Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 9[7] June 2020 : 109-121

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

REVIEW ARTICLE **OPEN ACCESS**

Applications of Artificial Intelligence in Pharmacy- Medicine and Health Care

Makrani Shaharukh [1]*, Siddiqui Nameera Amreen [2], Pathan Vahid Tajkhan [3], Ansari Mohd. Razi[4], Qazi Shoeb [5], Umme Rumana [6], Patel Afroza[7], Shaikh Nawaj Sharif [8]
[1,7] Department of pharmaceutics, Ali Allana College of Pharmacy Akkalkuwa, KBC NMU University, Jalgaon, Maharashtra-425002, India.
[2] Sayali College of Pharmacy, Aurangabad, Maharashtra, India.
[3] Ismail Mehta College of Pharmacy, Ambad Dist-Jalna, Maharashtra, India.
[4]School of Pharmacy and Medical Sciences, Singhania University, Pacheri Bari, Rajasthan, India.
[5]Department of Quality Assurance, Ali Allana College of Pharmacy Akkalkuwa, KBC NMU University, Jalgaon, Maharashtra-425002, India.
[6,8]Jamia College of Pharmacy, Akkalkuwa, Dist- Nandurbar, M.S, India.
Email- makranishaharukh@gmail.com,

ABSTRACT
Artificial Intelligence is an intelligent machine or program, which can take decisions on its own by analysing the situations, without human participation. Artificial Intelligence has been a abundant tool for solving hazardous problems and for working in conditions and situations where the work is too harmful for humans. For example, Repetitive works in many industries are unsafe for humans to do with high speed. Artificial intelligence (AI) is a division of computer science that deals with the problem solving by the help of symbolic programming. It has prominently changed into a science of problem solving with massive applications in business, health care, and engineering. The use of artificial intelligence in pharmaceutical technology has improved over the years, and the use of technology can save time and money while providing a better understanding of the relationships between different formulation and process parameters. In present article applications of artificial intelligence in various fields like pharmacy, medicine and health care are discussed.
Key words: *artificial intelligence, pharmacy, medicine, healthcare, intelligent machine, computer science.*

Received 21.03.2020 Revised 11.05.2020 Accepted 13.06.2020

INTRODUCTION

Artificial Intelligence is an intelligent machine or program, which can take decisions on its own by analysing the situations, without human participation. Artificial Intelligence has been abundant tool for solving hazardous problems and for working in conditions and situations where the work is too harmful for humans. For example, Repetitive works in many industries are unsafe for humans to do with high speed. However, it is needed to be done and done faster to help the company's work. In this kind of contradictory situations, Artificial Intelligence is used. Artificially Intelligent Robots can do the same monotonous work at very high speed without any assembled stress. Likewise, if a human does the same work, then because of the monotonous movements human might become injured for a lifetime. His hands or legs might become paralyzed or his hearing ability might decrease depending on the nature of work he does. In some cases, the computational ability of Artificial Intelligence is used to aid humanity in various programs and services. Like various programs which run sequences and thus complete a process [5].Artificial intelligence (AI) is a division of computer science that deals with the problem-solving by the help of symbolic programming. It has importantly changed into a science of problem-solving with massive applications in business, health care, and engineering. One of the fundamental applications of AI is the development of the expert system. The year 1956 is commonly considered to be the year when AI was born [7].

In Artificial Intelligence, "Artificial" means items that are made or created by human beings rather than taking place naturally, and "Intelligence" is the skill to form devices to achieve goals by interacting with

an information-rich surroundings therefore Artificial Intelligence purely represent the intelligence of machines and the separation of computer science that targets to generate it [10]. Artificial Intelligence is well-defined as a field that deals with the design and application of algorithms for analysis of, learning from and interpreting data. Thus, largely defined AI involves numerous subdivisions of statistical and machine learning, pattern recognition, clustering, similarity-based methods, logics and probability theory, as well as biologically inspired approaches, such as neural networks and fuzzy modelling, jointly described as "computational intelligence". Pharmaceutical drug manufacturing, from formulation development to ended product, is very difficult [4].

APPLICATION OF ARTIFICIAL INTELLIGENCE IN PHARMACY

IMPORTANCE OF AI IN PHARMACY

Presenting to a U.S. News analysis that was carried out on 150 professionals, pharmacists are the 13th best-paid professionals. The normal salary of a pharmacist was found to be $120950, and the joblessness rate was found to be 1.6%. The job of a pharmacist, for periods, has been to confirm that the prescriptions that are established by the pharmacy are occupied with the accurate medicine in the accurate amount and to also confirm that in case of several medications, the medicines do not display any adverse drug-drug interactions. Yet, the situation has extremely changed over the past 5 years. With the beginning of big data and AI, robots are nowadays becoming more reliable for doctors, and a huge quantity of organizations are now engaging robots laterally with human direction to carry out activities that were formerly done by humans [7].A huge number of compounds that could have the latent to fight a large number of precise diseases are available with pharmaceutical companies. Though, the companies have no tools at their discarding for their identification as such. Drug development and production is not ancalm task, and it may cost a pharmaceutical company as much as $2.6 billion along with a time frame of as long as 12–14 years for achievement. This is where AI becomes a bonus for pharmaceutical companies. AI decreases the time that is desired for drug development and, in turn, it cuts the costs that are connected with drug development, improves the returns on share and may even cause a decline in cost for the end user [7].

The keyprofit of AI is that it is much more higher to humans in investigating data and it can examine large number of data that would generally not fit into any of the unoriginal computers. AI is being commonly used in research areas presently. The processing power of AI is greater than any other tools available at anyone's disposal and in research, principally on gene mutation; it can go through piles of data and pick out the necessary information.

TOOLS OF AI PHARMACEUTICAL INDUSTRY

A huge amount of AI tools have been formed to encounter the recent necessity of the pharmaceutical industry.

a) Robot pharmacy

With the objective of refining the care of patients, UCSF Medical Center uses robotic technology for the preparation and chasing of medications. According to them, the technology has prepared 3, 50, 000 medication doses without any error. The robot has shown to be far improved than humans both in size as well as its ability to deliver exact medications. The abilities of the robotic technology include preparation of oral as well as injectable medicines which include chemotherapy drugs that are toxic. This has given independence to the pharmacists and nurses of UCSF so that they can use their expertise by centring on direct patient care and working with the physicians.

Inside the automated system of the pharmacy, the computers first collect medication orders electronically from the physicians and pharmacists of UCSF. Later this, individual doses of pills are picked, packaged, and dispensed by the robotics. This is followed by machines gathering the doses onto a bar-coded plastic ring. The thin plastic ring contains all medications that have to take by a patient within a period of 12 h. Adding to the capabilities of the automated system is their ability to prepare sterile preparations that are meant for chemotherapy along with filling of intravascular syringes with the right medications.

