Role Of Artificial Intelligence During COVID-19 Pandemic: A Narrative Literature Review

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Abstract

The COVID-19 pandemic brought in front of mankind an unprecedented challenge. It not only tested mankind's resilience but also the human intelligence to counter the unforeseen and rapidly evolving challenges threatening the survival of the human race. In this pandemic, mankind collectively came together to control the impact of COVID-19 and deployed all resources, intelligence and knowledge to contain it. This paper makes an attempt to focus on one such dimension, which is, the usage of Artificial Intelligence (A.I.) used in its various forms by humans to tackle the deadly COVID-19 virus. The objective of the narrative review paper is to identify, examine, summarize, and synthesize the extant literature on the role of A.I. during the COVID-19 pandemic. The main research question of the paper is to analyze how the existing body of literature identifies the various application of A.I. during the COVID-19 pandemic. What were the fields in which A.I. was extensively used during the COVID-19 pandemic? The narrative review paper will only confine itself to the scholarly articles published in the journal. The database identified for locating the research papers includes Proquest, J-Store, Google Scholar, Academia.edu, Scopus, and EBSCO research database. Search terms or keywords identified are Artificial Intelligence, COVID-19, and A.I. are identified. The time period identified for choosing the paper is 2020 onwards as the pandemic COVID-19 commenced during that year. The paper presents major themes, visual data of dominating themes and discussions.

1. INTRODUCTION:

The COVID-19 pandemic was a jolt to the whole of mankind. It showed the world how fragile humankind could be in front of a virus. It was an unforeseen challenge for which the world was not prepared. The whole of mankind came together to fight this virus. The pandemic resulted in the exponential loss of life and posed a question in front of the whole of humankind: how a small virus can stop everyone from even moving out of their home? As mankind, we may be aspiring to reach unattainable dimensions of space, nevertheless, one virus led to the world coming to a standstill. With the tremendous growth in computing and computer power, A.I. as technology was exploited during this tumultuous period. This paper attempts to focus on one such dimension, which is, the usage of artificial intelligence used in its various forms by humans to tackle the deadly COVID-19 virus. The paper investigates the various fields in which A.I. as

technology was used in prevention, detection, prediction, or any other processes related to COVID-19. The narrative review paper confines itself to scholarly articles published in various journals. This paper identifies major themes, presents visual data of dominating themes, and discusses the themes.

1.1. Objective:

The objective of the narrative review paper is to identify, examine, summarize, and synthesize the extant literature on the role of Artificial Intelligence (A.I.) during Covid 19 pandemic. The main research question of the paper is to analyze how the existing body of literature identifies the various application of A.I. during the COVID-19 pandemic. What were the fields in which A.I. was extensively used during the COVID-19 pandemic?

2. METHOD

2.1 Exclusion and inclusion criteria for review:

The narrative review paper only confined itself to the scholarly articles published in the journal. The database identified for locating the research papers includes ProQuest, J-Store, Google Scholar, Academia.edu, Scopus, and EBSCO research database. Search terms or keywords identified were Artificial Intelligence, COVID-19, and A.I. are identified.
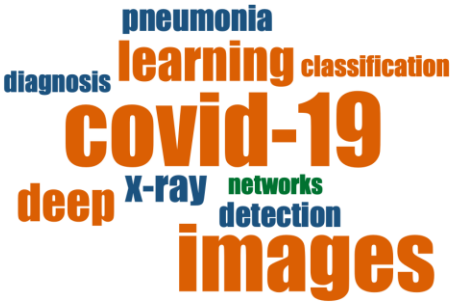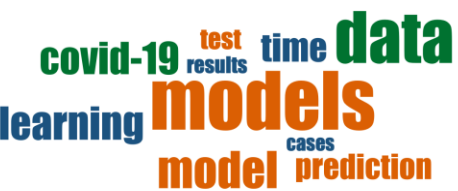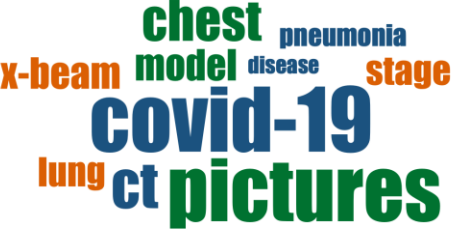
2.2 Time period:
Search terms or keywords identified are Artificial Intelligence, COVID-19, and A.I. are identified. The study excluded paid journal articles. In total eleven papers were identified and examined for: themes and patterns.
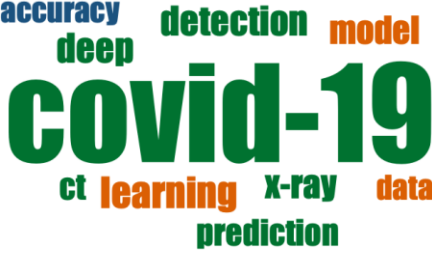
3. RESULT

3.1 Graphical representation of Data:

S No	Authors	Title	Publisher	Word Cloud
1.	P. Ramya, and P. Priyadharshi	Artificial Intelligence Driven Prediction Model for Predicting the COVID-19 Infections	International Journal of Production Technology and Management (IJPTM)	

