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AI IN HEALTHCARE SYSTEM (HOSPITAL PHARMACY)

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ABSTRACT
The use of AI in the healthcare system is very important as it helps to ease work and promote more accuracy and efficiency of service. They help to regulate the sale and dispensing of certain drugs like High Risk Drugs, Narcotic and Psychotropic substance, reduce medication error, accurate dispensing of SALA drugs, monitoring adverse drug reaction, dug-drug interaction, drug-food interaction, Hospital Pharmacy is defined as the practice of pharmacy in the hospital under the guide of a registered pharmacist. In hospital pharmacy, the use of AI helps to Analyse structure of a target protein in drug discovery and compounding of drugs. Hospital pharmacist helps in dispensing of medication, patient counselling, helps guide patients for medication Adherence purposes, medication history interview, medication chart review, clinical review, ward-round visit, budge preparation and implementation of budget, purchase and inventory control, analysis of drug expenditure (ABC analysis, VED analysis, EOQ, Lead time, Buffer stock), control and reporting of use of investigational drugs. Counsel patients on the use of OTC drugs, medication history of patients, pharmaceutical care, dosing pattern of patients and drug therapy based on pharmacokinetic and disease pattern, dose adjustment for patients. Certain challenges faced in the hospital pharmacy include medication error, SALA drugs dispensing error, Medication Dispensing error and Pharmacist Burnout, Medication Non-Adherence, Warehouse Labour cost, Drug Compounding and Discovery, Drug-drug interaction, Drug food interaction. With the help of AI, it can help reduce or put to an end in medication error, error in dispensing of medicationand pharmacist burnout, accurate arrangement and dispensing of SALA drugs, help patients in medication adherence and also help in drug discovery and drug compounding in the hospital.

KEYWORD: Pharmacy, Hospital, AI, Drug interaction, microchips.

1.0 INTRODUCTION

Over a long per almost all industries have innovated and came up with various ideas that could make their work easier. Some companies have incorporated AI in their work place, meanwhile hospital pharmacy has no much innovations especially when it comes to the use of AIs. We still find out most of the works are manually done which is prone to lots human errors which can lead to harmful effects and burn-out of workers.

When it comes to dispensing in hospital pharmacy[1], having the pharmacist only dispense medication to the patients all alone without the help of the AI (especially when there is large inflow of patients), pharmacist could get tired or face burnout and stressed (especially if there are few pharmacist working in the pharmacy). Due to stress, pharmacist could choose to quit job because of huge workload or give various excused that could keep them away from work in order to get some rest. This could be damaging the pharmaceutical care.

This article will explain various ways and places we can apply AI Hospital Pharmacy to ensure good and accurate pharmaceutic care.

2.0. Hospital pharmacists

They assist doctors in making important drug decisions for patients' use and benefits. They help patients to understand how to use their medication.[2]

2.1. Challenges of Hospital Pharmacy

Certain challenges are being faced in hospital pharmacy in which AI can be of great help.

They include.

- Medication error.
- SALA Drugs.
- Medication Dispensing and Pharmacist Burnout.
- Medication Non-Adherence.
- Warehouse Labour cost.
- Drug Compounding and Discovery.
- Drug drug interaction.
- Drug food interaction.

