Exploring Data Mining Techniques In COVID-19 Research

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Introduction

- COVID-19 pandemic posed unpredictable and difficult challenges.
- Data mining techniques were needed to extract knowledge and information from large datasets.
- Necessary for:
  - Tracking the spread of the virus
  - Predicting outcomes
  - Responding to the virus

Paper Overview

- “Using Data Mining Techniques for COVID-19: A Systematic Review”[1]
  - Application of supervised learning techniques. Natural Language Processing being the most used DM technique.
- “Using data mining techniques to fight and control epidemics: A scoping review”[2]
  - Supervised learning techniques: Logistic Regression and Classification
  - Unsupervised learning techniques: Clustering and deep learning approaches

Methods Used

- The primary goal of these papers was to compile a list of papers on the use of DM techniques in pandemics.
- **Natural Language Processing (NLP):**
  - Most used method (22%) in the literature for COVID-19
  - Disease spread, public sentiment, potential treatments
- **Supervised Learning:**
  - Most used across studies (90%)
  - Used to predict disease outcomes and trends
- **Clustering Algorithms:**
  - Grouping patients based on symptoms or outcomes
- **Association Rules and Frequent-Itemset Mining:**
  - Used for finding relationships between symptoms or coexisting conditions.

Methods Used

Author	Main approaches	Clinical scope	The applied method of data mining	Software (Environment)	Data source
Abd-Alrazaq A et al. [30]	Infoveillance	Social behavior	Text mining	Python	Twitter
Ahamad MM [19]	Disease characteristics	Infectious disease	Decision Tree, Random Forest, gradient boosting Machine, SVM	SPSS	Github repository
Ren X et al.	Treatment	Pharmacology	Association rule mining method, and association knowledge network	R	Traditional Chinese medicine system pharmacology database
Zhang Y et al. [31]	Infoveillance	Psychology	Time series, NLP, and deep learning	Python	Weibo social network
Sudirman ID Nugraha DY [59]	Risk factors	Infectious	Naive Bayes method	Rapid Miner	Ministry of Public Health Thailand
Huang C et al. [20]	Disease characteristics	Infectious disease	Text mining	Python	Sina Weibo social network
Han X et al. [32]	Infoveillance	Infectious disease	Time series, Random forest, Spatial Distribution	Python	Sina Weibo social network
Ibrahim et al. [61]	Tracing transmission	Epidemiology	ANN	not mentioned	CDC
Foieni F et al.[22]	Disease characteristics	Respiratory medicine	Multivariate Regression	SPSS	WHO
Zhao ZR et al. [46]	Patient monitoring and follow- up	Respiratory medicine Regression model	SPSS	COVID-19 PUI registry	Respiratory medicine Regression model
Fan Q et al. [60]	Risk factors	Cardiology	Logistic regression	SPSS	Wuhan Tongji hospital
Lei MT et al. [62]	Tracing transmission	Epidemiology	CART, Linear regression	SPSS	Macao Meteorological and Geo- physical Bureau
Dong YL et al. [42]	Patient monitoring and follow-up	up Infectious disease	Logistic regression	SPSS	Wuhan union hospital
Roland LT et al. [26]	Disease characteristics	Respiratory medicine	Logistic regression	SPSS	San Francisco (USF) institutional
Zhou YW et al.[51]	Early diagnosis	Infectious disease	Logistic regression, Nomograms	R	47 locations in Sichuan province
Li S et al. [54]	Early diagnosis	Psychology	Text mining	SPSS	Weibo posts
Ayyoubzadeh SM et al. [34]	Infoveillance	Epidemiology scope Linear regression and long short	term memory (LSTM) models	Python	Google data
Qiang X et al. [50]	Active case prediction	Infectious disease	Random forest (RF) method	R	China national genomics data center
Liu. Q et al. [27]	Disease characteristics	Infectious disease	Logistic regression	SPSS	Union Hospital, Tongji medical
KostkovaP et al. [41]	Outbreak prediction	Public health	Text mining	Not mentioned	Twitter
Kostoff RN [35]	Infoveillance	Informatics	Text mining	Not mentioned	Medical literature
Szomszo M et al. [36]	Infoveillance	Informatics	Text mining, linked resource	Not mentioned	Twitter

