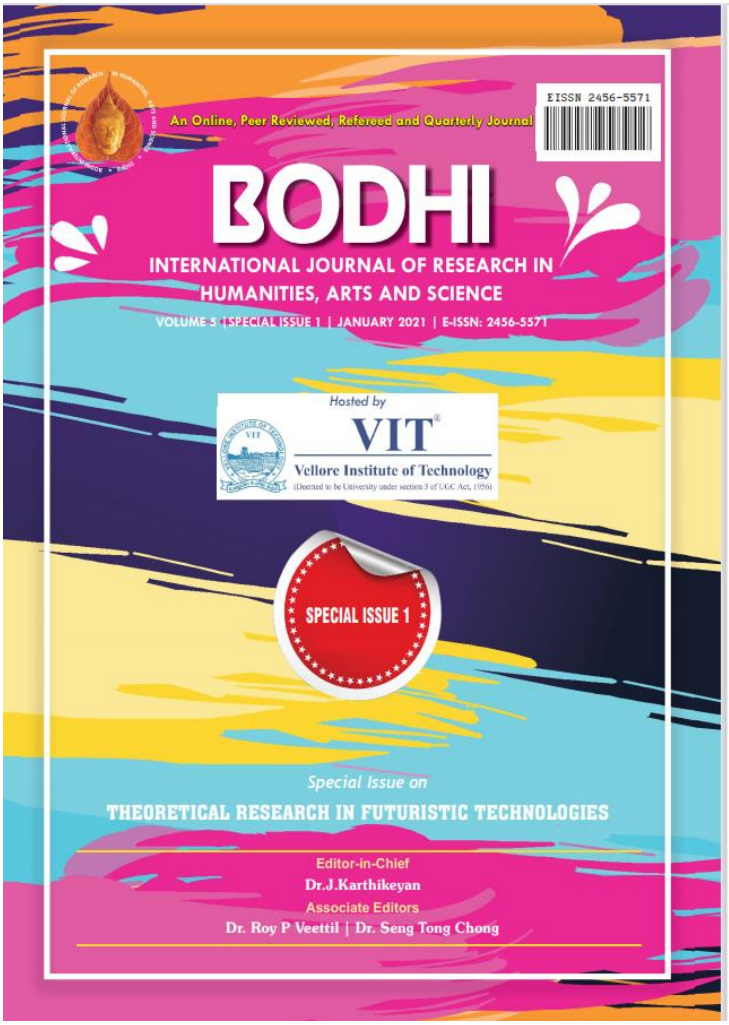

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ARTIFICIAL INTELLIGENCE IN BRINGING ABOUT A REVOLUTION IN THE HEALTHCARE INDUSTRY

ANANYA GHOSH
20MIC0063
School of Computer Science and Engineering
VIT, Vellore, India

Introduction

The Royal Society,(2018), The intelligence that is demonstrated by machines, which is not their natural intelligence like humans, the way of making computers, robots or software think intelligently, the science of making machines smart, using algorithms to allow computers to solve problems is called Artificial Intelligence. AI makes it possible for machines to learn from previous experience, perceive its surrounding environment, adjust to new inputs, rationalize and perform human-like tasks while exhibiting cognitive feature like learning and problem-solving that maximize its chances of succeeding in achieving its goals.

Nick Heath,(2018),The official definition and term AI was first coined by John Mccarthy in 1955.Disciplines such as Computer Science, Engineering, Linguistics, Mathematics, Psychology and Biology contribute to AI development. The main subfields of AI are Machine Learning, Natural Language Processing, Artificial Neural Networks and Computer Vision. The goal of AI is to create systems that portray intelligent behaviour, learn, demonstrate, solve problems and advice their user.

SAS India, (2020), AI can automate repetitive learning and discovery through the data and adds intelligence to existing products for example, bots, smart machines, automation and conversational platforms can be blended with huge quantity of data to improve technologies on several walks of life, from investment analysis to security intelligence. AI analyses data more deeply with neural networks. For example, building a fraud detection system with five hidden layers. Ai adapts through progressive learning algorithms. Ai is immensely accurate using deep neural networks, for example, interaction with Google, Alexa and in medical field, image classification and object recognition, which can be used to detect cancer. The data processed through AI can get intellectual properties. Ai has evolved to provide many benefits in all types of industries, one major being the Healthcare industry.

