



## Review on Artificial Intelligence (AI) in Drug Dispensing and Drug Accountability

A. Harika Anupama\*, G. Srilekha, G. Uma Priya

Clinosol Research Private Limited, 48-7-53, Rama Talkies Rd, Srinagar, Rama Talkies, Dwaraka Nagar, Visakhapatnam, AP 530016, India.

\*Corresponding author's E-mail: [addepallianupama1509@gmail.com](mailto:addepallianupama1509@gmail.com)

Received: 10-02-2020; Revised: 24-03-2020; Accepted: 30-03-2020.

### ABSTRACT

Research on artificial intelligence (AI) from the last two decades has enormously upgraded the performance of both manufacturing and service system. Artificial intelligence is the study of complicated information which progresses have their rules in any aspect of biological information processing. The key objective of artificial intelligence is to establish the useful information processing problems and give a detailed account on solving the problem based on the data of the patient. Artificial intelligence in drug dispensing has a greater impact in saving several people lives. Drug dispenser like Expense has been used which has Bluetooth connector, by voice, by pin or passwords to notify the patient that the drug is ready for consumption. Over the coming years, pharmacists will be replaced by artificial intelligence (AI) as it helps in identification of upcoming diseases.

**Keywords:** Drug dispensing, automated dispensing cabinet, sensors, automated pill dispensers.

### INTRODUCTION

From the past 25 years, pharmacy has been doing an immense job which includes the demand for prescription demand of Affordable Care Act. It also has done a tremendous job which promoted the efficiency of the work flow and minimizing the operating costs. At the same time developing safety, accuracy and efficiency in each and every pharmacy setting. In order to spend more time with a number of patients, there is an introduction of technology into the patient care which is known to be artificial intelligence (AI)<sup>1</sup>. Generally (AI) in health care is defined as technology that utilizes the software and the algorithms to estimate human cognition in the investigation of complex medicated data. The key target of artificial intelligence is to interpret the relationships between diagnosing techniques and the outcome of the patients.

Artificial intelligence (AI) in health case is defined as the adoption of algorithms and software to proximate human attention or awareness in the evaluation of complex medical data.

Artificial intelligence is also called as 'MACHINE INTELLIGENCE', this aids in processing enormous amounts of structured and unstructured data to generate intelligent and accurate decisions<sup>1</sup>. Precisely, artificial intelligence (AI) is the capability of the algorithms to proximate conclusions without unambiguous direct human input. Generally, this artificial intelligence (AI) is of 3 types. They are:

- a) Human created algorithms
- b) Machine learning
- c) Deep learning

Artificial intelligence (AI) can also be used in scrutinizing the data and also exhibiting the results which would

reinforce decision making, preserving human effort, time and money as it helps in saving people lives. Enormous level of personalized high-touch care for patients is facilitated by adaption of artificial intelligence<sup>1</sup>.

Artificial intelligence (AI) is contrary to humans who are impotent to deal with huge amount of data in short extent of time. With the practice of Natural Language Processing (NLP) and by culturing deeply from huge data sets, algorithms work. NLP grants computers to analyse and exploit human language for the performance of human like tasks. Radical impact on industries is established by artificial intelligence which was disciplined by punctilious rules and regulations<sup>2</sup>. By the regulatory environment, financial and health care industries are greatly altered as they make a serious brunt on general public lives. Regulations contemplate to ensure more financial matters in financial industry where as these regulations follow to safeguard all aspects of patient case in healthcare industry.

Advantages of Artificial Intelligence (AI) to Health -Care-Industry:

- ❖ It enables automated and definite conformity
- ❖ Promotes improved decision making
- ❖ Forecasting future diseases
- ❖ Understanding genetic makeup
- ❖ Prevent fraudulent billing.

**It enables automated and definite conformity:**

Due to continuous assessments in health care science and precision medicine, Govt. regulations are constantly emerging whose purpose is as follows:

- ✓ Protect the confidentiality and integrity of patient information.



- ✓ Make sure that patients obtain quality treatment.
- ✓ Provide definite and exact billing for patients and providers.