The automated capacity also consist an inventory management system that keeps track of every product along with a refrigerated and two non-refrigerated pharmacy warehouses for providing with storage and withdrawal of supplies and medications. All these facilities are entirely automated.

b) IBM Watson for oncology

IBM has established a supercomputer and named it Watson, which is a mixture of AI and classy analytical software designed basically to answer questions. Watson for oncology has been designed to contribution oncologists in taking better decisions for the treatment of cancer. It works by analyzing the medical information of a patient from an immense network of data and expertise and then providing treatment options based on the indication obtained. Watson for oncology is skilful of analysing both the connotation

and background of any data present in clinical notes or reports, be they correctly structured or unstructured. It can simply collect critical information concerning the patient and write it in plain English which can turn out to be a very critical step in providing the correct treatment plan for the patient. It associations critical traits from the file of a patient with external research, clinical research, and data and then decides the most real treatment plans that can be executed for a patient. Watson has a huge array of information from literature and rationales curated by MSK, over 200 textbooks, 12 million text pages, and over 290 medical journals.

c) MEDi robot

MEDi is a short form for Medicine and Engineering Designing Intelligence. The hurt management robot was established as part of a project led by Tanya Beran, professor of Community Health Sciences at the University of Calgary in Alberta. She got the idea after working in hospitals where children scream during medical procedures. The robot first builds a connection with the children and then tells them what to expect during a medical procedure. During the medical procedure, it guides them on what should be done, how to breathe during the procedure, and how to cope. While the robot cannot think, plan, or reason, it can be programmed such that it shows to have AI.

d) Erica robot

Erica is a fresh care robot that has been established in Japan by Hiroshi Ishiguro, a professor at Osaka University. It was developed in association with the Japan Science and Technology Agency, Kyoto University, and the Advanced Telecommunications Research Institute International. It can express Japanese and has a blend of European and Asian facial features. Like any normal human being, it likes animated films, desire to visit south-east Asia, and wants a life partner who would chat with it. The robot cannot walk freely; however, it has been developed with the ability to understand and answer questions with human-like facial expressions. Erica is the "most beautiful and intelligent" android as Ishiguro fixed up the features of 30 beautiful women and used the average for designing the robot's nose, eyes, and so on.

e) TUG robots

Aethon TUG robots are planned to independently travel through the hospital and deliver medications, meals, specimens, materials, and haul carry heavy loads such as linen and trash. It has two structures, i.e., fixed and secured carts as well as conversation base platform that can be used to carry racks, bins, and carts. The permanent carts are used for delivering medications, sensitive materials, and laboratory specimens, whereas, the exchange platform is engaged to transport materials that can be loaded on different racks. The TUG can deliver numerous types of carts or racks thus making it a very stretchy and utilizable resource. Throughout working, a touchscreen that is simple to use, allows users to determine where the TUG has to make deliveries or from where it has to pick up supplies or materials. In the case of multiple destinations, the TUG automatically computes the best path. It has sensors that overlap to ensure 180° coverage while navigation and to detect obstacles. The array of sonar and infrared sensors called "Light whisker" are able to detect low lying obstacles. The benefits of using TUG include 24/7 improved productivity, improved patient experience, worker safety, employee satisfaction, and patient safety.

f) MANUFACTURING EXECUTION SYSTEM (MES)

A MES is a control system that is planned to manage, monitor, and track the many manufacturing information in real time by getting minute by minute data from various sources which include robots, employees, and machine monitors. In today's world, MES is being broadly integrated with enterprise resource planning systems. MES simplifies compliance with regulatory procedures along with ensuring that drug makers get high-quality products in their manufacturing processes.

The profits of using MES include agreement with guaranteed legal regulations, reduced risks, improved transparency, reduced production cycles, enhanced resource utilization, controlled, and monitored production steps, and optimized up to batch release.

g) Berg

Berg is Boston-based biotech and is one of the vital players hiring AI in its numerous processes. It has an AI-based stage for drug discovery, which has a vast database of patients and this is used to find as well as validate the various biomarkers responsible for affecting diseases and then decides therapies according to the obtained data. The slogan of the company is to speed up the process of drug discovery and to bring about a decrease in the cost with the help of AI as it destroys estimation that is involved in the process of drug development. The steps that are followed by Berg include procurement of sequencing data from samples of human tissue, outcome information regarding metabolites, and protein formation, and testing of data using algorithms of AI to correctly determine the actual cause of disease.

h) AUTOMATED CONTROL PROCESS SYSTEM (ACPS)

The objective of an ACPS is to confirm that a process is carried out in a safe and commercial manner. This is attained by continually monitoring the various process variables which include temperature, pressure,

flow, vacuum, and concentration and as and when required, taking necessary actions such as slowing down pumps, opening valves, and turning the heaters up so as to ensure that the process variables are maintained at the required values. The benefits of ACPS are decent quality achieved at low cost, saving of material, assured personnel, plant, and processes safety, improved yield, and condensed labour cost. The components of ACPS include
(1) Sensing process variables' value,
(2) Transmission of signal to measuring element,
(3) Measure process variable,
(4) Presenting the value of the measured variable,
(5) Set the value of the desired variable,
(6) Comparison of desired and measured values,
(7) Control signal transmission to final control element, and
(8) Control of manipulated value [7].

A) AI IN DRUG DISCOVERY

Klopman presented a new program to study the structure activity relationship (SAR) of organic molecules. The program meant for structure evaluation is computer-automated, and it identifies structures of molecules from the KLN code, which is a linear coding routine of the molecule, mechanically and then further identifies, tabulates, and analyzes biophores, which are substructures that are really responsible for the biological activity of the molecules, statistically. The method was useful for studying the carcinogenicity of polycyclic aromatic hydrocarbons, ketoxime carbamates' pesticides activity, and to study the carcinogenicity of N-nitrosamine in rats. Aliper et al. newly presented an innovative approach of using deep neural networks (DNNs) for forecasting pharmacological activities of numerous drugs. The set of scientists trained DNNs such that it could be utilized for the guess of the therapeutic use of several drugs using data of gene expression. These data were gained from experimentations on human cell lines. The total number of drug samples involved in the study was 678 and the cell lines used were A549, PC-3, and MCF7. DNN was originate to be highly accurate in classifying drugs into different therapeutic categories. For the very first time, it was shown that DNN could be used for the recognition of pharmacological properties of several drugs [7]**.**
Drugdiscoveryisalengthyandmultipartprocessthatcanbebroadlydividedintofourmajorstages:
(1) Target selection and validation;
(2) Compound screening and lead optimization;
(3) Preclinical studies; and
(4) Clinical trials. Main, the target related to a specific disease needs to be identified. This needs cellular and genetic target evaluation, genomic and proteomic analysis, and bioinformatics predictions. The next step is hit identification, where compounds are identified from molecular libraries by using methods such as combinatorial chemistry, high-through put screening and effective screening (**Figure1**). Structure–activity and *in silico* studies in combination with cellular functional tests are used in an iterative cycle to progress the functional properties of recently synthesized drug candidates. Afterward, in vivo studies such as pharmacokinetic investigations and toxicity tests are performed in animal models (**Figure 1**).