2.1.1 Medication Error

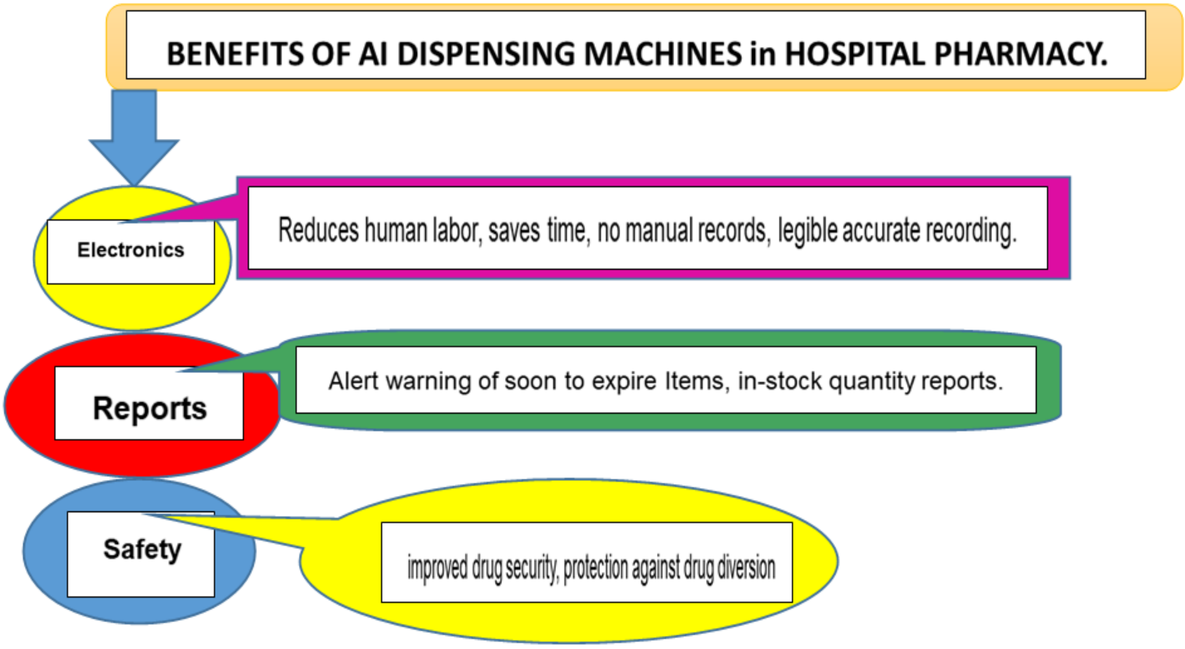
This can be as a result of not following the 5Rights of Medication Administration and Prescription (Right patients, Right Time, Right route, Right dose, Right drug).[3]

AI can help to reduce dispensing errors, transcription errors, and prescription error by creating of robots to collect and fill prescriptions.

2.1.2. Medication Dispensing and Pharmacist Burnout

As humans are forgetful and get tired or suffer memory loss when they burnout from heavy workload, it could lead to dispensing error; further more cause anxiety issues in workers.[4]

AI can help in dispensing of drugs with guided dosing, and this helps to save pharmacists time, stress & and burnout, by invention of automatic dispensing machines, and robotics which can read the doctor's prescription. Studies has shown that with the help of Artificial Neural Network, robots can read the doctors hand writing and detect the drugs prescribed.



2.1.3. SALA Drugs

this stands for "**Sound-Alike-and-Look-Alike drugs".** Humans make lots of mistakes when it comes to SALA drugs, and this has caused several dispensing and transcription errors, hence causing harm to patients, sometimes Death cases.[5]

With the help of AI, SALA would be dispensed more accurately without human error. 24/7 accurate dispensing with no restriction and no error, and with proper monitoring of dugs.

2.1.4. Drug-drug interaction[6,7,8]

Tab 1.

Negative Drug-drug interaction	
1. Asprin	Salbutamol
2. Levothyroxine	Omeprazole

Sometimes the pharmacist during dispensing might not look into the drug interactions before dispensing the drugs, the physician or nurses by mistake might not also have checked the drug-drug interactions of the medicine being prescribed; this can pose danger to the patient's health.

With the help of AI and Robotics, prescription can be filled more accurately and the AI can help detect that a certain type of drug combination is not proper and refuse to dispense it, until the pharmacist or physician looks into it.

For example; the above table, it shows Asprin and salbutamole are chemically incompatible as there is high risk of patient developing hypertension when these both drugs are combined.[9,10,11]

Secondly, looking into the above table (tab.1), Levothyroxine (thyroid drug) and Omeprazole (proton pump Inhibitor) are antagonist of each other, these two drugs cannot be administered together because the gastric PH interferes in the Levothyroxine absorption.[12,13,14]

2.1.5. Drug-Food interaction

Tab. 2.