Table 3 Frequency of data mining techniques in reviewed studies

DM techniques	Frequency		Studies
NLP techniques	11	22.00%	[20–30]
Logistic regression	10	20.00%	[31–40]
Time series	7	14.00%	[20, 41–46]
Random forest	7	14.00%	[47, 45, 48, 49, 42, 50, 51]
Regression models	7	12.00%	[52, 53, 40, 49, 54, 55, 39]
Decision tree	6	12.00%	[51, 48, 56–58,39]
ANN	5	10.00%	[52, 59, 60, 21, 61]
Naive Bayes	3	6.00%	[62–64]
SVM	2	4.00%	[49, 51]
Association rule mining	2	4.00%	[66, 58, 67]
Clustering	2	4.00%	[34, 30]
Apriori algorithm	1	2.00%	[65]
Genetic algorithm	1	2.00%	[55]
Fuzzy algorithm	1	2.00%	[41]

Methods Used

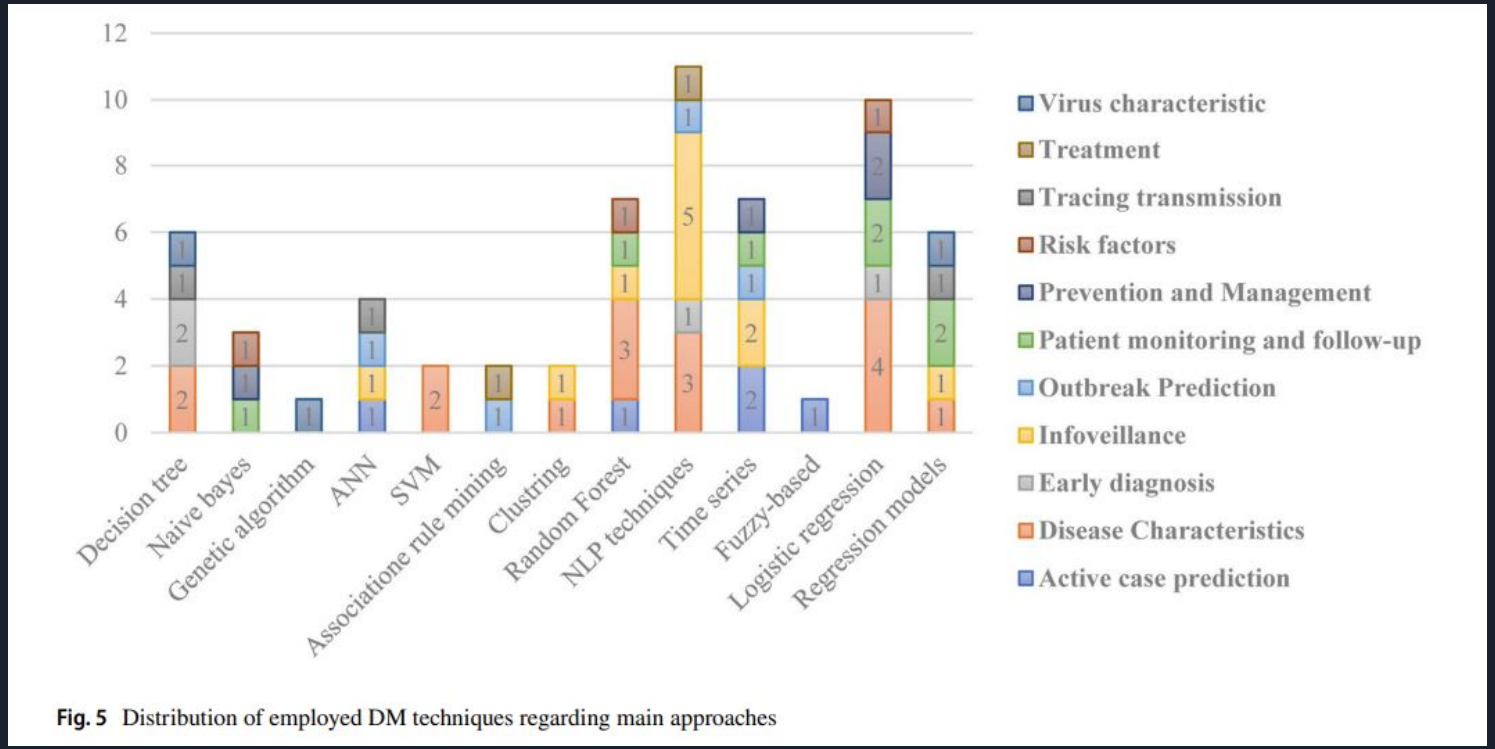


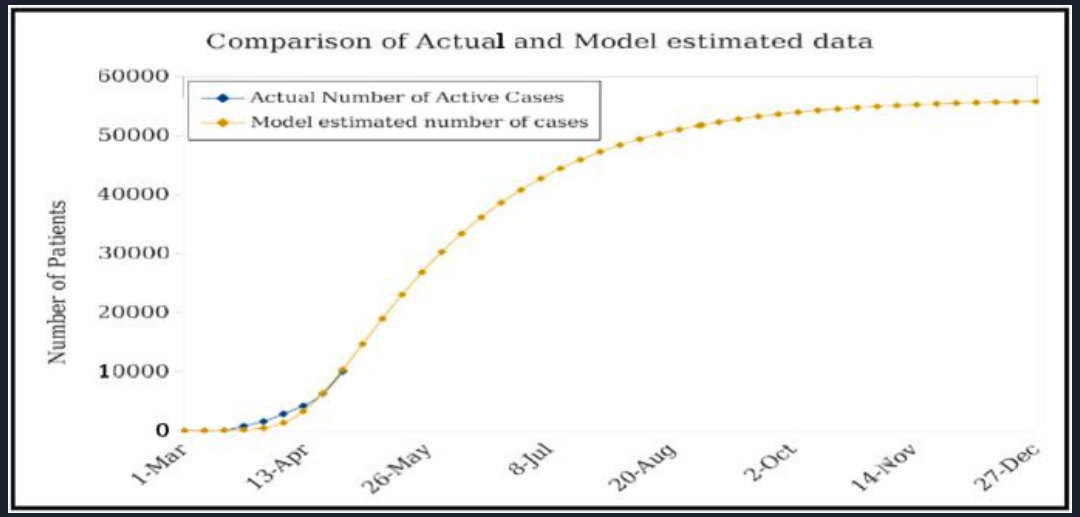
Fig. 5 Distribution of employed DM techniques regarding main approaches

Advantages and Limitations

- **Advantages:**
  - **Diverse Data Handling**
  - **Predictive Power**
  - **Pattern Recognition**
- **Limitations:**
  - **Data Quality**
  - **Data Availability**

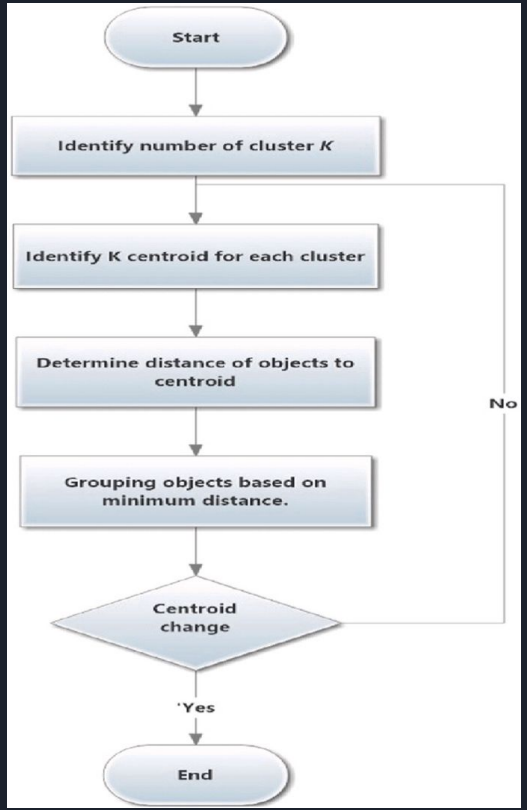
Paper Overview

- “Using data mining techniques deep analysis and theoretical investigation of COVID-19 pandemic”
  - Focused on covid-19 human body data in Iraq
  - Application of K-Means Clustering