2.	Masoud Alajmi,Osama A. Elshakankiry, Walid El-Shafai, Hala S. El-Sayed, Ahmed I. Sallam, Heba M. El-Hoseny, Ahmed Sedik and Osama S. Faragallah	Smart and Automated Diagnosis of COVID-19 Using Artificial Intelligence Techniques	Intelligent Automation & Soft Computing	
3.	Dr Saravana Kumar, Dr A.Ahila, Dr K.C.Gayathri et.al.	Intelligent Trust-based Artificial Intelligence for Identification of COVID-19	Neuro Quantology	
4.	Paul Menounga Mbilong, Asmae Berhich, Imane Jebli, Asmae El Kassiri, Fatima-Zahra Belouadha	Artificial Intelligence-Enabled and Period-Aware Forecasting COVID-19 Spread	International Information and Engineering Technology Association (IIETA)	
5.	Dr Santhiyakumari. N, Abinaya.P	Artificial Intelligence Based COVID-19 Detection Using Computed Tomograpy Images	International Research Journal of Engineering and Technology (IRJET)	

6.	Muhammad Anshari, Mahan, Hamdan, Norainie Ahmad, Emil Ali, Hamizah Haidi	COVID-19, Artificial Intelligence, Ethical Challenges and Policy implications	A.I. & Society	
7.	Viana Hassan & Georges Bellos	COVID-19: Reshaping Medical Tourism through Artificial Intelligence (A.I.) and Robotics	Athens Journal of Tourism - Volume 9, Issue 2, June 2022 – Pages 77-98	
8.	Lian Wang, Yonggang Zhang, Dongguang Wang, Xiang Tong, Tao Liu, Shijie Zhang, Jizhen Huang, Li Zhang, Lingmin Chen, Hong Fan and Mike Clarke	Artificial Intelligence for COVID-19: A Systematic Literature Review	Frontiers in Medicine	
9.	Raju Vaishya, Mohd Javaid, Ibrahim Haleem Khan, Abid Haleem	Artificial Intelligence (A.I.) applications for COVID-19 pandemic	Diabetes & Metabolic Syndrome: Clinical Research & Reviews	

10.	Muzammil Khan, Muhammad Taqi Mehran, Zeeshan Ul Haq, Zahid Ullah, Salman Raza Naqvi, Mehreen Ihsan, Haider Abbass	Applications of Artificial Intelligence in COVID-19 Pandemic: A Comprehensive Review	Expert Systems with Applications	
11.	Abid Haleem, Mohd Javaida, Ravi Pratap Singh, Rajiv Suman	Applications of Artificial Intelligence (A.I.) for Cardiology during COVID-19 pandemic	Sustainable Operations and Computers	

Combined word cloud of all final selected papers (MAXQDA generated):
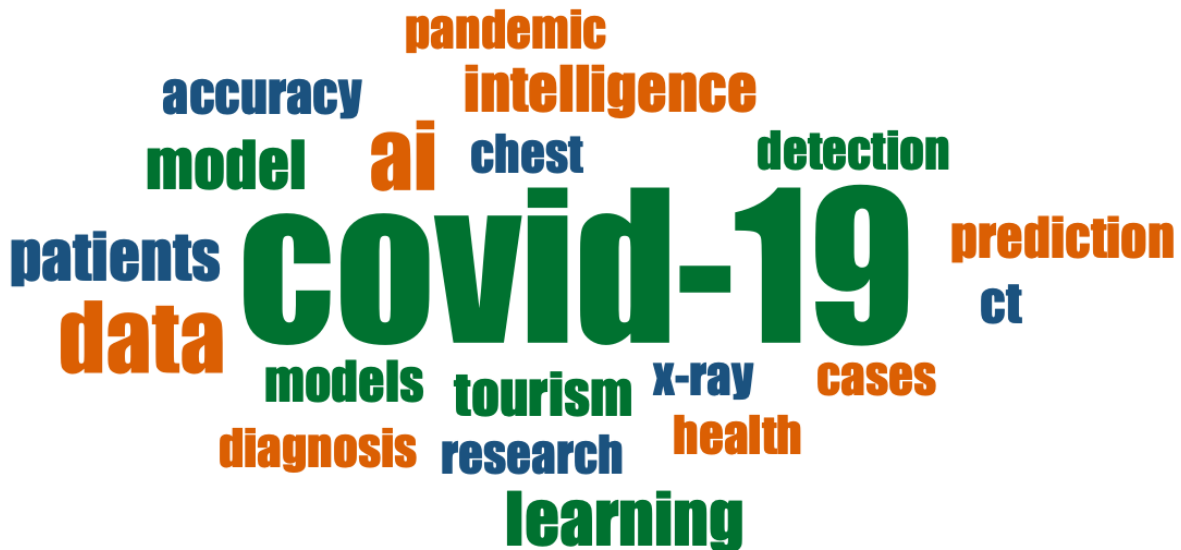
3.2 Major themes identified from the Data:

S No	Authors	Title	Themes
1	P. Ramya, and P. Priyadharshini	Artificial Intelligence Driven Prediction Model for Predicting the COVID-19 Infections	• Proposal to use Artificial intelligence (A.I.) system in supporting the clinical decision. • Usage of predictive analytic capabilities on real patient data. • COVID-19 effects on patients. • Challenges brought by COVID-19 on health infrastructure. • Role of A.I. in tackling challenges faced by the healthcare sector. • Role of A.I. in clinical decision-making. • Usage of algorithms to decide the criticality of the situation. • Usage of decision trees to use in predictive analysis in identifying the severity of the disease. • Usage of standard diagnostic technique like RT-PCR along with CT scans and X-ray tests (in some cases) in detecting COVID-19. • Sophisticated diagnostic systems using A.I. software will increase the speed of diagnosis and reduce time. • Need to reduce the time and commitment required to do CT scans and X-ray scans of patients suffering from COVID-19. • Advantages of the ability of A.I. to identify undetectable visuals in a qualified model. • A.I. ability to expedite clinical decisions. • Need for a more robust system to detect COVID-19.