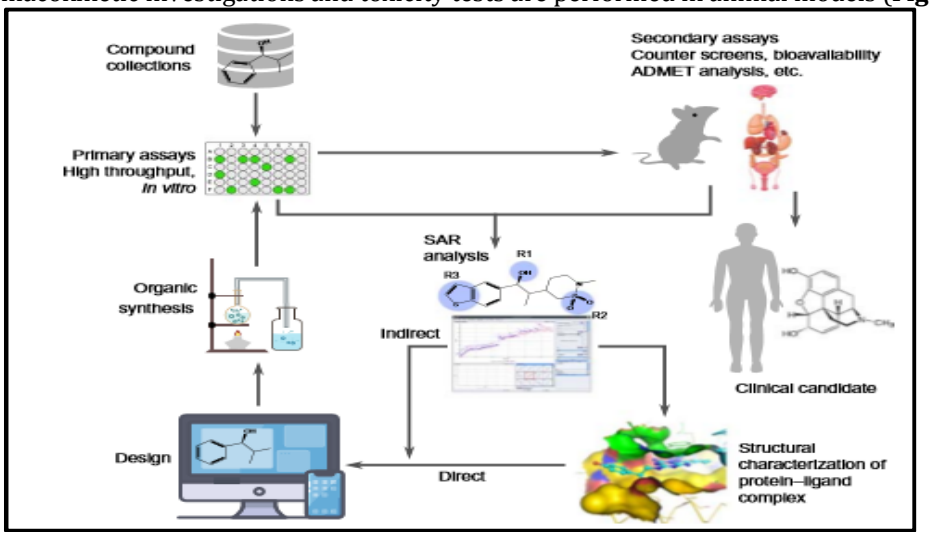

Figure 1: A Illustrative Channel of Drug Discovery

Lastly, the drug candidate, which has now successfully passed all preclinical tests, is administered to patients in a clinical trial. This step is noticeable by three phases that the drug needs to get through sequentially. Phase I, drug safety testing with a small number of human subjects; Phase II, drug efficacy testing with a small number of people affected by the targeted disease; and Phase III, efficacy studies with a larger number of patients. If the safety and efficacy of the drug candidate are confirmed in the clinical phases, the compound is reread by agencies such as the FDA for approval and commercialization. It has been projected that the average cost of a traditional drug discovery pipeline is 2.6 billion USD, and a comprehensive traditional workflow can take over 12 years [3].

Table 1: List of AI-Based Computational Tools for Drug Discovery

Tools	Description
AlphaFold	Protein 3D structure prediction
Chemputer	A more standardized format for reporting a chemical synthesis procedure
DeepChem	A python-based AI tool for various drug discovery task predictions
DeepNeuralNet-QSAR	Molecular activity predictions
DeepTox	Toxicity predictions
DeltaVina	A scoring function for rescoring protein–ligand binding affinity
Hit Dexter	ML models for the prediction of molecules which might respond to biochemical assays
Neural Graph Fingerprints	Property prediction of novel molecules
NNScore	Neural network-based scoring function for protein–ligand interactions
ODDT	A comprehensive toolkit for use in chemoinformatics and molecular modeling

B) Artificial Intelligence in Clinical Trial Design

It takes a normal 10–15 years and USD 1.5–2.0 billion to bring a new drug to market. Almost half of this time and investment is consumed during the clinical trial phases of the drug development cycle. The lasting 50% of R&D spending covers preclinical compound discovery and testing as well as regulatory processes (**Figure 2**). While Pharma and biotechnology companies have constantly increased R&D investment for eras, the number of new drugs gaining regulatory sanction per billion USD spent has shared approximately every 9 years [1].

Clinical trials of drugs are lifelong and costly, and machine learning has numerous useful latent uses in aiding to organize clinical trials. The application of an advanced, predictive analysis in identifying candidates for clinical trials, finding the finest size sample for increased efficiency, adjusting the differences in patient enrolment sites and using electronic medical records to reduce data errors can lead to more efficient and more commercial testing. Machine learning can also be used for remote monitoring and entree to real-time data for increased security; for example, monitoring biological and other signals for any sign of injury or death of the participants [8].

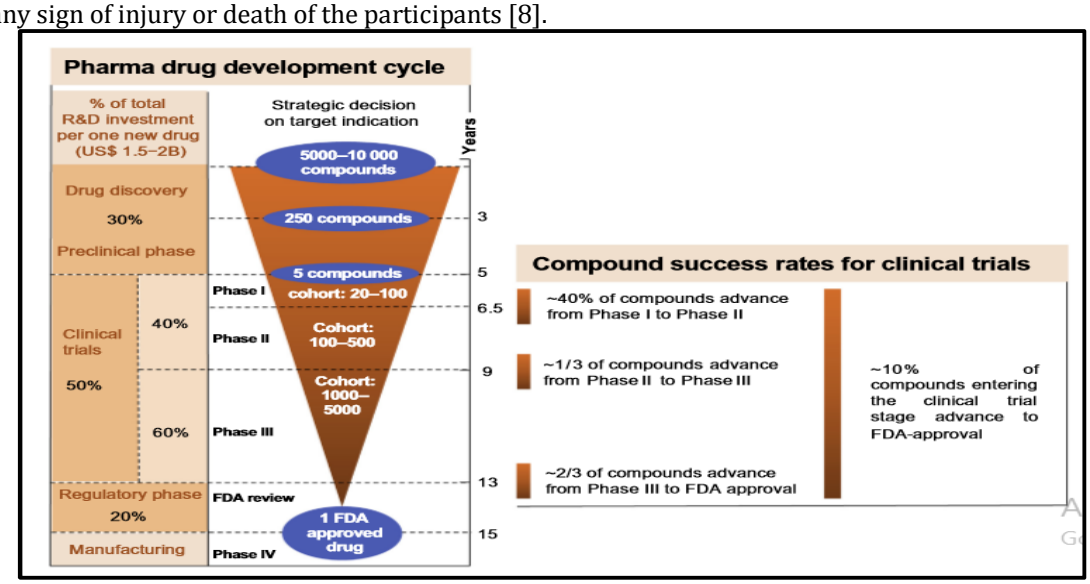

Figure 2: The Pharma Drug Development Cycle.