Negative Food-Drug Interaction	
FOOD	**DRUGS**
1. Grape fruit	■ High blood pressure drugs ■ High cholesterol drugs ■ Thyroid drugs ■ Cough drugs ■ Heartburn drugs
2. Alcohols	■ Sedatives ■ Morphine ■ Anti-histamine drugs
3. Dairy food and food product	■ Antibiotics – eg; (Ampicillin)

Grape fruits/juices and citrus fruits (like oranges, lemons, tangerines, limes) are good foods which can make Heart-burn or GERD symptoms (Gastro-Esophageal Reflux Disease) worse as citric acid content settle in the oesophagus sphincter and trigger acid reflux symptoms and worsen the symptom.[15-18]

3.0 Methodology[19-25]

Tab 3.

Problems	Examples	AI Effect
SALA Drugs	❑ **Lantus (glargine) vs Lante (insulin zinc suspension)** ❑ **Humulin (human insulin) vs Humalog (insulin lispro).** ❑ **Novolin vs Novolog** ❑ **Amgit (metronidazole) vs Anxit (Alprazolam)[26]** ❑ **Vinblastine vs. vincristine**	❑ **Will help to dispense the accurate and right medicine with a guided dosing to the right patient** ❑ **24/7 dispensing service without burnout, unlike humans.** ❑ **Automated computer Algorithm to eliminate error & confusion**
High Risk Drugs	❑ **Diazepam-10mg** ❑ **Heparin 25000** ❑ **Labetalol hydrochloride-5mg** ❑ **Lidocaine-10mg/dose**	❑ **Prevent Toxicity** ❑ **Limited Access** ❑ **Pharmacokinetic guided-dosing[27,28,29]**
Warehouse Labour cost.[30]	❑ **Drug store & Re-stocking**	❑ **Inventory management** ❑ **Faster product delivery** ❑ **Personalised software for delivery & restocking of drugs**
Medication Non-Adherence	❑ **Not taking medications at the required timing.[31,32]** ❑ **Forgetfulness**	❑ **Auto-Robot Text Message.** ❑ **Remind the Patient of the supposed time to take his medication, the drug name, shape and colour (for incase of uneducated patients)**
Drug Compounding and Discovery	❑ **Predicts the efficacy and toxicity of drug compound**	❑ **Accelerates drug discovery and reduce cost** ❑ **Predicts bacteria mutagenicity** ❑ **Optimize chemical structureto improve bioactivity (structure baseddrug design).** ❑ **Analyse the structure of a target protein and then use the information to design compounds for binding to the protein.**

4.0. INVENTION OF "MICROCHIPS" FOR ADVERSE DRUG MONITORING

AI plays a huge role in "**monitoring Adverse drug Reactions(ADR)"** in concerned patients and helps in identifying "**drug-drug interactions** and "**drug-food interactions"**. Microchips have tons of memories and can easily detect Adverse Drug Reactions and drug interactions more than humans (physicians, pharmacists and nurses) and save time, by.

- "Detecting the drugs causing the ADR.[33]
- "Negative or inverse interaction of drugs and
- "The possible immediate Remedy for patient safety".

In cases where patients are unable to say which food or drugs they have consumed leading to the adverse reaction they are getting; from the drug and food information stored in the microchips they can easily tell exactly what the patients have consumed, by taking a fluid sample from the patient (blood sample, urine sample, etc), the information can be displayed by using Microchip scanner. The microchips have a unique identifier to identify the contents of things based on the information being stored in them. These microchips will display information just like a mobile phone displays information based on the contents stored in the microchips and their integrated circuit.

It will display the following information.

- Drugs causing the side effect or ADR or the negative drug-drug interaction.
- Food particles present in the body causing the ADR or food-drug interactions, examples are found in cases where patients might have consumed Alcohol
- Possible remedy in case of emergency or death cases.[34]

Information gathered from the cause of the ADRs in patients is then reported using an "Adverse Drug Reaction Reporting Form (fig. 4)".

The information/ health links stored in the microchips cannot be lost, misplaced, stolen or counterfeited. It is very safe, and secure, and reversible; and always with you.