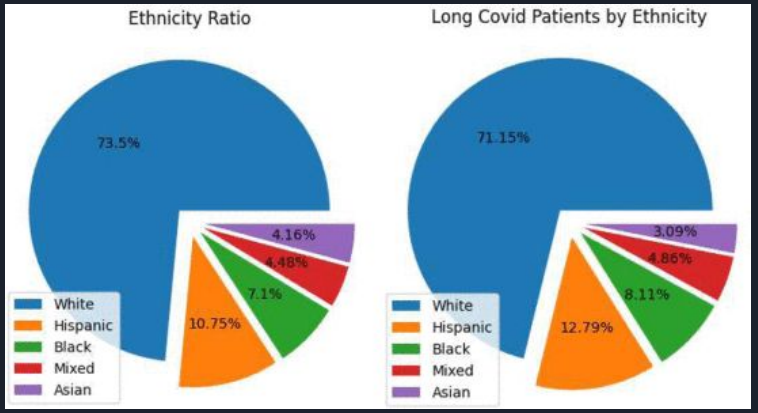
Analysis

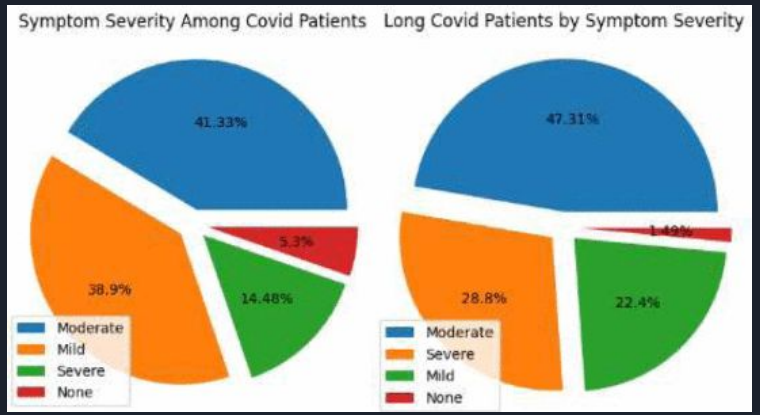
- **Advantages**
  - Lower parameter, less intense model preferred
- **Limitations**
  - Occasionally K-Means will evaluate irrelevant information or ignore essential facts
  - Data accessibility



Paper Overview

- “Mining Big Healthcare Data to Predict Long COVID Cases”
  - Focuses on predictions post COVID
  - Demographic and symptom analysis
  - Frequent Itemsets and Association Rules

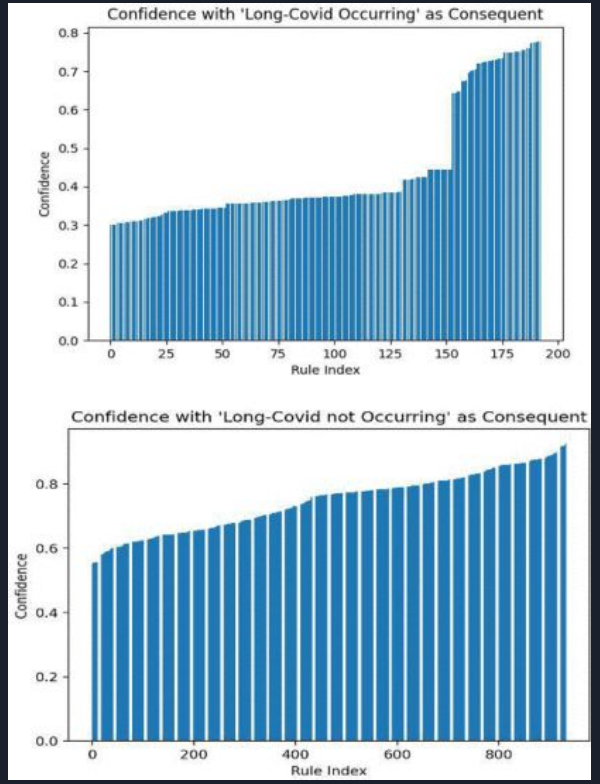




Analysis

- **Advantages**
  - Combination of different classifications of data can provide better results

- **Limitations**
  - Few studies on long COVID and the combination of demographic and symptom data



Paper Overview

- **“K-Means Clustering Identifies Diverse Clinical Phenotypes in COVID-19 Patients”**
  - Identify patients with similar viral stats
  - Mortality associated with use or not of antivirals in hospitalized covid 19 patients
  - Elbow method determined best number of clusters to be 5

Main characteristics of Clusters

K-means cluster	Median Ct (IQR)	Median days of pre-test duration of symptoms (IQR)	Median lymphocyte count (IQR) ($\times 10^9$/L)	60-day mortality (%)	60-day mortality/pts receiving remdesivir (%)	60-day mortality/pts who did not receive remdesivir (%)	*p* value
Cluster 1							
Derivation cohort *n* = 100	26 (23–30)	5 (3–7)	1.7 (1.5–2)	2	0	2.4	0.54
Validation cohort *n* = 167	25 (22–29)	6 (4–7)	1.8 (1.6–2.2)	6.6	0	7.2	0.28
Cluster 2							
Derivation cohort *n* = 273	24 (22–26)	8 (7–9)	0.8 (0.6–1)	11	0	11.3	0.35
Validation cohort *n* = 292	21 (18–25)	8 (7–9)	0.9 (0.7–1.1)	7.2	3.2	7.7	0.37

Paper Overview

- “Artificial Intelligence -based support for model for new drug development planning
  - New drug development success is currently very low
  - The approach taken combines association rules, collaborative filtering and content-based filtering approaches
  - Applied to see the success probability of a company developing a new covid vaccine

Comparison of Degree of Advancement in Clinical Trial Phase with Prediction Score

Phase advanced	Prediction score (mean)	Number of companies
0	0.029	41
1	0.159	23
2	0.188	14
3	0.411	8

Introduction to Medical Data Analysis

“Big data analytics for preventive medicine”

- Unlocking Insights, Improving Care, and Reducing Costs
- Overview of the complexity and importance of medical data analysis.