			- Need for automatic detection system to counter COVID-19. - Lack of PCR-RT kits. - Utilizing machine learning algorithms to design predictive A.I. based on analytics to generate accurate predictions. - Analytics-based predictive A.I. for COVID-19 patient severity detection. - Prediction analytics employing Application engineering. - Usage of the Gini index to measure each element's level of contamination. - A.I. can be employed to identify unusual patterns in new clinical presentations.
2.	Masoud Alajmi, Osama A. Elshakankiry, Walid El-Shafai., Hala S. El-Sayed, Ahmed I. Sallam, Heba M. El-Hoseny, Ahmed Sedik and Osama S. Faragallah	Smart and Automated Diagnosis of COVID-19 Using Artificial Intelligence Techniques	- Utilization of Machine Learning techniques in conjunction with modern medical technologies to detect and diagnose disease. - COVID-19 challenges health professionals to find precise and cost-effective early screening and diagnosis methods. - In COVID-19 cases, medical imaging played a crucial role in the utilization of intelligent technology through various image modalities. Medical imaging included X-ray imaging, Computed Tomography (CT) and Magnetic Resonance Image (MRI). - Utilization of machine learning in conjunction with image analysis involving artificial deep learning for COVID-19 detection. - Outbreak of COVID-19 pandemic emergency in China in Dec 2019. - COVID-19 outbreak implication on public health infrastructure, increase in financial burden for all countries. - Challenge of obtaining efficient vaccinations against COVID-19.

				- The urgent need to detect COVID-19 at an early stage proved indispensable in preventing the spread of the virus. - Usage of reverse transcription-polymerase chain reaction (RT-PCR) for detection of COVID-19 virus. - RT-PCR proved to be a time-consuming process. - The existing ineffectiveness and insufficiency of COVID-19 diagnostics have prompted a number of attempts to identify alternate test procedures. - Advantages of medical imaging in diagnosis. - Automatic disease diagnosis provides fast, precise findings in medicine. - Extensive usage of X-ray, CT, and MRI. - Impact of X-ray, CT, and MRI in detecting COVID-19 cases. - Recent development in Machine Learning and A.I. to provide smart healthcare. - Growing usage of Deep learning methods due to their precision. - Incorporation of convolutional neural network (CNN), recurrent neural network (RNN) and LSTM proving to be efficient. - Attempt to design a completely automated COVID-19 patient detection and recognition system using deep learning techniques. - Usage of RetinaNet and Mask R-CNN to detect pneumonia. - Usage of 'transfer learning and a deep residual network' in the prognosis of pneumonia in children. - Usage of a hybrid deep learning approach in the diagnosis of pneumonia.

			● Deep Learning CNNs approach for pneumonia-like: AlexNet, VGG-16, VGG-16 and Mask-RCNN used.
			● Usage of X-ray and CT scans to identify abnormality detection in lung diseases.
			● Usage of deep learning CNNs like AlexNet and hand-crafted features to detect identify abnormality detection in X-ray and CT scans.
			● Stages of progression of COVID-19 patient through CT images, including: 'early phase, progressive phase, severe phase, and dissipative phase'.
			● Deep learning and transfer learning classify bacterial pneumonia in COVID-19 from X-rays images.
			● Usage of deep networks like 'VGG19, MobileNet v2, Inception, Xception and Inception ResNet v2' for the classification of bacterial pneumonia in COVID-19.
			● Cross-population train/test models need A.I. tools.
			● Smart city is pertinent in the COVID-19 worldwide epidemic due to local resource availability.
			● COVID-19 detection system uses CNN and ConvLSTM to detect CT and X-ray images.
			● CNN and RNN are extensively used to extract image features.
			● Recurrent Neural Network (RNN) appears to be practically unstable in image classification.
			● Adoption of Long Short-Term Memory (LSTM) to counter limitations of RNN.
			● Three stages of smart and automated LSTM for the COVID-19 detection are: 'pre-processing, feature extraction, and classification stages'..

			● Convolutional Long Short-Term Memory (ConvLSTM) deep learning algorithm is a reliable method for identifying COVID-19 cases.
3.	Dr Saravana Kumar, Dr A. Ahila, Dr K.C.Gayathri et.al.	Intelligent Trust-based Artificial Intelligence for Identification of COVID-19	● A.I. as a potent tool against COVID-19. ● Usage of A.I. in COVID-19 for early warnings and alarms. ● Usage of A.I. in COVID-19 for monitoring and prediction. ● Usage of A.I. in COVID-19 in data dashboards, identification and prognosis. ● Usage of A.I. in COVID-19 in social control. ● Issue of data privacy and public health. ● Extensive human-A.I. interaction. ● Growing usage of A.I. in the healthcare sector. ● Main objective of A.I. in health care is to assist doctors and policymakers. ● A.I. has played a significant role in COVID-19 research, especially in prognosis, categorization, identification, intensity, and fatality risk. ● Effect of COVID-19 on elderly, children, and teenagers. ● Long incubation period of 4–14 days for COVID-19. ● Usage of Conventional statistical methods to predict COVID-19. ● Usage of forecasting techniques like Logistic Growth and the Susceptible-Infected-Recovered (SIR) model, statistical analysis model Autoregressive Integrated Moving Average (ARIMA), multiplicative model like Holt-Winters additive model (HWAAS), forecasting method to model time series data like TBAT, an open-source algorithm like