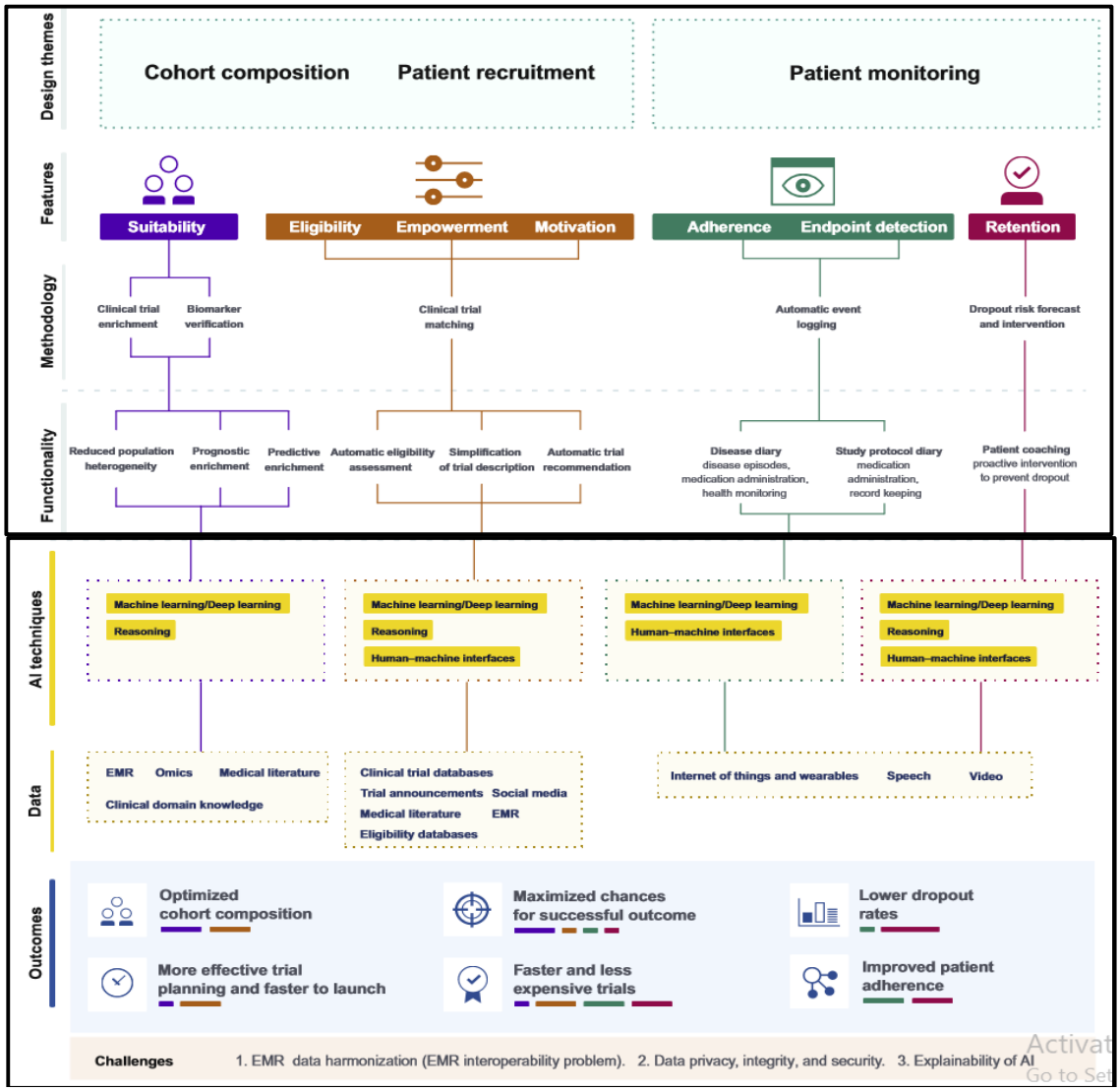

Figure 3: Artificial Intelligence (AI) for Clinical Trial Design from methodology to enhanced results [1].

Epidemiology

By using machine learning and AI, the history of the endemic can be studied, the activity of social media analysed, and it can be predicted where and when the epidemic can occur with significant accuracy. The AIME-AI Project in Medical Epidemiology and their platform make it possible to forecast the precise geographical location and the date of epidemics of infectious diseases such as tropical fever or zyka for three months in advance, with a precision of 86.37%. It has been found that 270 unfixed factors affect the widespread of epidemics. An independent system was developed so that every 23 seconds it originally mechanically goes through 270 variables. Some of them are the speed and direction of the wind, the temperature, the movement of the population.

Formulation of Pharmaceutical Preparations

The application of neural networks as one of the AI technologies is a recent approach to resolve the complex problems of formulating pharmaceutical preparations. The application of ANN signifies a new measurement in the formulation of pharmaceutical preparations due to exclusive advantages, such as nonlinearity, the ability to model and optimize with a small number of experiments. ANN have been successfully applied in designing compositions of pharmaceutical preparations, optimizing production processes, providing and controlling quality, predicting the stability of pharmaceutical preparations, in vitro testing the rate of release of the active substance from the pharmaceutical form and in vitro / in vivo correlation. With the development of new, powerful software packages adapted to the user, the application of ANN in the design and development of new pharmaceutical preparations is also foreseen, as well as for the quick and simple calculation of their stability, safety, and efficiency while at the same time significantly reducing costs .

Adherence

The advance of medicine is intended at treating the disease, but without a satisfactory way and frequency of taking drugs, the success of therapy is, nearly certainly, impossible. New technologies in medicine have found application in monitoring of therapy. Chronic therapy adherence is important because chronic diseases such as diabetes, hypertension, have no clear symptoms, so patients can often skip the dose. Studies suggest that 33-50% of patients do not take medication correctly, which contributes to nearly 100,000 premature deaths each year. Insufficient adherence is the main cause of uncontrolled hypertension, which is the main cause of stroke, coronary heart disease, cardiac insufficiency, and mortality [8].

C) AI IN DRUG DEVELOPMENT

AI Machine learning and deep learning

AI is labelled as the use of techniques that allow computers to mimic human behaviour in (**Figure 4**).

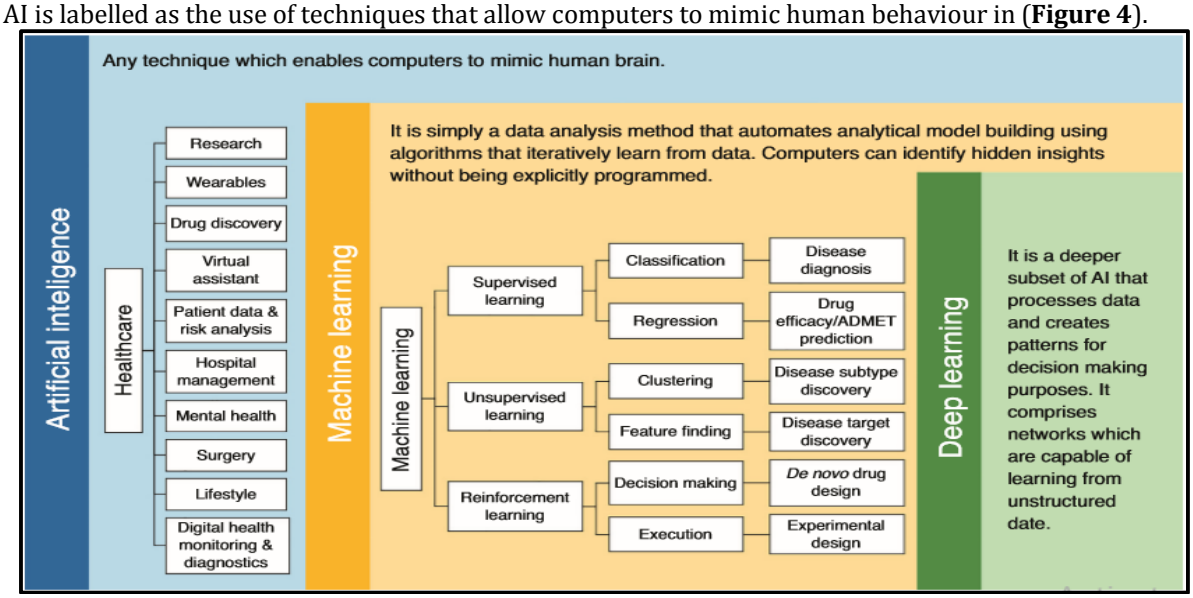

Figure 4: The Applications of Artificial Intelligence and its subfields: machine learning and deep learning in healthcare

The application of artificial intelligence in the process of drug development is proposed in (**Figure 5**).