4.1. IMPORTANCE / USES OF THESE MICROCHIPS

- To provide memory for storing information about drugs
- Storage for drug information.
- To process drug information and details
- Control drug information data.
- To help in the identification of the cause of an Adverse drug reaction.[35]

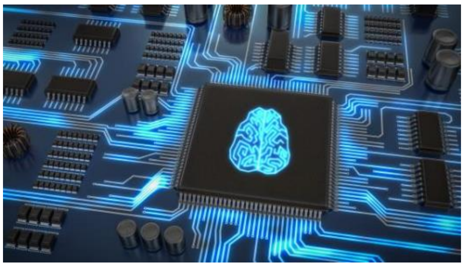


Fig. 1.

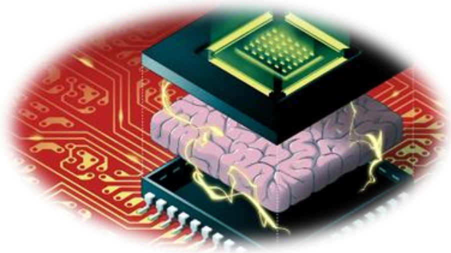


Fig 2.

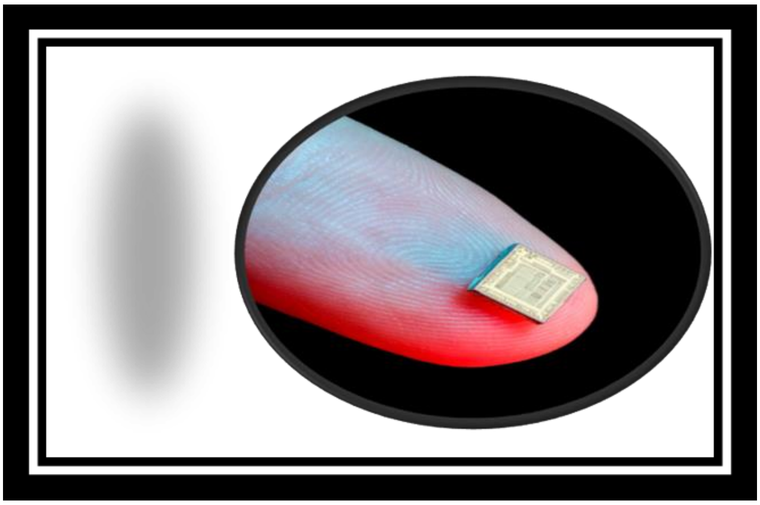
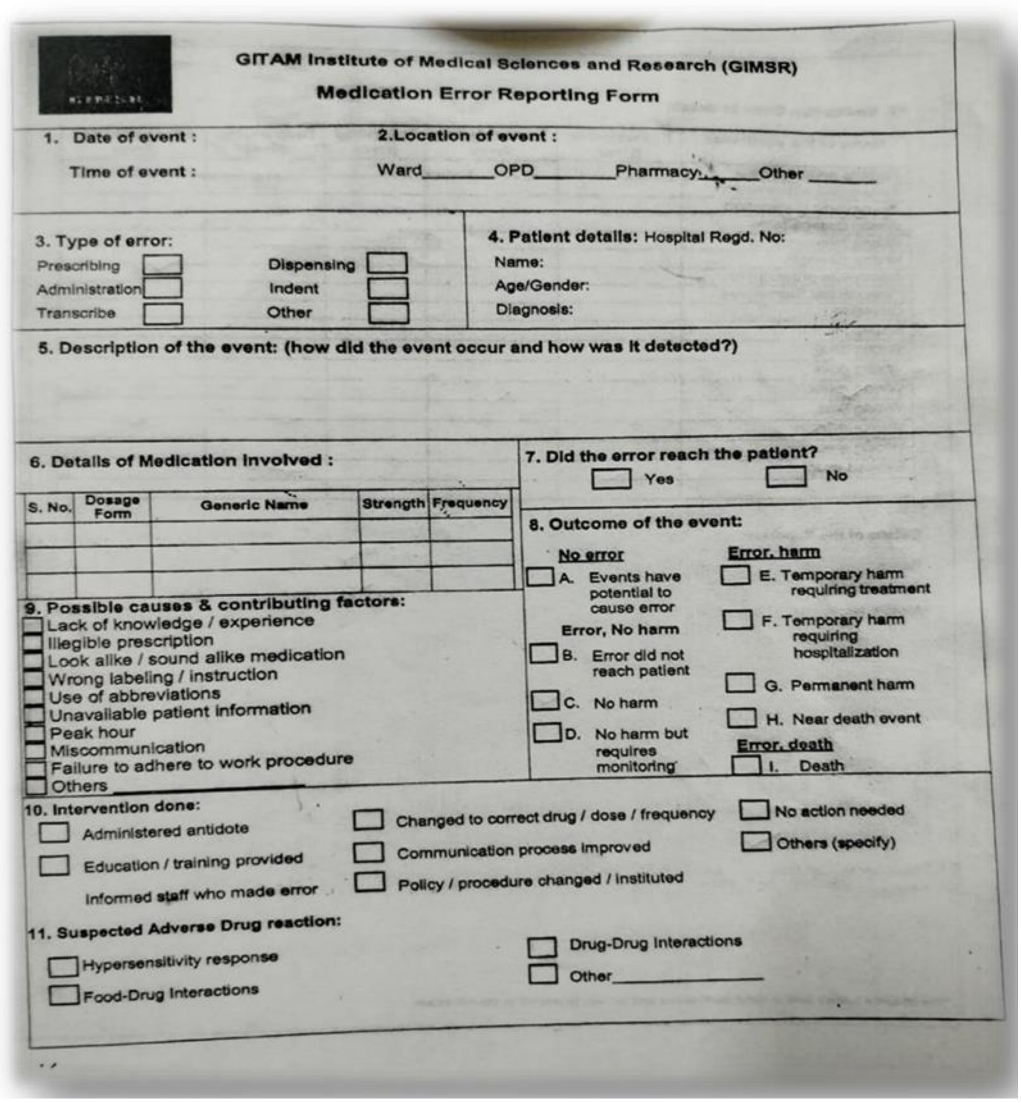