Challenges in Healthcare Data Analysis

- Data Volume
- Data Variety
- Data Quality
- Data Privacy and Security
- Interoperability
- Resource Constraints
- Complexity of Healthcare Systems
- Adoption Barriers

Advantages of Using Data Analytics in Disease Prevention:

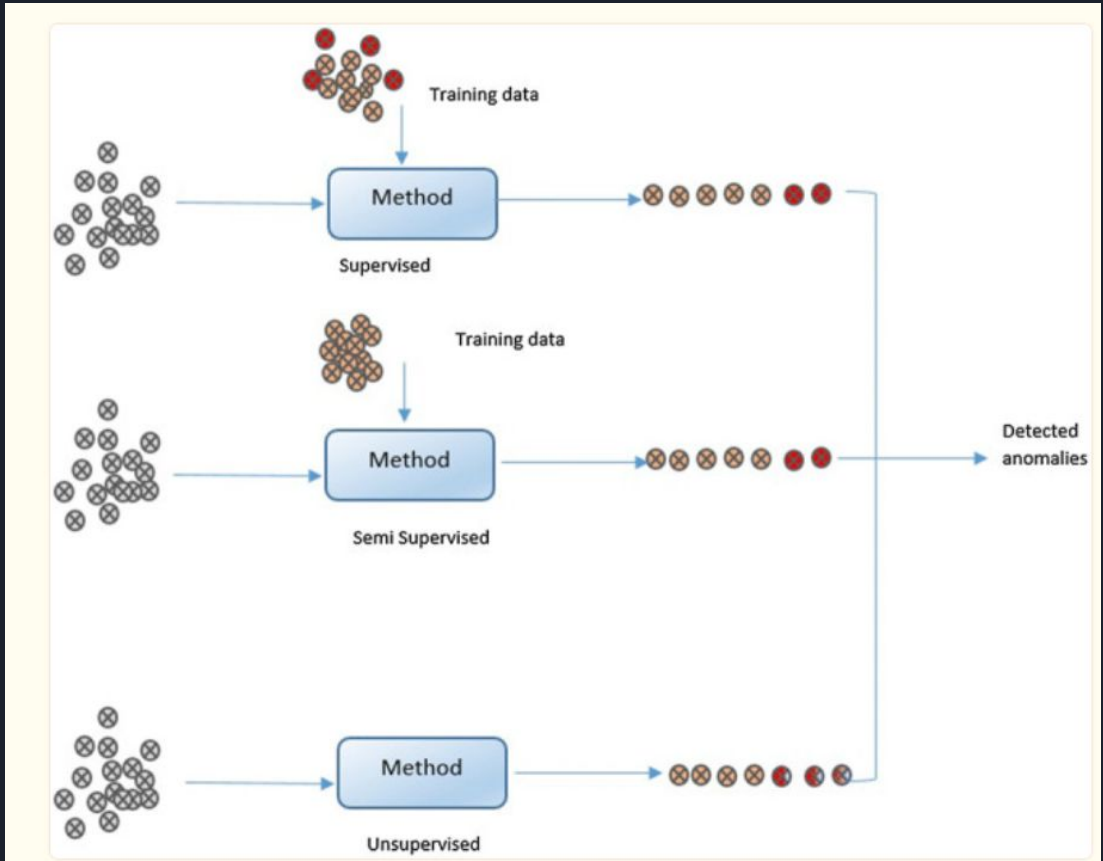
- Early Detection
- Personalized Medicine
- Predictive Analytics
- Evidence-Based Decision Making
- Cost Savings
- Continuous Improvement
- Population Health Management

Role of Data Analytics in Disease Prevention:

- Importance of Disease Prevention
  - Emphasize the significance of disease prevention in healthcare.

- Role of Data Analytics in Disease Prevention
  - Data analytics can contribute to disease prevention by efficiently analyzing large volumes of complex healthcare data.

Anomaly Detection in Data Mining Methods



Thanks for Listening!

Any Questions?

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