Obeying the above regulations, it has never been as laborious as it is positive till date<sup>2</sup>. But news is that artificial intelligence can be soon in hospitals and other health care companies to assure compliance.

#### ❖ Promotes improved decision making

Artificial intelligence (AI) contributes important benefits as it can effortlessly scrutinize huge amount of data and make decisions within a very short period of time. On the other hand, decisions made by humans are usually defective as they are incapable to analyze all the gradation of large data sets and are motivated by stress and emotions<sup>2</sup>. The incorrect decisions which are taken by the doctors and health care staff in health care industry in serious situations are destructive to the health of the patient.

The benefits of health-care industry due to incorporation of artificial intelligence are as follows:

- ✓ There is reduction in the risk of incorrect decision in association with human and artificial intelligence which aids to make authentic decisions based on past information.
- ✓ Depending on the symptoms of the patient, artificial intelligence tools meticulously diagnose specific diseases so that health care professional recommends accurate treatment or correct medicines which is based on certain needs of disease.
- ✓ Hospitals coordinate with artificial intelligence with its records to minimize the risk of prescription errors by doctors<sup>2</sup>.

#### ❖ Forecasting future diseases

From the wealth of available information, it aids in predicting the future diseases. They also forecast the complication of developing a particular disease in advance by depending on the present lifestyle and in advance of the symptoms of the disease starts showing up.

Certain studies have previously anticipated that possibility of the patient who can develop certain cardiovascular disease by monitoring the pulse rate of product. Depending on the current information available, for example, breathing rate and other software companies are establishing artificial intelligence powered applications to see the future health condition of the user.

#### ❖ Understanding the genetic makeup

The mastermind of all our activities which are going in our body are generally our genes. The important concept in compassionating the human genome is enormous complex data which is needed to be analyzed<sup>3</sup>. The pathway of transforming the data is assimilated and analyzed in genetic laboratories.

The advantages of artificial intelligence in genetic laboratories are as follows:

- ✓ Complex genomic data and support in gene sequencing and editing of gene is evaluated by artificial intelligence.
- ✓ Using artificial intelligence, the investigation, evaluation and sequencing of DNA have become efficient and cheaper
- ✓ Researches have been facilitated in maintaining deeper knowledge into the genetic blue print of human population.
- ✓ In genetic laboratories, artificial intelligence tools have the capacity to shield a enormous volume of genetic sample at single time with less amount of supervision.
- ✓ Depending on the genetic makeup of population, researches are capable to warn the patient on certain disease and give the required treatment<sup>3,4</sup>.
- ✓ Precision medicine which is a new field in the domain of medicine has been discovered which is due to artificial intelligence. The objective of precision medicine is to investigate the genetic behaviour of individual and environment to treat according to the instrumental factors.

#### ❖ Prevent fraudulent billing

Frauds in the health care are exhausting financially the entire system which causes immense distress for both companies and patients. Charges for treatment are collected from individual patients and health insurance providers which are never provided or fleece for economical treatments.

By the following ways, artificial intelligence aids to prevent frauds in health care industry:

- ✓ For the identification of irregularities frequently in the payment system artificial intelligence is designed.
- ✓ From enormous amount of accessible records, artificial intelligence can also study the cost of standard treatment of a peculiar condition.

### ARTIFICIAL INTELLIGENCE IN PHARMACY

For the contribution to the overall healthcare industry, pharmacy uses artificial intelligence. Guidance on drug interactions, drug therapy monitoring and drug formulary section is guided by artificial intelligence<sup>3</sup>. It has an impact on pharmacy section in health care system. Through clinical decision support screening, it can diagnose drug related problems. Artificial intelligence influences from dispensing of medications to providing a broader range of patient care services.

