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Acquisition, management, and delivery of drugs

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ABSTRACT

The need for drug delivery is very critical especially in populous countries like India. Medication management plays an important part in ascertaining if the people in a country have access to the basics needs of healthcare. The system proposed in this paper would provide for medication management which includes acquirement of medications, management, and delivery of the drugs to the patients. This system would remove the need for going to the medical stores and reduces the unavailability of drugs for use. A composition of various technologies such as Big Data, Business Intelligence and Networking help in providing a solution to this problem. The proposed system in this paper addresses this need for medication management. The proposed system is expected to reduce the stress on traffic snarls as well in the cities in which it is implemented.

Keywords: Medication management, Drones, Warehousing, Drug acquirement, Drug management, Drug delivery, Big data.

1. INTRODUCTION

The first thing that comes to mind when medicines are prescribed by the doctor is the availability of the drug in the pharmacy near you. The availability of the drug and also the timely delivery of these drugs to the patients is very critical as they can save lives and also help patients fight various diseases. The various drugs having the same combinations with various prices is another concern when drugs are bought. The need for medication management is hence rising with every passing day. In a world where medication plays an important part in curing and preventing most diseases, the timeliness and the accuracy of medication acquirement plays an important part. The proposed ecosystem here will completely automate and make error-free the system of medication management. There are three basic stages identified in this process and they are:

- Drug Acquirement
- Drug Management
- Drug Delivery

These three stages identified collectively act as a medium for medication management right after its manufacturing and till it is delivered to the patients in time. Figure 1 shows these three different stages of medication management. Medication management has these three stages and all the stages have to be completed accurately and on time for timely delivery of medication to the patients.

1) Drug Acquirement: The first stage of the ecosystem is the acquiring of medicines based on their composition, brand name and also preference of the doctors. There are certain medications that have the same compositions but are manufactured under a different brand altogether. These factors need to be considered as they play an important role in providing a cost-effective and accurate solution to medication management.

2) Drug Management: The second stage of the ecosystem is managing the drugs that have been acquired and also checking for various quality standards such as expiry date, composition etc. The management of these drugs is not easy as there are many drugs available in the market for various diseases and hence the management of the drugs at the warehouses is also critical.

3) Drug Delivery: The last stage is the delivery of medicines that are in need for the patients. The medicines must be checked for expiry and cost and hence should be delivered accurately to the patients through various means. The mode of delivery of these medications or drugs is very critical for timely delivery of medicines.

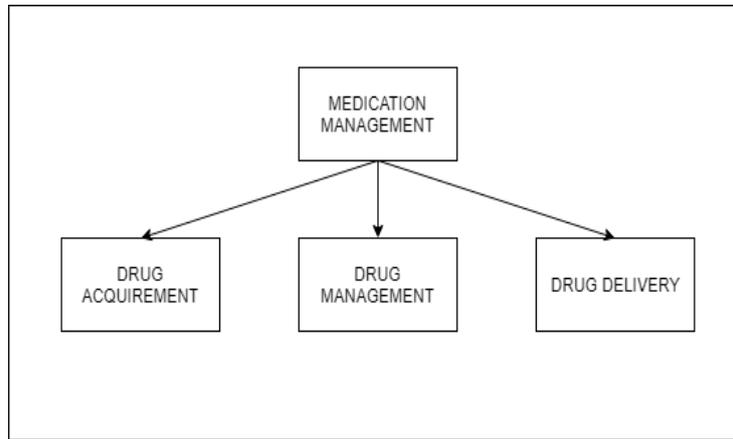


Fig. 1 Stages of medication management

The composition of various technologies and tools such as Big Data, Cloud Computing, Supply Chain Management and so can without a doubt create an ecosystem where the devices are smart enough to communicate with each other and automate most tasks which are currently handled by humans leading to various delays and errors. Eliminating these errors in the field of healthcare is a major concern and hence Figure 1 helps us understand how various technologies can help in the field of medication management.

