals staff depending on the priority of places with high need of healthcare services. Thus, in this context predictive analytics help managers in making right decisions about the resources allocation and management including the right distribution of workforce among hospitals to ensure the delivery of high quality of healthcare and services and this was emphasized by (Archana. C, 2017) who highlighted in his research that "*One fourth of all healthcare budget expenses go towards administrative costs. This is a proof that, there is a room for significant improvement to cut down costs and improve operational efficiency. Recent advances*

in healthcare analytics however, have helped make better administrative decisions improving efficient and cutting down on overhead "(Archana. C, 2017). And explained the significant role that predictive analytics can play to make enhanced administrative decisions and reducing costs.

4. Decision Making in Healthcare

In healthcare the decision making is complex, thus all the decision makers in hospitals such as managers have a considerable responsibility to use appropriately and manage the available resources, reducing costs, and providing a high quality of healthcare services. Furthermore, managers take decisions based on collected information which must be with high quality to be able to make and implement right and successful decisions. Some factors can be taken into consideration during decision making such as the decision maker characteristics, the nature and context of the decision, the availability of the information needed for making a decision, financial and economic factors, and the governmental regulations and politics. Moreover, the use of data and analytic tools, advanced personal skills and the convenient organizational climate lead to have better decisions based on evidence. (Akyürek, Sawalha, Ide, 2015)

In fact, one of the main reasons to use the information technology systems in the healthcare is to assist the decision-making process to make it more effective and efficient by reducing the time to access to the information (Elina. K et al, 2013). (Helen, Paul and Douglas, 2012) found in the use of computerized decision support systems (CDS) an opportunity for hospitals to solve their problems and to increase and encourage the adoption of CDS in hospitals by learning from the previous experiences in different disciplines where the decision support design has features such as the customizing interfaces for specific users and roles, effective presentation of data, generating multiple scenarios, allowing for contingent adaptations, facilitate collaboration. Moreover (Helen W Wu., 2012) emphasize on the importance of organizational culture and training in the success of CDS implementation and found that the best style of decision-making is by combining the two approaches of decision making which are rational analytic and naturalistic -intuitive styles. The rational- analytic style is based on data and models to make decisions its usefulness is in the synthesize of big amounts of information and reducing bias on the other hand naturalistic-intuitive decisions are made based on human experience.

(Çağdaş, Raya, Sina, 2015) argue that decision making in health care can be considered complicated as it has two sides a clinical and a nonclinical one, in addition the decision must take into consideration multiple factors such as patient treatment and cost, thus the pressure of decision making is high on the healthcare managers due to the necessity to make budgetary and operational decisions and improving operational efficiency and eliminating unimportant costs and maintain the quality of healthcare provided to patient high. (Çağdaş, Raya, Sina, 2015) highlight the factors that affect the decision-making process in healthcare organizations which are the knowledge based decision making, informative decision making, training, organizational factor, the usage of specific models for decision making and decision supporting tool have positive impact on decisions making process, in addition to the decision maker capabilities, financial resources, The timelines of decisions, the delegation of decisions, and shared decision making factors. Although, knowledge and evidence informed decision makingwas the most cited factor to influence the decision making

In fact, the healthcare sector faces more challenges than any other sector such as ensuring the patient access to services and keeping a high quality of healthcare. Although, the results at the end of research had shown that the prime factor affecting hospital performance among management practices and have the highest effect is the communication and in the other hand the lower effect is decision making which was explained by the fact that its supported by the structure. Moreover, the key decisions do not come from the hospital board rather from the ministry and district authorities. However, for effective management in hospitals this demand an efficient usage of funds, and expert governing structures (John. B.K.., 2015).

Indeed, making the right decision clinical or administrative at the right time is not an easy task especially in healthcare due to the complexity of structure, processes, and the role of external authorities such as government and ministry. Thus, taking decisions based on experience and intuitive of decision makers is not enough especially with the need to have rapid and effective decisions in hospitals for this decision makers can use the analysis results of analytic systems to take operational and tactical decisions based on the meaningful information presented by the analytic systems.

5. The Usage of Predictive Analytics During COVID-19 Pandemic

In the context of the Covid-19 which is the most difficult pandemic since the Spanish flu of more than a century ago. The fast outbreak of Covid-19 and the wide spread all over the world transformed a local disease, initially located in China, into a global problem; thus, the name: pandemic. Since and during the Covid-19 pandemic many researches has been done about the use of predictive analytics to help in reducing and limiting the spread of the virus and to help hospitals managing their resources appropriately to be able to treat the huge number of patients who increase rapidly every day.(Davide M et.al, 2020) proposed a model that can be used by medical doctors and decision makers to predict trends on short-term and long-term. The daily updated of the model with real data allow predicting some key indicators for decision making such as the beds allocation, residence time, doubling time, rate of renewal, maximum daily rate of change (positive or negative), etc… the models allow to distinguish the possible departure of the phenomenon from the predicted trend and thus can play the role of early warning systems and describe further outbreaks. This research used available simple mathematical models which are regression based in order to get higher accuracy predictions and reduce the difference between predictions and real data.(Shreshth. T et.al, 2020) applied an improved mathematical model to analyze and predict the growth of the