Jennifer Bresnick,(2018),Healthcare industry is the most demanded with consumers expecting high level of care and service irrespective of cost. But unfortunately it has not yet achieved the expectations of the society due to lack of proper implementation of modern technologies. The major challenges that healthcare industries face are the huge amount of data processing, lack of solution for the neurologically or trauma attacked patients, diagnostic results depend on tissue collection and pathological tests increasing risk of infection, shortage of trained healthcare staffs, time consumption in clinical documentation, production of drug resistant bugs, findings in images may escape human eye, costs related to hospital acquired condition penalties and only small number of people respond to current immunotherapy options and clinicians have no clear solution for this.

Davenport T. & Kalakota, R. (2019), There are endless opportunities to implement AI technologies in the healthcare industries. It seems to me that gradually with time, AI with its aides like robotics, ML, neural networks, deep learning, block chain technology, big data analysis, data structuring and mechatronics, is getting deeply consolidated with the most significant industry in the world- the healthcare industry. This has given birth to innumerable

opportunity for the industry to serve the population in a better way, and create immense improvement in the medical facilities provided.

Jennifer Bresnick ,(2018), There are a number of chronic diseases, like cancer, where there are endless opportunities to leverage AI technologies to adopt more efficient, accurate and precise in patient care. The algorithms help in analytics and clinical decision making while interacting with training data and lets the clinicians to gain unforeseen insights about care processes, variability in treatment, diagnostics and patient caring along with creating a kind of direct interface between the technology and human mind.There are many patients who have lost their ability to move, speak or interact with the environment after facing some trauma or neurological problem. The condition of these patients, with stroke or locked-in syndrome, can be drastically improved by Brain computer Interfaces (BCI) which can be backed by AI which can help restore the fundamental experiences and incidents of these patients hence reducing the mental stress. AI can also equip the various diagnostic tools to reduce the need for tissue sample collection and hence reduction of risk of infection. The each-pixel level imaging, virtual biopsies, advanced radiomics helps medical experts to develop a deeper understanding about the various diseases and tumours, cancer cells and their behaviour, aggressiveness and target treatments and also depict the phenotypic and genotypic properties of tumours. EHR technology is now incorporating AI to create more instinctual edges and automation in the routine procedures that may save time and money and this is also helping in identifying infection patterns and people at high risk.Voice recognition, dictation and video recordings of a clinical encounter can be fed into AI and ML algorithms to index them for future reference. Just like we have Alexa at home, one day we may also have virtual medical assistants and care at the service of the clinicians which will be implanted with AI or data entry and analysis. AI enhances the capability to identify deterioration of condition of patients, suggesting whether sepsis is taking place or complications are arising, hence improving the medical care outcomes and hospital acquired penalties. AI and ML algorithms have the ability to analyse highly complicated datasets and hence generate new targeting therapies to each unique genetic makeup. Even cell phone cameras now can produce images that can remain viable for future analysis by AI for research, diagnosis and treatment.

Literature Reviews

1. **Artificial Intelligence in Healthcare: Past, Present and Future**

Jiang F,….et.al.,(2017)Artificial Intelligence has immense potential to bring a powerful transformation in healthcare systems through its advanced algorithms designed to process huge volume of data with accuracy. Thus, assist physicians extract timely useful information from various literatures and patient population survey, to obtain health risk alert and outcome prediction. The work explains the flow of the processes from clinical data generation to Natural Language Processing (NLP) data enhancement, to Machine Learning (ML) and clinical decision making. It deals with both approaches of AI, that is, ML and NLP.

The research mainly concentrates around a few diseases, diagnosis and treatment:

- **Cancer** – IBM Watson Diagnosis
- **Neurology** – AI in Quadriplegia
- **Cardiology** – Arteries Cardio DL
- **Ophthalmology** – Convolution Neural network in congenital cataract
- **Psychiatry** – Support Vector Machine biomarkers of neurological disease
- **Stroke & Parkinson's** – Neural Networks
- **Stroke** - ML Algorithms for on-set detection
- **Chest X-Ray**- NLP for reading reports.

The paper is a survey of the past, present and future applications of AI, ML, Deep Learning, Support vector Machine, Neural networks and NLP, in the healthcare industry. This helps in producing advanced medical information, reducing diagnostic and therapeutic errors. While investigating the

current status and future of AI in healthcare, the various tools of AI implemented in diagnosis, treatment and future prediction of several diseases like cancer, cardiology, neurology and stroke and advanced applications like IBM Watson, a pioneer AI system and various challenges for real life implementations of AI, have been highlighted.