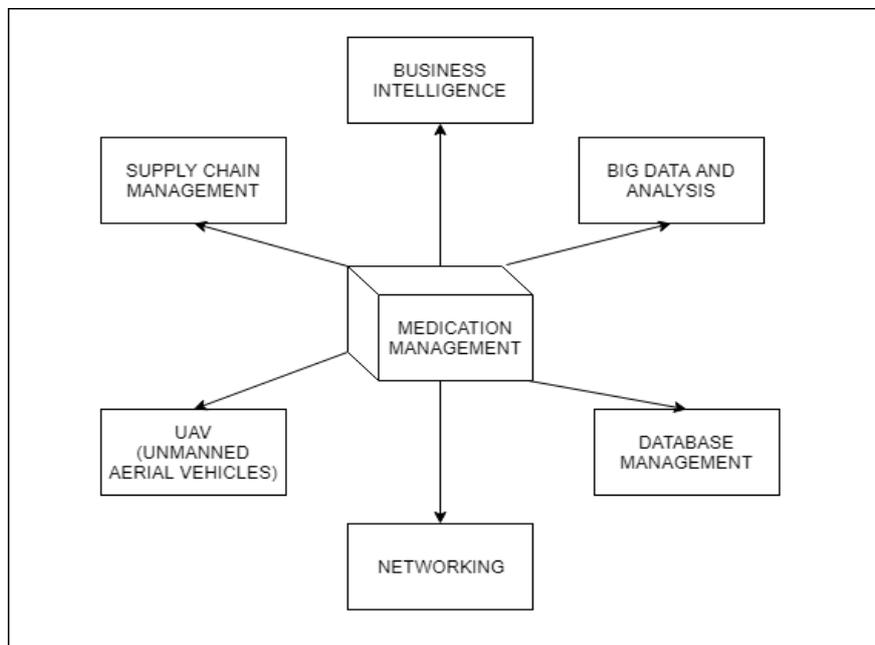


Fig. 2 Technologies and tools used for medication management

The use of the technologies and tools mentioned in Figure 2 are elaborated in the following section. They are:

1) Supply Chain Management: Supply Chain Management (SCM) is a range of activities that describe a process of a product's lifecycle right from acquiring the raw materials to the final distribution of the products to the customers. The acquiring of medication and the management and delivery of medications are processes elicited under SCM.

2) Business Intelligence: Business Intelligence (BI) is the process of analysing data and providing insights to the business users to help in decision making. In this case, the usage of certain drugs can be analysed and the decision to store more or less of the drug in line with demand can be taken and accordingly the delivery would become faster.

3) Big Data and Analysis: Big Data refers to capturing, transforming and visualising large amounts of data and hence help in descriptive and predictive analytics. The data here would be the medicine data and its compositions along with the demand for it. The visualisations of these will help medicine manufacturers in reducing or increasing the production based on the data and predictions.

4) Database Management: The database management is a process of storing information in an orderly manner and make it easier of analysis. The database would store the data about the medicines such as expiry date, cost per unit and composition stored at various warehouses.

5) Networking: Networking is a process that fosters the exchange of information and ideas among individuals or groups that share a common interest. It may be for social or business purposes. The network among the warehouses and the drones is critical as the availability of the drug has to be maintained. For instance, if a warehouse is out of a drug that needs to be delivered it has to communicate to the other warehouses or the supplier for acquiring a drug.

6) Unmanned Aerial Vehicles: An unmanned aerial vehicle (UAV), commonly known as a drone, is an aircraft without a human pilot aboard. UAV's are the heart of this ecosystem as they are responsible for acquiring the drug from the manufacturers and also deliver the same from the warehouses to the patients.

These technologies and tools work together to create an ecosystem for drug acquisition, management and delivery collectively medication management.

2. EXISTING SYSTEMS

2.1 Uber for Medicine Delivery

“It's an uber model for medicine delivery. Applicable for over the counter medicines only. Once you order medicine your nearest pharmacies get a notification. Once they confirm that they have got the medicines our delivery man takes the medicine from the pharmacy and deliver it to the customers. Delivery charges are applicable” says the start-up idea.

This is a start-up idea for delivering only over the counter medication through people who collect the medicines and deliver it to the needy. This system is only for delivery of these medications that are already available in the pharmacy and not any other medication and doesn't have any scope for acquiring and storing any medications.



Fig. 3 Uber for medicine delivery

This system concentrates on the delivery of medications through a cab-aggregator such as Uber, and this may not reach the patients on time because of the traffic snarls in most busy cities across the world and especially in countries such as India. The other prerequisite for this system is that medicines have to be available at the counters and then only can be delivered to the patients, failing which, the medicines may not be available for delivery.