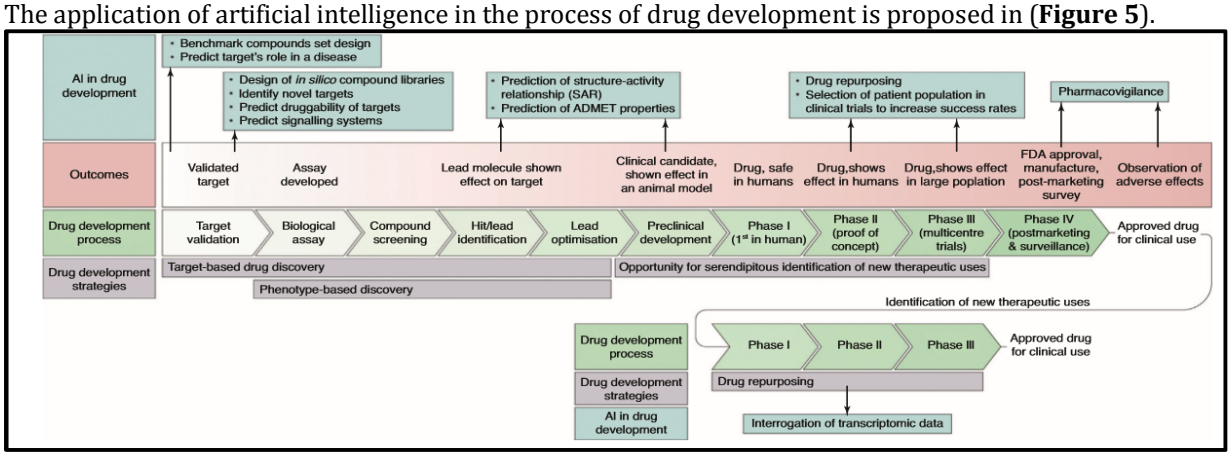

Figure5: Application of Artificial Intelligence In the drug development process [9].

D) APPLICATION OF AI IN PHARMACEUTICAL RESEARCH

In Formulation:

Controlled release tablets:

The first effort in the use of neural networks for modelling pharmaceutical formulations was performed by Hussain and co-workers at the University of Cincinnati (OH, USA). In numerous studies they modelled the in vitro release characteristics of a range of drugs dispersed in matrices prepared from various hydrophilic polymers. In all cases, neural networks with a single unseen layer were found to offer reasonable performance in the prediction of drug release. In common, the results were similar with those made through the use of statistical analysis, but when predictions outside the limits of the input data

were tried performance was poor. No effort was made to optimize the formulations using genetic algorithms, but the results generated did lead the researchers to propose the concept of computer aided formulation design based on neural networks. 12 In a more recent study involving the formulation of diclofenac sodium from a matrix tablet prepared from cetyl alcohol, personnel from the pharmaceutical company KRKA dd and the University of Ljubljana have used neural networks to predict the rate of drug release and to undertake optimization using two- and three-dimensional response surface analysis. Non-linear relationships were found between the release rate and the amounts of the ingredients used in the formulation, telling the possibility of the production of several formulations with the same release profile.

Immediate release tablets:

The networks produced were used to prepare three-dimensional plots of massing time, compression pressure and crushing strength, or drug release, massing time and compression pressure in an attempt to exploit tablet strength or to select the best lubricant. Although trends were observed no optimal formulations were given. The trends were comparable to those generated by statistical procedures. Comparable neural network models were generated and then optimized using genetic algorithms. It was found that the optimum formulation depended on the constraints applied to ingredient levels used in the formulation and the relative importance placed on the output parameters. A high tablet strength and low friability could only be obtained at the expense of disintegration time. In all cases lactose was the preferred diluents and fluidized bed the preferred granulating technique [2].

In Product Development:

The pharmaceutical product development process is a multivariate optimization problem. It includes the optimization of formulation and process variables. One of the most useful properties of artificial neural networks is their ability to generalize. These sorts make them suitable for solving problems in the area of optimization of formulations in pharmaceutical product development. ANN models displayed improved fitting and predicting abilities in the development of solid dosage forms in investigations of the effects of several factors on tablet properties (. ANNs provided a useful tool for the development of microemulsion-based drug-delivery systems in which experimental energy was minimized. ANNs were used to forecast the phase behaviour of quaternary microemulsion-forming systems consisting of oil, water and two surfactants. ANN was also used to simulate aerosol behaviour, with a view to employing this type of methodology in the evaluation and design of pulmonary drug-delivery systems. For controlling and decision-making, fuzzy logic is a very powerful problem-solving technique. It provides very useful rules from input data, in the form of "if… so… then". Fuzzy logic can be combined with neural networks as neuro fuzzy logic. This combination provides more flexibility and capability to the technique and provides powerful results [4].

Manufacturing measures

With the growing attention of novelty, the industry is sighted expanding number of third-party players proposing different inventory network arrangements. For e.g.: a US based programming arrangements organization, offers store network arrangement which empowers the utilization of prophetic examination in pharmaceutical production network he executives by utilizing important information and supporting gauge the board, necessities arranging, retail, deals and activities arranging. The misappropriation of new innovations, for example, AI and AI could robotize different procedures counting drugs coordination's, following, bundling and handling, giving less space for human mistake [6].

APPLICATION OF AI IN MEDICINE

A) Diagnostics

Bakst was one of the main researchers to discover the clinical potentials of ANN. He has developed a neural network model that exactly diagnoses acute myocardial infarction. Since then, ANN has been applied in almost every field of medicine. ANNs were used in clinical diagnosis, in the interaction of radiographs, MRI-magnetic resonance imaging, CT, ultrasound, and wave analysis, electrocardiogram (ECG), electroencephalograms (EEG), interpretation of data in the placement intensive care .

Fuzzy logic is a data processing methodology that allows uncertainty and is therefore particularly suitable for the application in medicine. The most probable field of application of this theory lies in medical diagnostics and, to a lesser degree, in the description of biological systems. Schneider et al. have shown that fuzzy logic was more precise than multiple logistic regression analysis in lung cancer diagnosis using tumour markers. It is also used in the diagnosis of leukemia, cancer, for the characterization of breast ultrasound, MRI brain. EC and the principles of genetic algorithms are used for the diagnosis of lung cancer, computerized analysis of mammographic micro calcifications for MRI segmentation of brain tumour to measure the efficacy of treatment strategies and to analyse computerized 2-D images for the diagnosis of malignant melanoma. Deep learning, a branch of the developing field of machine learning, has advanced over the past several years. In 2012, a deep convergent neural network, AlecNet showed

improved accuracy in the classification of high-resolution images and in 2015, similar versions, including Google's deep neural network GoogLeNetResNet's and deep neural network have exceeded the human limit of image recognition accuracy.