2. Artificial Intelligence And Machine Learning In Clinical Development: A Translational Perspective

Shah P.,…et.al.,(2019),Paramount transfiguration in the healthcare industry and clinical development has taken place in subsequent years due to confluence of AI and Machine Learning. Significant application of AI, ML and computer vision in clinical development along with involvement of variety of other sectors like academic, technology, corporation, biotechnology along with the challenges faced, has been important matter of discussion and application.

The problems include sluggish development of the clinical field due to precariousness in regulatory needs, risk, lack of knowledge and lack of actionable data source to uplift existing diagnostic and therapeutic technologies which only worked for a minute portion of the population.

AI and ML have introduced next-generation sequencing, helping us understand diseases in larger populations. It has helped formed effective drugs by co-developing diagnostic precision and therapeutic solutions along with digital clinical results, minimal cost imaging, sensor and treatment with response biomarkers assisting in monitoring and enabling safety against toxicity. ML has helped to predict pharmaceutical properties of compounds and targets for drug discovery based on bones, organs, pathology slides and retinal scans while deep learning has help predict new models for multimodal data hence enabling faster diagnosis and progress of health of patient.

3. Artificial Intelligent Technologies for Mobile Health of Stroke Monitoring and Rehabilitation Robotics Control

B.M. Elbagoury,…et.al,(2018), Stroke is a very urgent and sensitive scenario that may severely affect the brain, locomotion, nerves and emotions is an adverse way and may also result into hemiplegic conditions in patients leading to life-long disability. The development and implementation of a new intelligent mobile telephone technology and wireless communication system based on Artificial Intelligence, in the field of stroke for early detection, better diagnostic decision and fast response and rehabilitation of patient care, can create significant scientific advancement in the healthcare industry to mitigate the sufferings of the patients and contribute positively towards the society.

To fulfil the objective, there are few steps that are needed to be taken. First, it is important to build a real-time mobile computing for emergency state of patient by using advanced medical sensors like Electromyography sensors (EMG), which can provide immense source of information and for identification of neuromuscular disorders, nerve injury and muscle degeneration. Secondly, the development of an innovative Rehabilitation Robotics system for post-stroke treatment of patients, in which the robots interact physically with patients to assist in movement therapy hence helping to improve mobility and ensuring independent life of the patient by applying proprioceptive neuromuscular facilitation method or behaviour based control, while being cost effective as well. These technologies can help patients keep track of their own treatment during lack of access to healthcare facilities. Implementing ANN on mobile devices along with sensors, developing a home alert system (health system) can significantly improve lives of elderly by ensuring their safety and preventing accidents. Telemedication helps in enabling real-time interactive assimilation of medical information in wireless environment.

Hence the main objective is to develop a Hybrid Intelligent Remote Diagnosis Technique for Mobile Health Application for Brain Stroke Diagnosis and monitoring human health conditions using sensors and post- stroke medical care using Rehabilitation Robot Systems.

4. Artificial Intelligence In Surgery: Promises and Perils

Hashimoto,…et.al,(2018), Artificial Intelligence, with its subfields, is creating new horizons in surgery while assisting the surgeons in critical surgeries using robotics and machine learning. Pathologists, surgeons and radiologists are using AI to reduce errors in identifying cancer positive lymph nodes, lumpectomy and to take intra-operative decisions. The various data, such as blood pressure, temperature, glucose, weight, meals, can be tracked by mobile sensors and can be fed into EMR, of a patient, before undergoing a surgery. Considering the various subfields of AI and their contribution towards medical surgery and limitations:-

Machine Learning: Supervised Learning teaches the computer functions like recognizing a gallbladder in an image. Unsupervised Learning looks for any unseen structure such as identifying bleeding from non-bleeding tissue. Reinforcement learning helps control an artificial pancreas system to accurately measure and deliver the insulin to diabetic patient. This helped in prediction of surgical site infections and studying diagnostic, therapeutic and surgical aspects of any medical problem like predicting lung cancer.

Natural Language Processing: It helps in huge scale analysis of data as in the Electronic Medical Record(EMR) and physician's narrative documentations and prescriptions. Its application in medical surgery can progress through the data and can also read patients emotions like irritated, tired etc. The algorithms have a self -correcting capability as well hence appropriate for representing variety populations.