2.2 Medicine Delivery through Drones in Rwanda

This is another system where the people of Rwanda and Tanzania are expected to get their delivery of medication through drones at different locations through the country. These drones again just concentrate on only delivery of medication which is just one phase of the medication management.

In Rwanda, an early commercial test of unmanned aerial vehicles cuts a medical facility's time to procure blood from four hours to 15 minutes. You can hear the drone before it's visible, whining like a mosquito above the hillside grounds of Rwanda's Kabgayi District Hospital. The plastic sachets of blood are among the first commercial products ever delivered by drone, part of a partnership between the Rwandan government and the Silicon Valley-based robotics firm Zipline, which began introducing the blood drops at Kabgayi in late 2016. In a similar instance, Another U.S. firm, Matternet, has conducted test flights in collaboration with UNICEF to deliver infant HIV test kits in Malawi.



Fig. 4 Medicine delivery through drones in Rwanda

These systems are concerned only about the delivery of available drugs rather than acquiring and storing no-available drugs. The availability of medicines is a pre-requisite in such systems and non-availability of medicines will lead to failure of such systems.

3. LIMITATIONS OF EXISTING SYSTEMS

When various papers were referred, and various systems studied, there were certain limitations that were common in most system. The following put these limitations in a precise manner:

- These existing systems are poised at only delivery of medicines and not at acquirement and storage of medicines. These systems do not worry about acquisition and storage and management of medicines. The availability of medications is a pre-requisite and the delivery of the medications depends on that completely. For instance, if the system wants to deliver a medication but it is not available in the counter of a pharmacy, the medication or drug is not derived to the patient and thereby resulting in a delay of the treatment.
- These systems propose delivery of medication through traditional means such as person delivering it personally, or a taxi-aggregator delivering it from the stores to the needy person. The drawback of this method drug-delivery is the stress on traffic it adds and also the delay due to traffic snarls in big cities in countries such as India. These may lead to unwanted delays in delivery of the medication to the patients.
- These systems require a huge role of people which can be error-prone and not on time. The various errors include delivering expired drugs to patients, delivering wrong medicine to the patients. These errors can cause various side-effects and hence can lead to severe implications as well for the patients.

4. PROPOSED SYSTEM

The proposed system is an ecosystem of various subsystems that work and communicate together to perform the three stages of medication management such as drug acquisition, drug storage, and drug delivery. These sub-systems would work together automatically to provide the whole of medication management.

The major people involved would be the patients and the doctors and the medicine suppliers. The doctors would diagnose a particular disease or abnormality in the body of the patient and prescribe a drug for it. This medicine or drug is entered by the doctor onto an application. This application would send a link to the patient for confirmation and also payment of the medicines. This medicines than would be delivered to the patients through UAV's or drones to predefined locations close to the location of the patient. These medicines can also be routine medicines that the patient would need, the system would calculate the medication required and deliver the same periodically to the patients. This is the whole overview with respect to people.