Using AI, processing a series of images in its databases (specifically 129,450 images), more precise classification of skin lesions can be made that represents skin cancer in different stages. Further development involves the creation of an application that will allow dermatologists to work beyond their specialist offices, which is of great importance in the early screening of skin cancer.

B) Prevention of disease

Prevention of disease is an enormously important branch of medicine. With the help of neural networks, patients who have been inclined to a condition can be identified, and it is possible to focus on them in order to prevent the progress of the disease. It is also possible to predict the existence of patients with breast cancer and colorectal carcinoma. When guessing the result of treatment for patients in intensive care units, ANN showed better prediction power compared to APACHE II test for the severity of patients' condition. In a search for a dependable sign that a patient with mild cognitive impairment would suffer from Alzheimer's, experts initiated neuroimaging of brain structures of people with Alzheimer's disease. They have pulled the data from global tests, in which they collected recordings and clinical assessment of patients with mild cognitive impairment. A group of researchers then used AI and big data to develop an algorithm that would recognize dementia two years before the first symptoms. The data they used to teach AI to recognize dementia are amyloid positron emission tomography (PET) of the brain of patients who are prone to developing Alzheimer's disease. After analyzing thousands of PET patient records, the algorithm has managed to recognize which of them are susceptible to dementia with 84% accuracy.

C) Applications for physicians and patients

A study conducted in the UK has shown that thousands of patients die in acute renal failure or sepsis due to insufficiently rapid diagnosis. That's why Deep Mind has developed an application that generates patient information and notifies doctors about changes in vital signs, biochemical parameters, without the need for medical staff to review the documentation. This application saves 2 hours of working time to medical staff daily. An application has been developed to monitor patients using antidepressant therapy. It is known that the effects of therapy need to be prolonged for a longer period of time, but with the help of this application, monitoring of the effects of therapy is enabled. The condition of the patient is evaluated more often and in a more efficient manner, which speeds up their recovery. The effects of the therapy can be monitored daily. The test works on smartphones, tablets and any web browser. Patients complete the test within 10-15 minutes, which includes recognizing facial expressions and emotions, and answering a range of health issues, which determine whether there is a shift in therapy. The American Heart Association and the American Society for Infarction of the brain sponsored a web environment for the monitoring of cardiac patients called the Heart360 Cardiovascular Wellness Center. Heart360 allows patients to monitor their blood pressure, blood glucose levels, cholesterol, weight, diet, and physical activity, and on the basis of these data, they receive advice and information specific to their condition. More precisely, patients can collect and record these parameters, set goals, and monitor their progress, review their data in charts that they can print and share with others involved in their family health, receive news and articles of potential interest based on their health information. More than 20% of the time of the medical staff is spent on data entry. Considering that physicians are overloaded with technical tasks, such as electronic health records, instructions, orders, they have less time for patients, research, mastering new technologies and improving their skills. Radical productivity improvements are needed, in order to maintain the current health standards and to make progress. The combination of human expertise and automated functionality creates a model of "perfect" physician. Immortality is the idea of alchemists since ancient times. Company *In silico* medicine has created an algorithm, which can calculate the biological age of any patient based on parameters of their blood. This is the way in which AI can help people, by calculating biological age, to prolong life. This artificial neural network is trained by hundreds of thousands of patient data. After the acquired values, a person can change the lifestyle; include certain medications, supplements in the therapy. In a study published in 2018, the accuracy of the acquired values was tested with this application, and the results showed that blood parameters can be used reliably in determining biological age [8].

APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN HEALTH CARE

The most seeming use of artificial intelligence in healthcare is data management. Collecting it, storing it, normalizing it, and tracing its descent. It is the primary step in transforming the obtainable healthcare systems. AI is a branch of computer science and technology familiarizing with the simulation of smart behaviour in computer system. Organizing the experience, information, and human contact of clinicians

with the power of AI will enhance the high quality of patient care and also lower its cost. Data from whole patient populations can be analysed using AI to discover new evidence and determine high-quality healthcare practices.

Doing repetitive jobs Analysing tests, X-Rays, CT scans, data entry, and other usual tasks can all be done much faster and more accurately by robots. Cardiology and radiology are two fields where the amount of data to examine can be overwhelming and time intense. Cardiologists and radiologists in the future should only look at the leading classy cases where human supervision is helpful. IBM commenced another algorithm known as Medical Sieve. It is an ambitious long-term investigative project to build the next generation "cognitive assistant" with analytical, reasoning capabilities and a extensive range of clinical knowledge. Medical Sieve is eligible to help in clinical decision making in radiology and cardiology. The "cognitive health assistant" is able to examine radiology images to mark and identify complications faster and more reliably.

Treatment design AI is resulting in progressions in healthcare treatments, such as upgrading the organization of treatment tactics, analyzing data to provide superior treatment strategy, and monitoring treatments. AI has the ability to rapidly and more accurately recognize signs and symptoms of disease in medical images, such as MRI, CT scans, ultrasound and x-rays, and therefore permits faster diagnostics reducing the time of patients wait for a diagnosis from weeks to mere hours and expeditiously the introduction of treatment choices. Doctors can now search information, such as Modernizing Medicine, a medical assistant used to gather patient information, record diagnoses, mandate tests and prescriptions and arrange billing information. Furthermore, the aptitude to explore public databases with information from thousands of doctors and patient cases can assist physicians manage better personalized treatments or discover similar cases. AI will encourage clinicians adopt a more extensive strategy for malady administration, better facilitate care designs and help patients to all the more likely oversee and satisfy with their long haul treatment programs.

A) Digital consultation

Healthcare Monitoring tools that use AI techniques are presently in wide use. They can be utilized as remote patient monitoring for health indicators, such as post operation heart action, patient height and weight, and so on. Wearable gadgets, similar to wristwatches, such as those of Fit BIT commercial fitness trackers, are now often used. AI can be used to remotely decide persistent treatment designs, or alarms to give the client with any issues. Wearable gadgets can monitor information related to health and comfort, such as the number of steps walked, or else the number of calories burned. This might be important to patients seeking to drop weight. AI can then interpret this information to provide people better access to knowledge regarding their physical state and thus, give confidence to patient lifestyle changes.

B) Drug creation

Machine learning algorithms are now being used with numerous achievements to decrease drug discovery times. Developing pharmaceuticals by means of clinical tests is remarkably tedious, as frequently as possible taking considerably more than 10 years, and cost billions of U.S dollars. Using AI to restore parts of the drug discovery process can be much quicker, cheaper, and safer. At the same time AI cannot totally remove all the stages concerned in drug creation, it can assist with stages like, discovering new compounds that could be possible drugs. It can also assist to find new applications for previously tested compounds. Between the West Africa Ebola in 2014 virus outbreak, a program powered by AI was used to scan accessible medicines that might be redesigned to fight against the disease. Two drugs were discovered to reduce contamination in one day, when analysis of this kind generally takes months to years, a difference that might signify saving thousands of lives. Not long from now, AI platforms united with in-memory computing technology will have the capacity to offer accelerated drug discovery and development and delivery and also help scientists find new uses for drugs.