			Facebook's Prophet, forecasting algorithm like DeepAR, and deep neural architecture N-Beats.
			• Usage of ARIMA to track the spread of the COVID-19 pandemic in China.
			• Usage of the SEIHRD model, a mathematical model to calculate the number of infected people from COVID-19.
			• Social media posts to understand and predict the outbreak of COVID-19.
			• Search engine patterns, keywords, and social media search indexes to understand and forecast patterns during the COVID-19 pandemic.
			• Usage of data analytics in the COVID-19, including historical data, and geographic information systems (GIS).
			• Usage of Machine Learning and artificial intelligence in constructing prediction models for COVID-19. Example: Neural Networks, NAdam training process.
			• Analysis of temperature and gender from COVID-19 cases
			• Evaluating the impact of COVID-19 in all facets of life.
			• A.I. can scale up, boost processing power, and surpass humans in certain healthcare operations.
			• A.I. models to correctly identified COVID-19-related lung abnormalities along with chest CT images to determine illness severity and duration.
			• Shortage of hospital beds during the COVID-19 pandemic.
			• Model to predict the bed occupancy for COVID-19 patients.
4.	Paul Menounga Mbilong, Asmae Bereich, Imane Jebli, Asmae El Kassiri,	Artificial Intelligence-Enabled and Period-Aware	• Usage of A.I. in predicting the spread of COVID-19 • Effectiveness of machine learning techniques: Case study Morocco

	Fatima-Zahra Belouadha	Forecasting COVID-19 Spread	- Deep Learning models effectiveness in early detection of COVID-19 cases. - Transformation impact of A.I., ML and DL in the medicine and epidemiology field. - Impact of Coronavirus 2019 (COVID-19) on countries. - COVID-19, a global health crisis. - Usage of ML and DL technologies by governments around the world to manage the pandemic. - Usage of six regression techniques to ensure COVID-19 accurate predictions, including, Machine Learning algorithms like Linear Regression (LR) and Random Forest (RF) or random decision forests, and Deep Learning techniques like Multilayer Perceptron (MLP), Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), and Convolutional Neural Network (CNN). - Usage of Susceptible- Infected-Resistant (SIR)-based models for predicting epidemic outbreaks. - Low accuracy of Susceptible- Infected-Resistant (SIR)-based models and COVID- 19 virus irregular spread behaviour, led to the usage of ML prediction models. - Usage of an Adaptive network-based fuzzy inference system (ANFIS) and multi-layered perceptron-imperialist competitive algorithm (MLP-ICA) to predict the outbreaks of COVID-19 in different countries. - Usage of Kermack-Mckendrick SIR and Prophet models to predict the onset of infection and the possible convalescence period. - Usage of sixth-degree polynomial regression model along with Random

			Forest and Kalman filter in predicting COVID-19 cases in India.
			● Usage of a type of the SEIR (Susceptible - Exposed - Infectious - Recovered) model to confirm and predict fatalities due to COVID-19 in the USA.
			● Usage of the Long Short-Term Memory (LSTM) model to track COVID-19 infection and recovery cases across countries.
			● LSTM model usage in forecasting used by Canada, Italy, and USA.
			● Usage of deep learning to predict the spread of COVID-19.
			● Machine Learning is a subset of A.I. and Deep learning is a type of ML algorithm.
			● Advantages and limitations of ML and DL techniques.
			● ML techniques include Linear Regression (LR) and Random Forest (RF).
			● DL techniques include Multilayer Perceptron, MLP), Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), and Convolutional Neural Networks (CNN).
			● Procedure to predict COVID-19 propagation involves standard ML/DL items and is consisting of four phases: "data gathering, data preparation, model training and parameterization, and model testing and validation"
			● In the Morocco case study, CNN proved to be a reliable model for predicting COVID-19 cases.
5.	Dr Santhiyakumari.N, Abinaya. P	Artificial Intelligence Based COVID-19 Detection Using Computed	● COVID-19 as a global health crisis. ● Beginning of the COVID-19 pandemic in China in December 2019. ● COVID-19 emerging as a global health crisis.