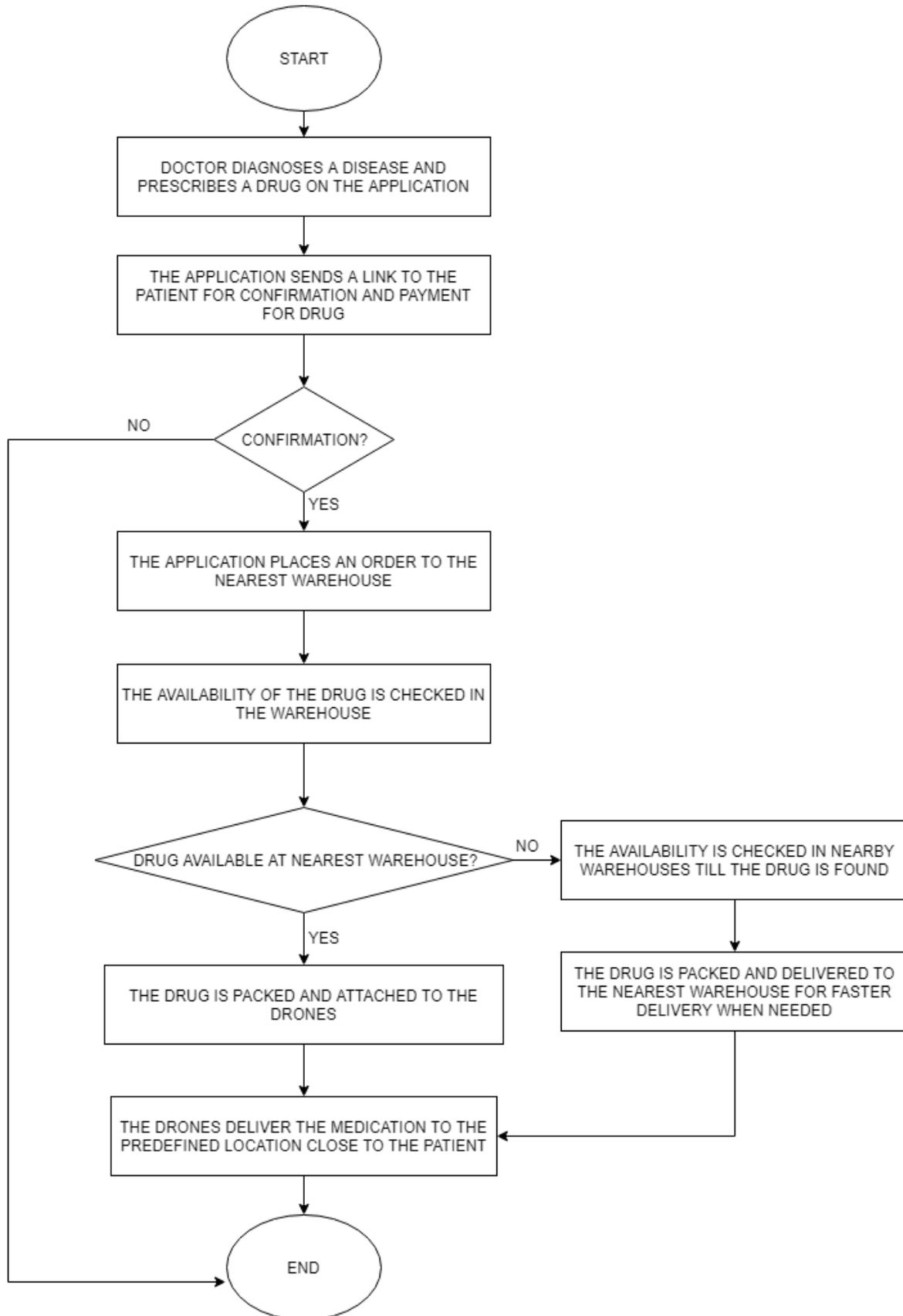


Fig. 5 Flow chart of the proposed system

The overview of the system is roughly portrayed in Figure 5 and shows how the system would work when in ideal conditions. The other side of the proposed system is drug acquisition from the suppliers and to various warehouses where the medications would be stored for future delivery periodically or once depending on the needs. This system would communicate with various drug making companies and automatically deliver it to the patients.

To understand the proposed ecosystem better Figure 6 shows the schematic diagram of how the proposed system would work. The major actors in this system would be the doctors and the patients. The system would not only deliver medicines but also acquire and manage it. The warehouses act as places where the drugs are stored and managed. The drugs are directly acquired from the manufacturers depending on the need into the warehouses.