Artificial intelligence (AI) has an advantage in aiding the people to get better from medicines and keep them healthier<sup>4</sup>. When pharmacy adopts artificial intelligence it ensures the good workflow efficiency and reduce the



operating costs, instant promoting safety and accuracy. Further, to get employed in enormous volume of patients and also augmenting the outcome of their health is contributed by automated dispensing which has aided pharmacy in playing an important role in patient care. Rather than medication fulfilment, pharmacies can grow into health management centres. Many exemplifying offers are presented by artificial intelligence which includes advice, guidance and expanded suite of services. Health trackers or wearables will provide real time collection of data which enables the pharmacist to investigate into risky conditions of the patients and check the quality of improvement<sup>4</sup>.

The health records of patient are confidential which requires the patients to handover definitive permissions. Pharmacist are still not embodied with health-care professionals (HCP) who have the right to approach them. For the purpose of investigating the information and trying to paste the pieces in well balanced to afford quality patient care is done by health-care data which is distributive among many systems.

Artificial intelligence incorporates overall expansion of computers which results in faster data collection and ore powerful data processing, growth in the availability of health related data from personal and health care related devices and records. Machine learning has several capabilities starting with initial screening of drug compounds to the forecasting of the success rate of drug in the initial stages of drug discovery<sup>5</sup>. Artificial intelligence lays a key role in several aspects like drug target identification and validation, target based, phenotypic and multi-targeted drug discoveries, drug repurposing and biomarker identification.

Application of artificial intelligence for the purpose of drug trails would minimise the time of getting approval of the drug and reaching the market which thereby minimises the overall cost. Multiple tasks such as data entry, laboratory test analysis which clears up time to target on more compound tasks and to collaborate with patients. Data management which includes medical records, evaluation of health care systems for the identification of inefficiencies are delivered by artificial intelligence<sup>5</sup>. Offering in a high rigorous manner to individual patients by special pharmacies is granted by artificial intelligence, which generally focuses on the prevention and conformation which was not yet seen.

Evaluation of enormous amounts of data in fascinating dynamic manner, improvement in the budgeting, minimising operational costs and betterment in organizational efficiency etc., these are all progressed by artificial intelligence (AI). The catalyst i.e., the increment in efficiency attained throughout the organisation facilitates the pharmacists to allot extra time in providing personalized, detailed, high touch care to their patients, establishing approaches to personalized drug consolidations which treats several diseases that enables an improvised and several effective treatment options.

Applications of artificial intelligence (AI) are growing in the health care sector. IBM Watson gathers millions of documents, investigate the test results and implements the recommendations in a period of 30seconds which even co-operates the disconnected physician, which aids from the sharp knowledge in the world. Many areas like cancer, diabetes, heart and chronic diseases etc are targeted by several other companies. Advanced sensor development, training applications for surgery, robotics and bug data etc are been included in the local projects. The massive need for data is the common thread for AI.

#### ❖ AI in Drug Dispensing

Dispensing of drugs is the systematic way of preparation and dispensing medicines to a particular person on the basis of prescription. The patient uses the prescription which comprises the exact explanation of the wishes of the person who has prescribed and the systematic preparation and the labelling.

Regardless, where and when the dispensing is done, any miscalculation in the process of dispensing can certainly affect the patient care. For the betterment of the rationale use, certain programs include concentrating on prescribing habits, overlooking, dispensing and medicines used by the patients.

Most of the world's prescribed medications are been depleted by seniors. As innumerable disease conditions may affect us in subsequent life, therefore there is a compulsion of these medications for controlling and handle the age –related disorders. Due to medication non-adherence there is a hospital re-admission<sup>2</sup>. There is an increase in the number of deaths every year due to the error in the medications. As long as possible, seniors also wanted to be independent in their lives.

In the real time, based on the current data, artificial intelligence (AI) can be used to diagnose the conditions<sup>2,3</sup>. A senior whose requirements vary during the day are well-considered on the best treatments by health care providers who are advised to serious decisions. Based on the current data, artificial intelligence has been shown to anticipate the future data.

Patient data is needed by artificial intelligence (AI) for investigating not only the populations but also particularly the data of an individual for the application of its results for the definitive individual. The patient data is supplied by sensors and IoT appliances.