		Tomography Images	- Usage of A.I. in COVID-19 for early warnings and alarms. - COVID-19 outbreak and its impact on the world, with special reference to the health sector. - Usage of X-rays, MRI and CT scan in detecting COVID-19 infection. - Learning-based model to identify COVID- 19. - Usage of chest processed tomography (CT) pictures, Residual Attention U-Net strategy, Auto Diagnostic Medical Analysis, X-beam and CT pictures, convolutional neural network like AOCTNet, Mobile Net and Shuffle Net etc. - Application of Honing strategy on CT Scan pictures of COVID 19 patients. - Usage of multi-picture expansion on CT Scan pictures for a better understanding of data to be used in CNN. - Usage of LeNet model (CNN architecture) to predict COVID and non-COVID cases from CT Scan images of lungs. - Usage of Rectified Linear Unit (ReLU) part of deep learning to test images of COVID and non-COVID cases. - Timely detection of COVID-19 patients is essential for preventing the virus's propagation.
6.	Muhammad Anshari, Mahan, Hamdan, Norainie Ahmad, Emil Ali, Hamizah Haidi	COVID-19, Artificial Intelligence, Ethical Challenges, and Policy Implications	- COVID-19 as a global health crisis. - Disruption caused by the COVID-19 pandemic. - Usage of A.I. in COVID-19 and expert systems to combat the COVID-19 pandemic. - Usage of A.I. in predicting the spread of COVID-19.

| | | | | Moral and ethical issues related to A.I. usage. Issue of data privacy and public health. Challenges posed by A.I. due to ethics, challenges, utilitarianism, and deontology. A.I. and ethics Policy for ethical usage of A.I. Impact of COVID-19 in all facets of life. Effect of COVID-19 on business and economy. Usage of A.I. by both public and private organizations to mitigate the negative effect of COVID-19. Usage of A.I. applications to combat COVID-19. Examples: Disaster prevention, rapid reaction, and enhanced communication amongst various stakeholders. A.I. and expert systems link physical and cyber networks to analyze real-time data. Usage of A.I. in the health sector. Example: remote monitoring, chronic illness management, A.I.-enabled Telehealth etc. Role of A.I. in developing activities to engage both public and private organizations. A.I. using different strategies on social media to engage people effectively. Usage of A.I. in social media to gain insights and influence behavior. Usage A.I. in social media to increase public awareness about COVID-19. Concern about the usage of A.I. on social media, including, terms of privacy, consent and discrimination. Three major ethical concerns must be addressed to safeguard the interests of all users and reduce the ethical |

				deficiencies and detrimental effects of A.I. in the public sphere.
				● A.I. growing capacity to harvest big data's value.
				● Surveillance can use directed, automated, and volunteered data sources.
				● A.I. in social media is an effective advertising instrument.
				● A.I. assists in understanding user behavior.
				● Facebook privacy-related issues.
				● Facebook's 'unethical psychological experiment on users.
				● Cambridge Analytica used Facebook users' data without consent to influence elections.
				● Public participation and good governance.
				● Role of social media in public participation and good governance.
				● Usage of social media by public agencies.
				● Shift from traditional public participation as 'receiver', modern public participation witness interaction between the public and government.
				● Role of A.I. in increasing public participation.
				● A.I.-enabled social media platforms can motivate public participation, innovative cooperation, and transparency monitoring through interaction.
				● A.I. is advantageous as it allows multi-channels of interconnectivity between public, private, administration, and NGOs.
				● Growing sphere of social media.
				● Public agencies need to understand their target audiences and their behavioral patterns before identifying

				and classifying the targeted segment they will serve.
				● A.I. is a quick, cost-effective tool for data analytics.
				● Usage of A.I. to interpret large amounts of data into useful insights for improved predictions and more intelligent decisions.
				● Machine ethics
				● Role of A.I. in human decision-making,
				● A.I. capacity to extract data of users from social media platforms.
				● Role of A.I. in understanding and predicting consumer behavior.
				● A.I. can help businesses meet customer needs, enhance competitive edge, and make preemptive data-driven decisions.
				● Usage of A.I. during the COVID-19 pandemic provided advantages like real-time public information, improved public services, and insight and suggestions on public policy decisions.
				● A.I. was used to detect hoaxes and fake news during the pandemic.
				● Characteristics of fake news/ hoax.
				● A.I. data misuse can violate ethics.
				● Privacy concerns are the main issue with A.I.-enabled apps.
				● To address A.I. ethical-related security issues, consider the data provider, collector, miner, and decision maker involved in the A.I. process.
				● A.I. is applied in the process of decision-making, which may exacerbate 'racism, discrimination, and inequality'.
				● The use of search engines can result in unfair and inaccurate perceptions of an individual and their ethnicity.
				● A.I. uses data publicly shared on the Internet by users who may not have

				given their consent or were unaware of how their information was used. ● Defining ethics, types of ethics, and theories of ethics. ● Utilitarian approach of ethics. ● Ethics of duties (deontology) approach. ● Types of deontology; act-deontology and rule-deontology. ● Limitation of the deontology. ● Immanuel Kant and John Stuart Mill's on ethics. ● A.I. and moral reasoning to act ethically. ● A.I. is devoid of human rational thinking capacity. ● Ethics in A.I. is the responsibility of humans involved in the A.I. process. ● Bentham's "theory of human nature". ● A.I. and Ethical Decision Making. ● Right to privacy ● Policy recommendations in the usage of A.I. during COVID-19 are: upholding data privacy of users to build trust, encouraging transparency, informed consent, timely and accurate disclosure, need for the governments to introduce regulations to ensure ethical practices in business, data safety of users, compensate if due to privacy violation damage was caused, governments need to pace up with meta verse needs, usage of detecting discrimination in algorithms to check discrimination and promoting good governance. ● Companies' eagerness to monetize A.I. leads to strain among research, industry, and business interests. ● Other ethical challenges before A.I. also include: 'a) environmental sustainability b) privacy and