Artificial Neural Networks: These process the signals and maps the corresponding tasks as in image recognition and data classification function. It can be tremendously accurate in risk prediction like prediction of pancreatitis acuteness six hours after admission to hospital. Accepting inputs like patient history, blood pressure, medications etc, ANN can predict in-hospital mortality, after doing the abdominal aortic aneurysm repair, with high accuracy.

Computer Vision: Healthcare surgery utilises computer vision for image acquisition and analysis of patients during surgery, computer aided diagnosis, virtual colonoscopy, image guided surgery, decision making in surgery by use of videos that are interpreted and analysed by computer vision to suggest solutions and methods to be followed.

Limitations: In many cases traditional techniques can outperform AI. Faults may occur in AI analysis based on systematic biases and incorrect input. Risk prevails in lack of interpretability of AI in few instances, as it cannot yet determine casual connections in data and hand in an automated clinical analysis.

5. Deep Learning Technology For Improving Cancer Care In Society: New Directions In Cancer Imaging Driven By Artificial Intelligence

Coccia M, (2020), Deep Learning Technology (or DELT), can be applied to cancer in, early detection, interpretation of cancer by image classification and transfer learning as in lung and breast cancer detection, identifying cancer subtypes by integrating gene expression and transcriptome alternative splicing of data, identifying stages of cancer, volumetric demarcation of tumours, cell mutations, development of metastasis and possible anti-cancer treatments. This can significantly ensure appropriate and timely treatment that can increase the patients' survival rate. This can also benefit poor regions where there is lack of proper health facility.

Current technology is based on molecular biomarkers, biopsy and blood test which is time taking, costly, may turn out faulty and hence causes life risk for the patient. Hence Deep learning can bring about a revolutionary improvement in this field.

Application in Lung Cancer: Deep Convolutional Neural Networks(CNN) are capable of establishing complex visual recognition work, provide appropriate result for sorting lung patterns. These have been accepted in skin cancers, hepatocarcinoma, diabetic retinopathy, gastric cancer and colorectal cancer. These can automate analysis

of tumors, cancerous vs normal cells and lung adenocarcinoma vs. lung squamous cell carcinoma.

Application in Carcinomas: Deep Learning Algorithms can be used in whole slide pathology images to identify metastasis in sentinel axillary lymph node in Carcinomas.

Limitations: DELT may be costly initially and may lead to workflow in hospitals. Furthermore, there is not enough human capital and education to take up this huge challenge.

6. 10 Promising AI Applications In Health Care

Kalis B.,…et.al.,(2018),Clinical healthcare and administrative sectors have merged with AI technologies. There is huge potential for profits and annual savings due to this confluence in the long run. Although AI applications in clinical judgement and diagnosis has not yet developed fully, AI is creating marvels in other areas.

AI assisted Robotic Surgery: AI assisted Robotic orthopaedic surgery can analyse data and physically guide surgeon's instruments causing huge reduction in surgical complications and reduction in duration of patient's stay in hospital after surgery, saving $40 billion annually.

Image analysis: AI in image analysis for diagnosis and treatment saves $3 billion.

Medical Dosage Estimation: A trial in California concluded that a mathematical formula developed with AI can accurately determine the correct dose of immunosuppressant drugs for organ transplant patients.AI as solution to costly problem of dosage errors saves $16 billion.

Virtual Nurse assistance: Virtual Nurse Assistants not only provide most effective care, but also saves time for nurses while saving $20 billion.

Voice-to-text transcription: Voice to text transcription can smoothen administrative workflow and help save time while saving $18 billion.

Fraud Detection: AI application to improve speed and accuracy in Fraud Detection in Medicare claims saves $17 billion.

Monitor Cybercrime: AI to monitor cybercrime in medical field saves $2 billion.

Advantages of Artificial Intelligence in Healthcare Industry

1. Requirement of Work Force in Healthcare

The population is increasing at an unprecedented manner and aging simultaneously as well, and the fact that this is causing high demand for more healthcare workers, cannot be overlooked. Robotic revolution, like **Nursing Robots**, based on AI technology can prevent this deficiency of healthcare workers.