epidemic. A machine learning ameliorated model has been applied to predict the potential threat of COVID-19 in countries worldwide. Machine learning is used to handle large data and intelligently predict the spread of COVID-19 and the cloud computing can be utilized to rapidly promote the prediction process using high-speed computations. Further, a case study has been presented in this research which shows the severity of the spread of COVID-19 in countries worldwide. Using Robust Weibull model based on iterative weighting and the results show that this model is able to make statistically better predictions than the baseline. The baseline Gaussian model shows an over-optimistic picture of the COVID-19 scenario. A poorly fitting model could lead to a non-optimal decision making, leading to worsening of public health situation. This research presents a prediction model deployed using HealthFog framework leveraging the FogBus for deploying multiple analysis tasks in an ensemble learning fashion to predict various metrics, like the number of anticipated facilities to manage patients and the hospitals., the increase and decrease of the number of cases in near future and the date when different countries may expect the pandemic to finish. The dataset used in this case study is the Our World in Data by Hannah Ritchie. The dataset is updated daily from the World Health Organization (WHO) situation reports. Another research has been done by (Manotosh. M et.al, 2020) who formulated a mathematical model introducing a quarantine class and governmental intervention measures to reduce the spread of the disease. The researchers have proposed and analyses the classical SEIR type mathematical model to include the COVID-19 scenarios in the system. Researchers have studied the dynamical behavior of the model in terms of the basic reproduction number of COVID-19. And the results show that reducing the contact of exposed and susceptible humans is the most critical factor in achieving disease control. (O. Torrealba-Rodriguez et.al, 2020) also used modelling and prediction of COVID-19 cases of infection in Mexico through mathematical and computational models utilizing only the confirmed cases provided by the daily technical report of COVID-19 in Mexico until May. The mathematical models: Gompertz and Logistic, as well as the computational model: Artificial Neural Network were applied to carry out the modeling of the number of cases of COVID-19 infection from February 27 th to May 8 th. The results show a good fit between the observed data and those obtained by the Gompertz, Logistic and Artificial Neural Networks models. Moreover, Gompertz, Logistic and inverse Artificial Neural Network model were used to predict the total number of COVID-19 infected until the end of the epidemic. Currently, COVID-19 pandemic has spread more than 200 countries, and many newly affected countries are failing to manage better healthcare services due to a lack of accurate prediction. Regarding this condition, the early prediction might improve the healthcare service facility. (Najmul Hasan, 2020) proposed a hybrid model which combines ensemble empirical mode decomposition (EEMD) and artificial neural network (ANN) to predict the daily trend of the COVID-19 epidemic based on the real-time global COVID-19 time series dataset. Firstly, researchers used the EEMD decomposition technique to denoise the time series and then build an ANN model to train and predict the data. And at the end researchers compare the suggested EEMD-ANN model with some traditional statistical techniques. Based on the results, EEMD-ANN provides a promising indicator to predict the COVID-19 epidemic. The implications of this stud y are that firstly the model offers decision-makers the chance to analyze the effects of the new COVID-19 pandemic in their jurisdictions and can get the idea of implementing social-distancing mitigation strategies such as a lockdown. Secondly, the government and national policymaker might apply this EEMD-ANN model for short term prediction for better handling of an imminent uncertain hazard. Thirdly, the health care provider or hospital management may use this model for understanding the short-term future demand for understanding the healthcare equipment demand like medicine, ICU, ventilator, and also can get a clear understanding of managing the number of nurses and doctors.

6. Conclusion

Certainly, predictive analytics has been used widely in different sectors and in healthcare and has shown many benefits of its usage such as in solving medical problems, reducing costs, High quality of healthcare, better services, better resource management and allocation, better clinical decisions, saving people lives, and preventing diseases. However, the usage of predictive analytics was limited in healthcare in comparison to other sectors while it was more focused to solve medical problems while latest research has shown that predictive analytics can play an important role to make and improve the administrative decisions and reducing costs. Indeed, making the right decision clinical or administrative at the right time is not an easy task especially in healthcare due to the complexity of structure, processes, and the role of external authorities such as government and ministry. Thus, taking decisions based on experience and intuitive of decision makers is not enough especially with the need to have rapid and effective decisions in hospitals for this decision makers can use the analysis results of analytic systems to take administrative decisions based on the meaningful information presented by the analytic systems. And this what has been done during the COVID-19 pandemic where many researches has been done about the use of predictive analytics to help in reducing and limiting the spread of the virus and to help hospitals managing their resources appropriately to be able to treat the huge number of patients who increase rapidly every day. The research has shown that the usage of predictive analytics during COVID-19 pandemic has help in predicting some key indicators for decision making such as the beds allocation, residence time, doubling time, rate of renewal, maximum daily rate of change (positive or negative). And, it helped the health care provider or hospital management to understand the short-term future demand forthe healthcare equipment demand like medicine, ICU, ventilator, and also can get a clear understanding of managing the number of nurses and doctors. To conclude, the usage of predictive analytics during covid-19 pandemic has proved its benefits that it can be widely used in healthcare due to its ability to help and support the decision making and its usage is not restricted to medical use and decision making.

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