			confidentiality c) data accuracy and e) equality'. • A.I. is advancing faster than regulatory authorities and policymakers can respond.
7.	Viana Hassan & Georges Bellos	COVID-19: Reshaping Medical Tourism through Artificial Intelligence (A.I.) and Robotics	• Growth of tourism and travel sector. • Impact of COVID-19 on the tourism and travel sector. • History of healthcare in human history. • Medical tourism • Usage of A.I. in tourism and travel administrative and customer service tasks. • Research on medical tourism packages. • Positive impact of A.I. medical tourism services. • COVID-19 challenges on the Medical Tourism industry • A.I. and Robotics role in the Medical Tourism industry • A.I. and Robotics reshaping and reviving the Medical Tourism industry • COVID-19 had a disastrous impact on medical tourism due to travel restrictions and lockdowns. • Role of A.I. in medical tourism. • A.I. and Robotics are becoming important parts of the global healthcare sector for treating diseases and performing complex processes, as well as continuing to support well-being and mitigation. • A.I. and Robotics have the capability to reinvigorate medical tourism post-COVID-19 disastrous impact. • Growing usage of Robotics and Telehealth after COVID-19. • Medical Travel Agency • Concept of 'Smart Hospital' • Usage of blockchain technology to increase the safety and efficient usage of health data

			● IR 4.0 technologies will enhance expert mobility in virtual spaces ● Growth of medical tourism in future, due to cheaper cost, and availability of cosmetic surgery products. ● Role of ICT tools, along with augmented reality (AR) or virtual reality (VR) in the promotion of medical tourism. ● Remote surgeries and robotics will boost medical tourism. ● Internet of Medical Things (IOMT) and Medical Tourism. ● Role of A.I. in the health sector. ● Assimilation of IR 4.0 technologies into basic healthcare.
8.	Lian Wang, Yonggang Zhang, Dongguang Wang, Xiang Tong, Tao Liu, Shijie Zhang, Jizhen Huang, Li Zhang, Lingmin Chen, Hong Fan and Mike Clarke	Artificial Intelligence for COVID-19: A Systematic Literature Review	● COVID-19 as a global health crisis. ● Usage of A.I. techniques to combat COVID-19, including detection, forecasting. Predicting trends, probing potent and safe drugs and vaccines. ● A.I. demonstrated superior performance in COVID-19 prognosis, predictive assessment, pandemic forecasting, and drug development. ● A.I. can boost the medical and healthcare system's efficacy during the COVID-19 pandemic. ● Impact of COVID-19 on various facets of life. ● Advantage of A.I. in the health sector. ● A.I. models of predictions, A.I.-powered chatbots, A.I.-enabled scanners for thermal imaging, A.I. usage for social distancing, surveillance etc. in combating the COVID-19 pandemic. ● Different applications of A.I. technologies to combat the COVID-19 pandemic.

			● Growing need for Deep Learning with a convolutional neural network (CNN) for image recognition. ● Deep CNN model to predict COVID-19 cases. ● Usage of CT images, X-rays and MRI in COVID-19 cases. ● Usage of used A.I. to identify drugs, drug discovery, drug development and safe vaccines. ● Usage of long short-term memory (LSTM) models, Susceptible– Exposed– Infectious–Recovered (SEIR) model, multi-layer perceptron (MLP) artificial neural networks, Support vector regression (SVR), autoregressive integrated moving average (ARIMA), Bi-directional long short-term memory (Bi-LSTM) to predict the pandemic trend. ● Usage of (CT) scan, RT-PCR for diagnosis of COVID -19. ● Deep Learning to distinguish COVID-19 from non-COVID-19 patients.
9.	Raju Vaishya, Mohd Javaid, Ibrahim Haleem Khan, Abid Haleem	Artificial Intelligence (A.I.) applications for COVID-19 pandemic	● A.I., Internet of things (IoT), Big Data, and Machine Learning are needed for healthcare delivery. ● A.I.'s role in analyzing, and preventing, and fighting COVID-19 and other outbreaks. ● Healthcare sector is in dire need of real-time decision-making technologies to control COVID-19 and prevent its propagation. ● COVID-19 as a global health crisis. ● Usage of A.I. techniques to combat COVID-19, including detection, 'proper treatment and monitoring, contact tracing, projection of cases and mortality, development of drugs and vaccines, minimising health providers'

			work pressure and prevention of the COVID-19 spread.
10.	Muzammil Khan, Muhammad Taqi Mehran, Zeeshan Ul Haq, Zahid Ullah, Salman Raza Naqvi, Mehreen Ihsan, Haider Abbass	Applications of artificial intelligence in COVID-19 pandemic: A comprehensive review	• COVID-19 as a global health crisis. • Growing usage of A.I. in the healthcare sector. • Common symptoms of COVID-19 • Beginning of the COVID-19 pandemic in China in December 2019. • A.I. has played a significant role in COVID-19 research, especially in prognosis, categorization, identification, intensity, and fatality risk. • Usage of A.I. models, DL models and ML models to combat COVID-19. • Usage of lockdowns and curfews to control and mitigate COVID-19. • Usage of A.I. in various fields. • Various applications of A.I. to combat the COVID- 19 pandemic. • Application of ML in the Detection, Diagnostics, categorizing and forecasting of COVID- 19. • Usage of ML to identify patterns in data sets. • ML techniques used to combat the COVID-19 pandemic, included: support vector machine (SVM), logistic regression (LR), random forest (RF), and decision tree (DT). • Deep Learning applications used in combating COVID -19 like Convolutional Neural Networks (CNN) and Long-short Term Model (LSTM). • Usage of CT scans, X-Ray, and MRIs in the detection of COVID -19. • Challenges in implementing A.I. to mitigate COVID -19, including lack/unavailability of the standard dataset, lack of cross-validation of data leading to bias in decision making, the