C) Recognition of facial symptoms

Technology that permits AI systems to identify faces in digital photographs is now presenting the similar potential in discovering physical identifiers in some medical conditions. Facial emotion recognition (FER) is a most important area in the fields of computer vision and artificial intelligence owing to its remarkable educational and commercial potential. Even though FER can be carried out utilizing multiple sensors. To demonstrate, consider Face2Gene phenotyping purposes that use face detection and machine learning to assist healthcare providers in recognizing uncommon genetic disorders. These applications draw data points from a image and evaluate it to images of patients from a database, who have also been treated with these disorders

D) Management of diabetes

The cause for AI in analysis or checking of diabetes and its tiresomeness can build up the patient's impressiveness of life. The computer aided diagnosis, decision support systems, specialist systems and execution of software may help physicians to reduce the intra and inter observer variability. The

application of AI improves interpretation of consequences with high precision and maximum speed. For an instance, The Diabeter Clinic‟s latest observational test applied a system built on top of a self-optimizing AI platform. The system, named as Rhythm, forecasts and manages blood glucose levels of people with diabetes, relied only on non-invasive biometric sensors and AI.

E) Robot assisted surgery

Robotic surgery, computer-assisted surgery, and also robotically-assisted surgery are terms for technological improvements that utilize the robotic systems to aid in surgical procedures. Robotically-assisted surgery was created to master the limitations of pre-existing minimally-invasive surgical procedures and to improve the capacity of surgeons performing open surgery [10].

F) AI from Bench to Bedside

The use of artificial intelligence techniques in healthcare research has intensely improved in recent years. The ability to generate and store large data sets as never before and to scale up computations has allowed AItothrive. The subfield of AImost significantly improved by this big data revolution has been machine learning (ML), where learning is driven by contact to pre-existing large datasets. Completely these developments create novel and exciting opportunities for AI to positively impact the medical field across multiple stages (**Figure 6**).

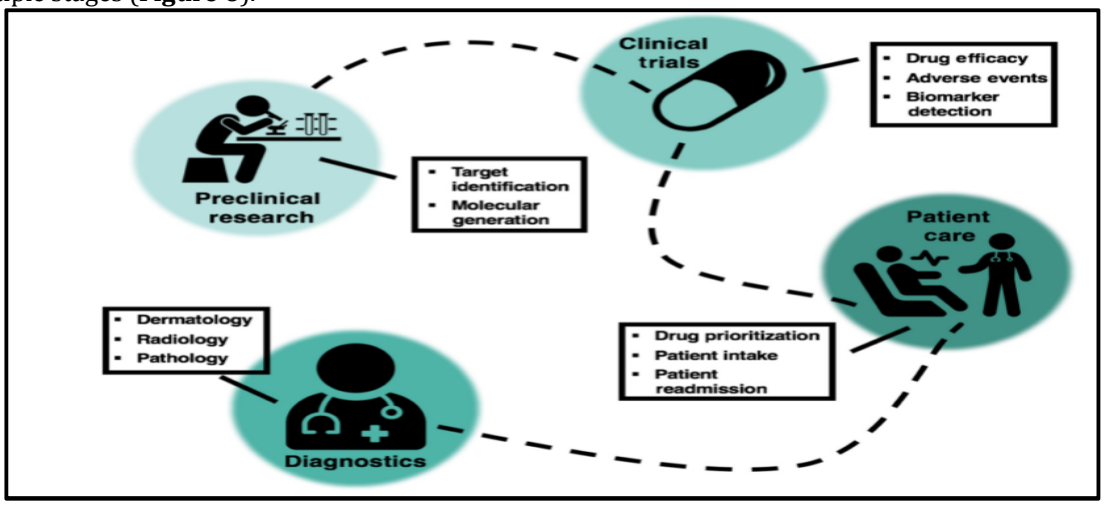

Figure 6: Artificial Intelligence Applications within the Health care Background [2].

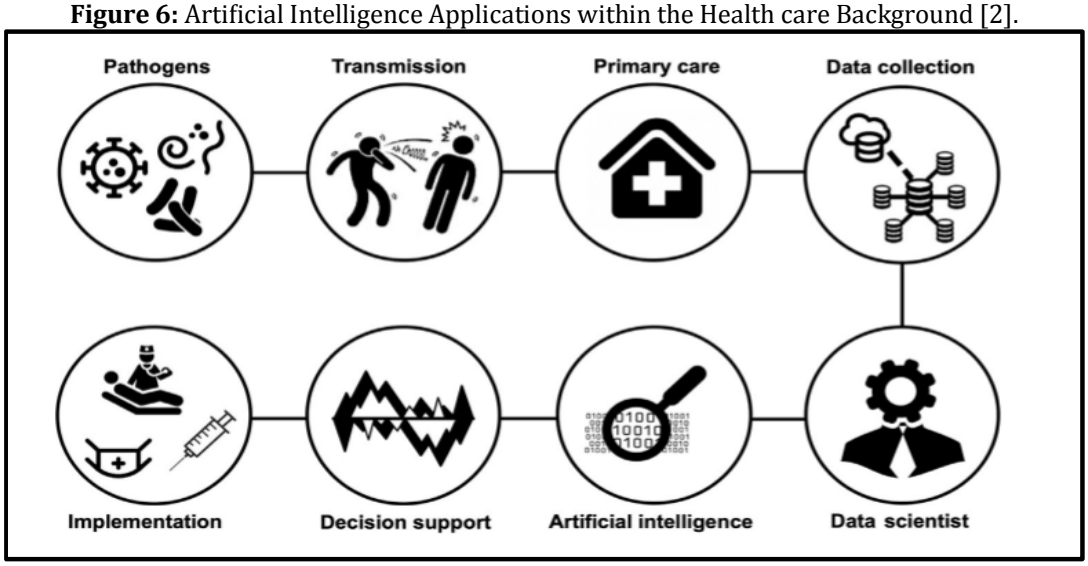

Figure 7: Vital principles in the control of infectious diseases [5].

OTHER APPLICATION OF ARTIFICIAL INTELLIGENCE

A) Industries

In industries, AI agents are used very regularly nowadays. Most of the car manufacturing companies use robots comprehensively. Robots are used successfully in many situations where it is considered dangerous and degrading for human. Robots are also very expert at repetitive works in which sudden lapse of concentration can cause damage and/or accidents.

B) Transportation

Fuzzy Logic controllers have been produced for programmed gearboxes in cars. For instance, the 2006 Audi TT, VW Toureg, and VW Caravell include the DSP transmission which uses Fuzzy Logic. Various Škoda variations additionally right now incorporate a Fuzzy Logic-based controller. Additionally, Google Car that is driven consequently with no driver is a miracle of AI use as of late.

C) Finance

The use of AI in banking can be followed back to 1987 when the Security Pacific National Bank in USA set-up a Fraud Prevention Task power to counter the unapproved utilization of debit cards. Applications like Kasisito and Money stream are utilizing AI in budgetary administrations Banks utilize artificial intelligence frameworks to sort out tasks, put resources into stocks, and oversee properties. In August 2001, robots beat people in simulated money related exchanging competition. Budgetary establishments have since quite a while ago utilized counterfeit neural system frameworks to identify charges or claims outside of the standard, hailing these for human inspection.