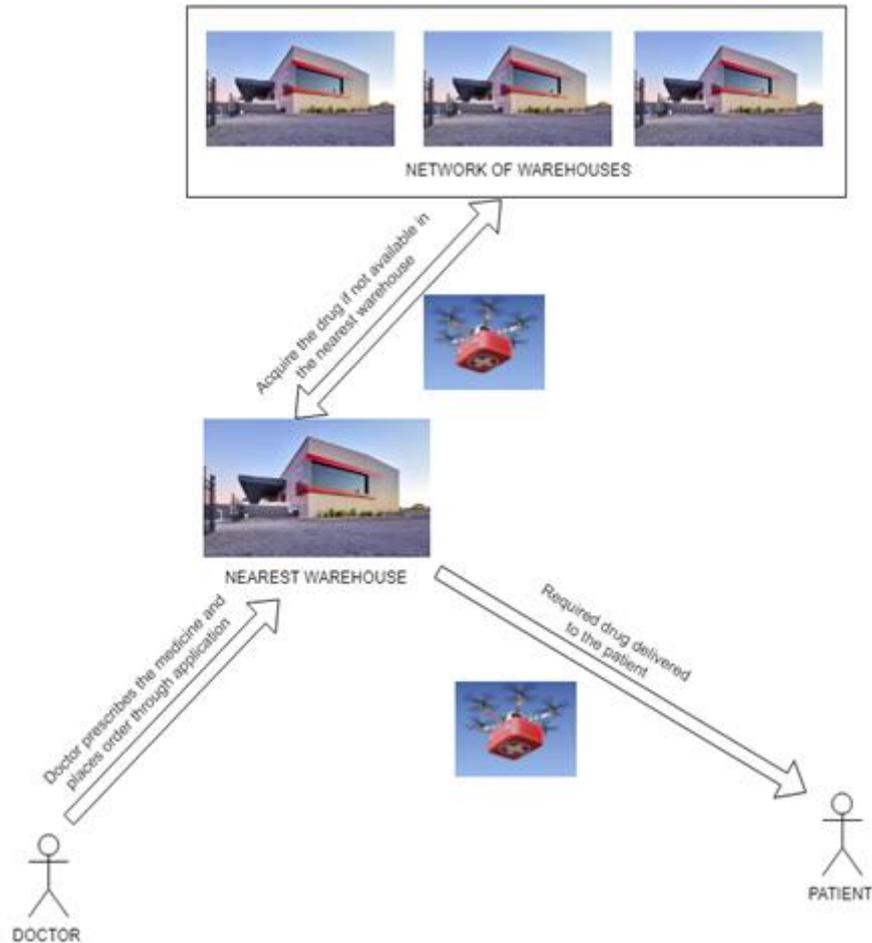


Fig. 6 Schematic diagram of the proposed system

In the proposed system, the doctor prescribes medications through an application and the order is placed in the warehouse near the location of the patient. The patient receives a link through which he or she can confirm the order and pay for the medications. After the payment, the nearest warehouse is checked for the availability of the drug. If the drug is available, then the drug is delivered to the patient directly to the predefined location. If the drug is not available at the nearest warehouse, the nearest warehouse contacts the network of warehouses and procures the drugs. These drugs are then delivered to the nearest warehouse and packed and sent to the predefined locations all through the drones

The location of the patients is traced through GPS and the nearest drop-off point is identified to which the drones would deliver the medicines to. This location is tracked through the GPS module in the patient's mobile phone.

There are various advantages of this proposed system. The most important ones include:

- 1) Reduce traffic congestion: In this ecosystem, the delivery is done by drones and hence there is no addition to the already congested roads in metropolitan cities especially in countries like India.
- 2) Greater Availability of medicines: The acquisition on medications is done dynamically and whenever needed, thus increasing the availability of medications in the warehouses thus preventing the delay in getting the medications.
- 3) Timeliness of the delivery of medicines: The timelines of delivery of medicines are maintained and the hence the treatment is done on time thus helping in the curing of the diseases.

Other than those mentioned above, the proposed system is completely automated with respect to the management of the medications and also it is a simple interface that allows for ease of use for doctors as well as patients. The proposed system has various challenges as well along with the advantages. The weather conditions play an important role in the operation of the drones, where inclement weather can lead to the failure to deliver the medications on time. Also, the storage of medications at the drop-off points is another challenge, where the medicines will be delivered and the customer (patient) is not present at the points to collect the medicines.

4. CONCLUSION

The acquisition, management, and delivery of medicines play a very important role in providing the society a holistic and complete healthcare. These medicines when delivered in a timely and accurate manner can help in curing many diseases when these medications are administered to the patients on time. The greatest challenges of this system is that of security and also prevention of abuse of drugs. This system will help in providing a solution to the mentioned problem and does the same by not adding any more pressure on the traffic snarls in the metropolitan cities.

The proposed system can be used by both the doctors and the patients to make sure that they do not have to wait for medications and can get the medications when needed and also make sure that the treatment happens in a very timely manner. However, the delivery and location of the patient is a vital constraint. Therefore, this system will surely provide the healthcare domain with a solution to the challenges of medication management.

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