2. Disease Diagnosis and Test Recommendations

AI can analyse vast medical data of physiology, laboratory, behaviour, medical images etc and can combine these using ML to identify specific diseases and provide more assistance to healthcare workers. For example, distinguish between benign and malignant tumours and hence help doctors to quickly obtain the information, provide accurate diagnosis and saving time for disease treatment. Oncologists are using **IBM Watson** (AI/ Deep learning/ NLP based system) to treat cancer patients efficiently at low costs as well. **Care Trio,** using IBM Watson has suggested a three step process to give proper care to cancer patients:

- **Care Edit**: tools that creates best practice guidelines and tells the doctor the best possible treatment options for various forms of cancer.
- **Care Guide**: Uses the above information to assist doctor to come out with the best treatment solution through a clinical decision support system.
- **Care View**: Analytical tool to evaluate results of implemented treatment

MYCIN is one of the most earliest expert systems using AI that can help in diagnosis of infectious blood diseases and also provides recommendations for treatment of it.

3. Disease Prevention

AI and its analysis models combined with social media can help in utilising human behavioural data to identify risk of mental health illnesses and it can also be used to figure out risk of suicide among patients with psychiatric problem or people like solders and prisoners. **Ginger.io** is a mobile app that

treats psychiatric diseases. It helps in analysing the patient's mood and understands what instigates the emotions in the patient like anger and analyses their behaviour changes and lays down strategies suggested by doctors to recover from this condition.

4. Nursing Assessment

AI used for patient monitoring, can help nurses easily collect more real time information about patient like blood pressure, sleep quality, oxygen saturation, pulse an blood glucose. This improves accuracy, healthcare quality and patient satisfaction. This can be beneficial to maternal and child care as well in medical resource lacking country. Antenatal records are also highly improved by **cloud-based electronic medical record system**, which also helps in efficient sharing and circulation of information, hence helping in decision making as well. It also assists HIV patients to receive treatment early and reduces HIV care gaps.

5. Reduction of Workload

AI operations will help nurses in multitasking environment, collection of samples, patient reports, checking vital signs, medication managing, infectious illness supervision etc. Hence nurses with AI technology support will be able to deliver their job efficiently.

6. Healthcare Data Management

Electronic Health Record System based on artificial intelligence can be effectively used to keep track of the clinical health data by doctors and hospital management systems. It helps in organisation and efficient handling of medical data. This will also prevent patient harm related to misdiagnosis or wrong medication or administrative errors. For example, patients are allowed to review their own notes after a meet with a doctor and due to this, they understand what kind of healthcare plan has or is going to be implemented on him and will get a better understanding of the treatment, medications and conditions which increases patient's confidence in taking control of his own health.

7. Decision Making

AI based **nursing data system** helps to form a nursing diagnosis guideline to assist nurses in taking a clinical decision. All the above points help in effective decision making in healthcare system. An AI application saves money as well. **E-health Telemedicine platform** encourages homecare assists and discourages hospitalization resources as it transmits the patient's analysed data from home to clinic by using **cloud transport or medical smart sensor** to understand the patient's current status.

8. Nursing Assistance

Intelligent carrier robots can function like nurses by helping patients move from bed to wheelchair or to move from one place to the other through a command received by it from the user through a smart touchpad. Various types of **flexible e-skins** using AI technology has been developed which exhibit excellent sensing abilities. **Interactive robots** having AI and complaint pressure sensing devices with computer control and information processing and analysing algorithms have extremely advanced sensing capabilities that can be used to perform tasks like taking care of the old people and nursing patients.

9. Individual environment Virtual assistance and Disease Self-management

AI wearable device/sensor can be used to get self-health conditions in real- time. Some AI systems are used for giving reminders and guidance to a person like a **virtual assistant reminds** to take medicine or informs about health alert conditions. Company like **AiCure** has developed a **face-recognition app** which helps doctors ensure that the patients are taking correct medicines on time and if that does not happen, an alarm message is sent to the doctor. Similarly company like **NextIT** has come up with a AI based **Health Coach Application**.AI based **nurse chatbots** or **mental health chatbots** has positive effects on the user as it helps in reducing depression symptoms. **Companion robots** are used to give company to old people with dementia. These gives emotional support while reducing loneliness and uplifting confidence of a patient. Assistive robots help patients perform tasks like a **smart walker** that can detect the obstacles on the way and also make a visual map of the environment surrounding the

patient so that the user gets a more convenient and safer walking route.

10. Innovative solutions to clinical problems and Research about drugs

AI assisted care programs that are conducted, can give rise to innovative solutions like an **intelligent hand hygiene system** for the healthcare professionals and hence avoid infection. AI is used to predict reactions and interactions between drugs and harmful side-effects of drugs and hence helping in clinical research as well.