			challenge of privacy-related issues, and variation in data pattern and similarity in COVID-19 symptoms with other diseases.
11.	Abid Haleem, Mohd Javaida, Ravi Pratap Singh, Rajiv Suman	Applications of Artificial Intelligence (A.I.) for Cardiology During the COVID-19 Pandemic	- Growing usage of A.I. in the healthcare sector. - Usage of A.I. in cardiology during the COVID-19 pandemic. - Utilization of A.I. for analyzing and measuring the human heart's function. - Cardiovascular diseases are one of the leading causes of human mortality. - A.I.-enabled cardiac-based algorithms can provide sustainable treatment to patients suffering from cardiovascular diseases. - Digital technologies usage in monitoring devices produce a huge data in cardiology. - A.I.-based technologies like ML, ANN, and Natural Language Processing etc. are extensively used in the health sector. - History and types of A.I. - Past usage of A.I. in cardiology. - A.I. usage in the prediction and diagnosis of cardiovascular diseases. - Physician investigators, clinicians, and computer scientists use A.I. in cardiology. - A.I. assists in identifying heart disease symptoms, and history of the disease and can prescribe the right treatment. - A.I. tools used in cardiology during COVID-19, include, 'smart robots, cloud-based data, soft analysis, smart monitoring' etc. - The advantages of artificial intelligence in cardiology include decision making, complex task/surgery, cardiovascular imaging, precise surgery, lower risk, improved

| | | | cardiac healthcare, health care service from a distance, patient records, and research. |
| | | | • A.I. applications in cardiology for COVID-19 patients include heart anatomy analysis, MRI ventricle segmentation, arrhythmia detection, heart imaging analysis blood pressure, oxygen saturation, heart rate analysis, blood flow monitoring, predicting heart attacks, etc. |

4. DISCUSSION

Ramya, P., & Priyadharshini, P. (2021) notices that A.I can be utilized in the prediction of patterns. The researchers have proposed a concept of making an A.I. framework that offers help for clinical decision-making through predictive analytics capacities applied to genuine patient-related information and data. Unlike Alajmi, M., et.al. (2022) the methodology put forward by Ramya, P., & Priyadharshini, P. (2021) contends that it will work all the more effectively for data sets that are of small size or imbalanced; consequently, rather than being limited to full datasets this strategy considers significant responses right off at the start of the outbreak. They forward this contention that this strategy likewise forestalls reliance on a specific biomarker or a research facility like laboratories that are challenging to get and hence draws a set of indicators or predictors together to create choices and decisions. A similar view has been taken up from an ethical perspective in Anshari, M., et.al. (2022) that features the constraints of A.I. in the collection, managing, deciphering, and analyzing the large data sets to gain insights and derive more intelligent choices. It has highlighted that regardless of its advantages, its reception and execution might be acted in ethical contemplations which emerge from the patient's data and information security and assent or consent. Here the authors have underlined the significance of data and information security in the utilization of A.I. in the detection of coronavirus.

Unlike Ramya, P., & Priyadharshini, P. (2021), Alajmi, M., et.al. (2022) state that Machine Learning is used to detect and diagnose disease. However, early diagnosis of the disease at a cheaper cost is one of the challenges faced by clinicians. This paper combines machine learning with imaging analysis in an artificial deep learning approach for COVID-19 detection.

Kumar, S., et.al. (2022), on the other hand, agree that artificial intelligence has played a big role in COVID-19 research especially when it comes to diagnosis, categorization, detection, severity and probability of death.

Mbilong, P. M., et.al. (2021) stressed the advanced data technologies and A.I., especially machine learning and deep learning that have transformed the medicine and epidemiology sector. The paper has highlighted the efficiency of machine learning and deep learning models as well as the impact of the time-lag size and the confinement and deconfinement context of predicting the propagation of coronavirus in the world by evaluating the case study of Morocco and also to tried to estimate the capability of these A.I. techniques to provide mean term forecast

from small size data sets. The conclusion underlined the benefits and advantages of deep learning models compared to machine learning ones. The authors of the paper have highlighted that their findings could be advantageous in the contexts of other epidemics as well and for designing deep learning models that will help to forecast and anticipate the spread of viruses in other countries of the world. However, the limitation of the study as put forward by the researchers is that their model could be optimized with the use of larger and rich data sets.

Santhiyakumari, N., & Abinaya, P. (2022) highlight a different model of the Convolutional Neural Networks (CNN) model for the early forecast of coronavirus. The author proposed a profound exchange learning-based approach and utilised chest CT exam in images procured from ordinary COVID-19, bacterial and viral pneumonia patients to naturally anticipate COVID-19 patients. The authors claimed that to identify COVID-19 at the beginning phase this study would give out knowledge on how profound exchange learning techniques can be utilized to forecast COVID-19 in patients. The proposed model does not require physical extrication, but the entire process from start to finish is a mechanized structure.