#### HOW AI CAN BE IN FUTURE?

The AUTOMATED DISPENSING DEVICES(ADD) play a vital role which features the automation in dispensing of a drug according to the prescription which has the involvement of the pharmacist. Few of the automated dispensing devices are:

- Alarm modules
- Speakers



- Keychains
- Automated dispensing cabinet
- Automated pill dispenser
- Other ADD'S

### Alarm Module

This type of automated device notifies with an audible alarm tone and an LED light blinking throughout the alarm process<sup>6,7</sup>. It is designed in a certain manner that, it plays different patterns of audible sounds through speaker till the patient responds and press the button to take the poach of pills. There is also a string of display provided which gives the instruction how to consume? When there are low pills in the storage unit, a second alarm is provided for the care-taker to reload it. This second alarm only gives a warning of blinking rather than audio.

### Speaker

This speaker warns the patient to consume the medicine with a beep sound at the recorded time. In case of refilling of the container, the same speaker call the name of the patient and notifies him. This type of facility may help the blind.

### Keychains

This automated device has a control access and can only be retrieved by the person who consumes as the medicines harm the children who opens it. This type notifies the patient with a buzzer that the pill is to be taken<sup>6</sup>. Mostly, every individual carries a keychain which initiate the pill dispensing for the patient.

### Automated Dispensing Cabinet

It is computerized drug storage device which is used in hospitals and by many health care sectors. This grants the storage of medication and dispense the medications. The key goal of this to ensure the safety of the patient from consuming a false drug which is most common drawback in the health-care sectors.

### Automated Pill Dispensers

This type of pill dispensers combines with high advancements in technology which is effortless to use a dispenser. This works on the fact that the medications which are to be taken are loaded into the dispenser and individual dose that should be taken by the patient is a preset in the schedule. There will be an audio which reminds the patient that it is the time for consuming the

pills. This helps the patients to take the prescribed medicines at regular intervals and avoid the false dosages.

### Others ADD'S

With the help of audible and visual cues also, the patient is notified when the dose is ready for consumption. The medications are received, opened and ready for consumption when the patient validates by voice, pin or password. There is a presentation of instructions where by the patient confirms that medications were consumed.

### CONCLUSION

The artificial intelligence is very helpful and is made ease. In future, there will be advancement in drug dispensing through AI by means of several devices like sensors, speakers, automated dispensing cabinet, key chains, alarm modules etc which help the patients to take their medication on time especially for the gaeriatric patients through buzzers/alarms/LED light at certain time. In case if the patient doesn't take the medicine after the alarm, message is sent by the ADD'S to the particular number that is fed in the system memory. Through artificial intelligence we can predict the fore coming diseases and diagnose them before their occurrence. Artificial intelligence helps pharmacists in minimising their efforts in dispensing the medicines and focus on the health of patient which is the key concept of AI.

### REFERENCES

1. Van Eijken M, Tsang S, Wensing M, et al. "Interventions to improve medication compliance in older patients living in the community: a systematic review of the literature. *Drugs Aging*", 20, 2003, 229-240.
2. Medication reconciliation National Patient Safety Goal, National Patient Safety Goals, Joint Commission on Accreditation Program, March,2009.
3. Tsai, P. H., C. S. Shih, and J. W. S. Liu, "Algorithms for scheduling multiple interacting medications," Institute of Information Science, Academia Sinica, Taiwan, Technical Report TR-IIS- 08-001, April 2008 Pei Hseun Tseui, "Smart Medication Dispenser: "Design, Architecture and implementation", IEEE journal, Vol-5, March-2011.
4. Shapiro SC. Artificial intelligence. *Encyclopedia of Artificial intelligence*, Vol. 1, 2<sup>nd</sup> edn. New York; Wiley 1992.
5. Dasta JF. Application of artificial intelligence to pharmacy and medicine. *Hosp Pharm*, 27, 1992, 312-5:319-22.
6. Turing AM. Computing machinery and intelligence. *Mind*, 59, 1950, 433–60.
7. Keshavan M. Berg: Using Artificial Intelligence for Drug Discovery.

Source of Support: Nil, Conflict of Interest: None.