D) Hospital and Medicine

An MC can use the AI system to sort out bed plans, make a staff turn, and give therapeutic data and other noteworthy undertakings. Artificial neural systems are utilized as clinical choice emotionally supportive networks for therapeutic analysis, for example, in Concept Processing technology in EMR programming software.

a) Different shops in medication that can possibly be performed by AI include: Computer-helped clarification of restorative pictures. Such outlines help check computerized pictures, for example from processed tomography, for regular looks and to feature projecting segments, for example, potential infections. A normal application is the identification of a tumour.

b) Heart sound test

c) Watson's task in where the use of AI in this field is Q/A program that proposes for specialists of cancer patients.

E) Online and Telephone Customer Service:

Artificial Network is actuated in electronic online associates that can be viewed as symbols on web pages. It can profit for endeavours to diminish their activity and preparing cost. An important fundamental innovation in such frameworks is natural language preparation.

F) Music

The advance of music has consistently been prejudiced by technology. With AI, researchers are trying to cause the PC to copy the exercises of the adroit musician. Structure, execution, music theory, sound handling are a portion of the important territories on which research in Music and Artificial Intelligence are centring. Among these endeavours, Melomics seems to go ahead by powering PC authors that figure out how to make the manner in which people do.

G) Aeronautics

The Air Operations Division (AOD) uses AI for the standard-based master outlines. The AOD has a use for artificial intelligence for substitute administrators for battle and preparing the system test, mission guides, emotionally supportive networks for planned basic leadership, and post handling of the test system information into symbolic gist's [5].

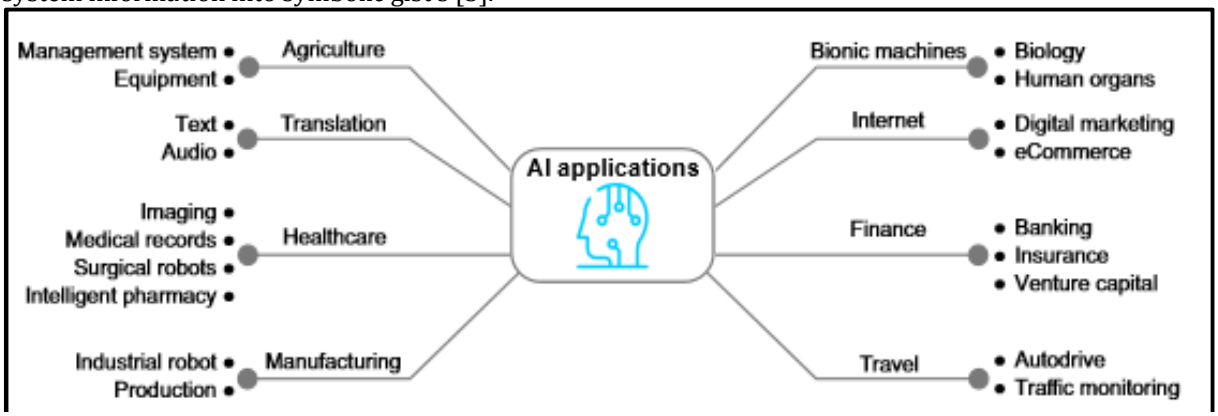

Figure8: Miscellaneous applications of AI in different areas [3]

CONCLUSION

The present article concludes that:

a) Artificial Intelligence is the newest curiosity in science. Similar most other marvels of science, it also has many advantages and drawbacks. Artificial Intelligence today is used in numerous researches because

of interest. Not because they are needed but because they are wanted. The purpose of using Artificial intelligence should be the greater good of humanity.

b) The AI is very fundamental part of pharmaceutical industry as well as health-care team. With numerous researches being carried out through the world to advance the productivity of manufacturing and other health-care related activities, researchers are observing into the view of employing AI for every activities carried out.

c) Artificial Intelligence is developing science which has applications in various fields as well as medicinal services outline. Studies prove that AI is a basically emerging market in the field of healthcare. It has extensive variety of applications in this field such as data management, drug discovery, diabetic management, digital consultation etc.

ACKNOWLEDGEMENT

The authors are thankful to Hazrat Maulana G.M. Vastanvi Sahab, President of Jamia Islamia Ishaatul Uloom's Ali Allana College of Pharmacy Akkalkuwa Dist. Nandurbar for providing the work facilities.

REFERENCES

1. Stefan, Harrer., Pratik, Shah.,Bhavna, Antony., and Jianying, Hu.,(2019). Artificial Intelligence for Clinical Trial Design,*Trends in Pharmacological Sciences*, **40**: 8.
2. Coryandar,Gilvary., Neel,Madhukar., Jamal,Elkhader., and Olivier,Elemento.,(2019). The Missing Pieces of Artificial Intelligence in Medicine,*Trends in Pharmacological Sciences*, **40**:8.
3. H.C. Stephen, Chan., Hanbin, Shan.,Thamani, Dahoun., Horst, Vogel., and Shuguang, Yuan., (2019).Advancing Drug Discovery via Artificial Intelligence,*Trends in Pharmacological Sciences*, **40**:8.
4. Prital,Sable.,Vineeta, V Khanvilkar,(2018). Pharmaceutical Applications of Artificial Intelligence, *Int J Pharma Res Health Sci*, **6** (2):2342-45
5. Mir Akmam, Noor Rashid., Momin, Mullah.,Zakaria, MohdZain.,(2020). Application of Artificial Intelligence: A Review, *IJAERS*, **7**:3.
6. Ade, Maria Ulfa., Afandi, Saputra., Yuswardi, Phong., Thanh, Nguyen,, (2020).Role of Artificial Intelligence in Pharma Science, *Journal of Critical Reviews*, **7**:1.
7. Manish, Vyas.,Sourav, Thakur.,Bushra, Riyaz., Kuldeep, K Bansal., Bhupendra, Tomar., Vijay, Mishra.,(2018). Artificial Intelligence: The Beginning of a New Era in Pharmacy Profession, *Asian Journal of Pharmaceutics*,**12** :(2).
8. Emilija J, Kostić1.,Dimitrije A, Pavlović., Miroslava D, Živković., (2019). Applications of Artificial Intelligence In Medicine And Pharmacy - Ethical Aspects, *Acta Medica Medianae*, **58**(3):128-137.
9. Kit-Kay,Mak.,Mallikarjuna,RaoPichika.,(2019). Artificial intelligence in drug development: present status and future prospects,*Drug Discovery Today*,**24**:3.
10. N. Murali., N. Sivakumaran.,(2018). Artificial Intelligence in Healthcare – A Review, *IJMCICT, 1*(6):103-110.

CITATION OF THIS ARTICLE

M Shaharukh, S N Amreen, P V Tajkhan, A Mohd. Razi, Q Shoeb, U Rumana, P Afroza, S N Sharif. Applications of Artificial Intelligence in Pharmacy- Medicine and Health Care. Bull. Env. Pharmacol. Life Sci., Vol 9[7] June 2020 : 109-121