Fig 3: A Pictorial Representation of The Microchip.



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Medication Error Reporting Form

1. Date of event : 2.Location of event :

Time of event : Ward______OPD______Pharmacy______Other ______

3. Type of error:
Prescribing ☐ Dispensing ☐
Administration ☐ Indent ☐
Transcribe ☐ Other ☐

4. Patient details: Hospital Regd. No:
Name:
Age/Gender:
Diagnosis:

5. Description of the event: (how did the event occur and how was it detected?)

6. Details of Medication Involved :

S. No.	Dosage Form	Generic Name	Strength	Frequency

7. Did the error reach the patient? ☐ Yes ☐ No

8. Outcome of the event:
No error
☐ A. Events have potential to cause error
Error, No harm
☐ B. Error did not reach patient
☐ C. No harm
☐ D. No harm but requires monitoring
Error, harm
☐ E. Temporary harm requiring treatment
☐ F. Temporary harm requiring hospitalization
☐ G. Permanent harm
☐ H. Near death event
Error, death
☐ I. Death

9. Possible causes & contributing factors:
☐ Lack of knowledge / experience
☐ Illegible prescription
☐ Look alike / sound alike medication
☐ Wrong labeling / instruction
☐ Use of abbreviations
☐ Unavailable patient information
☐ Peak hour
☐ Miscommunication
☐ Failure to adhere to work procedure
☐ Others

10. Intervention done:
☐ Administered antidote
☐ Education / training provided
Informed staff who made error
☐ Changed to correct drug / dose / frequency
☐ Communication process improved
☐ Policy / procedure changed / instituted
☐ No action needed
☐ Others (specify)

11. Suspected Adverse Drug reaction:
☐ Hypersensitivity response
☐ Food-Drug Interactions
☐ Drug-Drug Interactions
☐ Other______

Fig 4: ADR Reporting Form.

5.0. CONCLUSION

with the above few points we have been able to see that AI plays a hugely important role in hospital pharmacy and helps to ease the workload on the Pharmacists, Nurses, and Doctors.

6.0. Future scope

Based on the feedback we get from the activities of the Microchips; it can be modified for more efficient services.

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