While Ramya, P., & Priyadharshini, P. (2021), Alajmi, M., et.al. (2022), Kumar, S., et.al. (2022), Mbilong, P. M., et.al.(2021), Santhiyakumari, N., & Abinaya, P. (2022) talks about the application of A.I., Machine Learning and Deep Learning strategies in the detection of COVID-19, Anshari, M., et.al. (2022) highlighted the ethical considerations. Taking a complete detour, Hassan, V. & Bellos, G. (2022) highlights the importance of artificial intelligence and its application in medical tourism. Hassan, V. & Bellos, G. (2022) talk about the term 'Internet Of Medical Things' (IOMT) as an extension of IoT that was highlighted by the Department of Health, Abu Dhabi (2020) during the 12th Annual World

Medical Tourism and Global Healthcare Congress in 2019. The researchers conclude that there is a positive connection between A.I. and robotic technology with medical tourism. The authors reasoned that their research findings indicate that medical tourism will be upgraded and enhanced soon since patients are looking for such travel options in search of less expensive therapies and treatments in countries allowing them for a short stay while they recuperate from any medical procedure or clinical mediation.

Wang, L., et.al. (2021) incorporates 78 research papers as a part of a systematic literature review in tracking down the connection between A.I. and Coronavirus. In this paper, the researchers have presumed that A.I. has accomplished high performance in diagnosis, prognosis evaluation, epidemic prediction, and drug discovery for Coronavirus. The researchers have expressed that A.I. can essentially improve existing clinical and medical and healthcare frameworks effectively during the Coronavirus pandemic.

Vaishya, R., et.al. (2020) have featured the fundamental utilization and applications of A.I. in the Coronavirus pandemic. The researchers have underlined its application in early detection and diagnosis of the spread of the infection, monitoring and checking the treatment, tracing contacts of people, projection of cases and mortality, detection, a decrease of the workload and responsibility of medical services and healthcare workers and in precautions in the prevention of the disease.

Khan, M., et.al. (2021) also agree with the use of effective application of A.I. in the detection of covid 19. The authors have highlighted state-of-the-art A.I. applications to combat the COVID-19 pandemic. The applications of A.I. include screening and diagnostics, drug repurposing, and prediction and forecasting of COVID-19. It was discovered that the Convolutional Neural Network (CNN) and its modified models were used for COVID-19 pandemic prediction

whereas, in the case of machine learning support vector machine, k-means, linear regression and random forecast were mostly used for COVID-19 pandemic combat. On the lines of Anshari, M., et.al. (2022), this paper also highlighted and addressed the challenges associated with the use of A.I. during the COVID-19 pandemic. Apart from the issues of data privacy, the authors also highlighted other limitations like unavailability of standard data, cross-validation, usage of advanced approaches, variations in pandemic data patterns, and similarities in symptoms among others.

Haleem, A., et.al. (2021) highlight the involvement of A.I. in predicting successful diagnosis and treatments in areas of cardiology. The various techniques used here are cognitive computing, deep learning and machine learning which are used to make a decision and resolve complex challenges. The paper identifies eleven major applications of A.I. in cardiology during the COVID-19 pandemic which are in the areas of analyzing heart anatomy of covid-19 patients, cardiac magnetic resonance imaging (MRI) ventricle segmentation, detection of arrhythmias of the COVID-19 patient, analysis of heart imaging of COVID-19 patients, analyzing blood pressure, oxygen saturation, heart rate detection and analysis, predicting heart attack, keeping heart data in digital format, analysis of blood flow rate and providing proper information on medication for COVID-19 patients.

5. CONCLUSION

With the COVID-19 pandemic, the usage of A.I. has got a major boost. Through this narrative review paper, it was established to an extent that A.I. was deployed for prediction, during a pandemic. A total of eleven papers relevant to the topic based on inclusion and exclusion criteria were analyzed to compile and present this narrative literature review. One of the important

uses of A.I. in combating this deadly virus was the method of predictions wherein real-time datasets were used to predict the spread, growth, and expansion of this virus. One of the important themes also was the role of A.I. in tackling challenges faced by the healthcare sector. The algorithms according to various review papers are also being used for deciding the criticality of the situation. Decision trees are being formulated with the help of A.I. to discuss and determine the severity of the disease. It has been established that A.I. can be used to identify unusual patterns in new clinical presentations. Medical imaging is another field which is being utilized to detect and predict various COVID-19-related issues. Machine learning is being utilized along with deep learning to detect COVID-19. It has also been highlighted in the various research papers that were analyzed that A.I. is a potent tool against COVID-19. A.I. is also being used for Social Control against COVID-19. However, the issue of data privacy and public health also remains a concern. The Moroccan Case study by Mbilong et al highlighted the effectiveness of Machine Learning techniques in combating COVID-19. Timely detection of COVID-19 patients is essential for preventing the virus propagation and A.I. plays an important role in the same. However, moral, and ethical issues related to A.I. are also a concern. It was also highlighted in the study that A.I. plays an important role in medical tourism as well and is fulfilling the concept of Smart Hospitals. The various spheres of use of A.I. are A.I. models of predictions, A.I.-powered chatbots, A.I.-enabled scanners for thermal imaging, A.I. usage for social distancing, surveillance etc. in combating the COVID-19 pandemic. It can be easily concluded after analysis of various papers that A.I. played a very important role in combating COVID-19. The healthcare sector was in dire need of decision-making technologies to prevent the propagation of COVID-19 and A.I was an effective tool for the same.

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