Conclusion

United Nations had emphasised that incorporation of AI in healthcare industry can help achieve sustainable development goals on good health and well-being. India has immense capacity to embrace AI in its healthcare system as it will highly benefit the country's growth and development. Scope, impact and application of AI in India:

1. AI to help in Diagnosis and Prevention

We have seen India face surge of communicable/non-communicable diseases and an increased aging population. The burden of disease management is increasing hence need for innovation is required. AI can help in identifying vulnerable patients early and classifying them into high risk and very high risk. Antibiotic resistance, malaria, tuberculosis, health insurance, diabetes, cardiovascular diseases and cancer are some fields which can be highly benefitted by AI. Cancer screening, Imaging Biobank for Cancer, Diabetic Retinopathy Screening and Chronic Obstructive Pulmonary Disease Diagnosis are few applications of AI in Indian Healthcare system.

2. AI is the technology to Empower the Healthcare Sector

There prevails a huge inequality in the healthcare distribution in India along with lack of trained healthcare professionals and infrastructure and low government spending on the healthcare industry. India hence, has room for immense innovation, sustainability, scalability and scope for application of various technologies like AI in the healthcare industry to improve the life of the population.

3. AI applications to reduce Healthcare costs

Indian Government's Niti Aayog estimated that there can be an increase of USD 957 billion which can be summed up with the GDP by 2035 by incorporating AI in healthcare sector and hence boosting India's annual growth by 1.3% by 2035. India has a very scattered and under-developed healthcare system and infrastructure and definitely. AI can bridge the resource gap in healthcare system in India and hence reduce the costs. AI helps in informative assistance for doctors and hence saves lot of time and money.

4. AI helped to fight the pandemic

- Infrared sensor with an AI powered facial recognition technology to check temperature of people at various places.
- Drones with AI thermal screening system are launched in public places to detect fever.
- AI and cloud computing is helping in vaccine development
- AI powered virtual assistance agent called the Watson Assistant for citizens helps the government to give people correct information.
- Chatbots powered by AI helped identify the best action plan based on their symptoms.
- Decentralised contact tracing tool has been developed as well.

References

B.M. Elbagoury, M.B.H.B. Shalhoub, M.I. Roushdy, Thomas Schrader, (2018) Artificial Intelligent Technologies for Mobile Health of Stroke Monitoring and Rehabilitation Robotics Control. Emerging Technologies for Health and Medicine- Virtual Reality, Augmented Reality, Artificial Intelligence, Internet of Things, Robotics, Industry 4.0,Part II, 7,89-100.

Coccia, M. (2020). Deep learning technology for improving cancer care in society: New directions in cancer imaging driven by artificial intelligence. *Technology in Society*, *60*, 101198.

Davenport, T., &Kalakota, R. (2019). The potential for artificial intelligence in healthcare. *Future healthcare journal*, *6*(2), 94.

Hashimoto, D. A., Rosman, G., Rus, D., &Meireles, O. R. (2018). Artificial intelligence in surgery: promises and perils. Annals of surgery, 268(1), 70. https://healthitanalytics.com/news/top-12-ways-artificial-intelligence-will-impact-healthcare#:~:text=AI%20offers%20a%20number%20of,treatment%20variability%2C%20and%20patient%20outcomes.

Jennifer Bresnick. Top 12 Ways Artificial Intelligence Will Impact Healthcare. April 30, 2018

Jiang, F., Jiang, Y., Zhi, H., Dong, Y., Li, H., Ma, S., ...& Wang, Y. (2017). Artificial intelligence in healthcare: past, present and future. Stroke and vascular neurology, 2(4), 230-243.

Kalis, B., Collier, M., & Fu, R. (2018). 10 promising AI applications in health care. Harvard Business Review.

Nick Heath

SAS India. Artificial Intelligence - What it is and why it matters? 2020. https://www.sas.com/en_in/insights/analytics/what-is-artificial-intelligence.html

Shah, P., Kendall, F., Khozin, S., Goosen, R., Hu, J., Laramie, J., ...&Schork, N. (2019). Artificial intelligence and machine learning in clinical development: a translational perspective. NPJ digital medicine, 2(1), 1-5.

The Royal Society. What is artificial intelligence?. Nov 28, 2018. https://www.youtube.com/watch?v=nASDYRkbQIY

What is AI. Everything you need to know about Artificial Intelligence. February 12, 2018. https://www.zdnet.com/article/what-is-ai-everything-you-need-to-know-about-artificial-intelligence/

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