MEDITIMER: YOUR PERSONAL MEDICAL TIMER

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Abstract

Drug therapy is the primary intervention for most illnesses and a staple to mainstream medication. Proper intake of medication has proved to inhibit disease progression, effectively managing the disease, and overall improving patient outcomes with minimal errors. However, the reliance on drug medication has caused potential for both beneficial and detrimental effects on patients. Evidence has shown that these potential harms are consequences caused by errors, such as wrong time, wrong dose, or even the abuse of these drugs. There are various causes for these errors, patient related ones mainly surround the lack of understanding and initiative to ask, the complexity of the medication itself, the age of the patient, and others. This becomes an issue especially for complex and progressive medication where consistency is required, such as in the highly prevalent tuberculosis disease where failure to administer medication is highly likely and is subject to severe consequences. As an effort to reduce medication errors, the Java based MediTimer software is developed to ensure patients administer the correct medication at the right time and right dose. This software powers a device that reminds, limits and ensures correct drug administration from the hospital to the patient. Serving as a solution to the highly avoidable error and abuse of drug medication.

***Keywords**: Medication error, drug reminder, Java, mobile application, innovation*

Abstrak

Terapi obat adalah intervensi utama untuk sebagian besar penyakit dan instrument pokok untuk penyembuhan. Asupan obat yang tepat telah terbukti menghambat perkembangan penyakit, mengelola penyakit secara efektif, dan secara keseluruhan meningkatkan hasil pasien dengan kesalahan minimal. Namun, ketergantungan pada obat-obatan telah menyebabkan potensi efek menguntungkan dan merugikan pada pasien. Bukti telah menunjukkan bahwa potensi bahaya ini adalah konsekuensi yang disebabkan oleh kesalahan, seperti waktu yang salah, dosis yang salah, atau bahkan penyalahgunaan obat-obatan ini. Ada berbagai penyebab kesalahan ini, yang terkait pasien terutama seputar kurangnya pemahaman dan inisiatif untuk bertanya, kompleksitas pengobatan itu sendiri, usia pasien, dan lain-lain. Ini menjadi masalah terutama untuk pengobatan yang kompleks dan progresif di mana konsistensi diperlukan, seperti pada penyakit tuberkulosis yang sangat umum di mana kegagalan untuk memberikan pengobatan sangat mungkin terjadi dan memiliki konsekuensi yang parah. Sebagai upaya untuk mengurangi kesalahan pengobatan, perangkat lunak MediTimer berbasis Java dikembangkan untuk memastikan pasien memberikan obat yang benar pada waktu yang tepat dan dosis yang tepat. Perangkat lunak ini menggerakkan perangkat yang mengingatkan, membatasi, dan memastikan pemberian obat yang benar dari rumah sakit ke pasien. Melayani sebagai solusi untuk kesalahan yang sangat dihindari dan penyalahgunaan obat.

Kata Kunci: Penyalahangunaan obat, pengingat obat, Java, Aplikasi mobile, Inovasi

INTRODUCTION

In the new dawn of medicine, drug therapy has become the primary means of disease intervention. In this regard, the World Health Organization (WHO) always emphasizes the need for rational use of medicine in accordance to the clinical guideline (WHO, 2020). According to a Slone Epidemiology Center

survey in 2006, on average 56% of children below the age of 18 are taking one medication with 27% taking two or more drugs and 21% taking prescribed drugs (Slone Epidemiology Center, 2006). Meanwhile in the adult population, 82% are taking at least one drug and 29% are taking five or more drugs. Whereas 17-19% of people aged 65 and above are taking at least 10 drugs in a day. Its usage has proven both beneficial and detrimental to some. Potential detrimental effects derive from the harms of medication errors. These errors include consuming an appointed drug at the wrong time and/or dose, as well as the abuse of these drugs. WHO also deemed medication errors as global health issue as well (WHO, 2016).

Medical errors are a significant global concern that can cause some serious medical consequences for the patients (Sabzi, Mohammadi, Talebi, & Roshandel, 2019). Medicine can cure diseases, prevent any serious problem from chronic diseases, and ease pain. However, if the medicine is to be misused or prescribed in the wrong way, then it can also cause harmful reactions to the patients. Medication errors are the most common medical errors that may occur because of the inappropriate use of the medicine, in each one of the medicine prescription stages for the patients (Wigiyantoro & Surya Darmawan, 2018).

When caring for patients, there are many steps where medication errors can occur, from ordering the medication, and to the time when the patient is administered the drug. Thus, the errors are commonly found during the ordering or prescribing stage (US Food and Drug Administration, 2019).

There are many causes of medication errors, such as the incorrect duration of the medicine intake, in which it occurs when the patients received their medication for a longer or a shorter period of time than the prescribed duration (Gorgich, Barfroshan, Ghoreishi, & Yaghoobi, 2015). Incorrect timing for medication is also one of the causes of medication errors, because it is challenging to be able to accurately administer the medication according to the scheduled dose. There's some concern regarding this, since there are some medications that their medications absorptions are greatly altered if taken before or after eating food. Incorrect dose, which include overdose, underdose, and extra dose contributed to the cause of medication errors(Al-Ramahi et al., 2017). Incorrect dose occurs because an inappropriate or different medication dose was given rather than the ordered one, and omission errors when a scheduled medication dose were not given (Tariq, Vashisht, Sinha, & Scherbak, 2020).

The objective of this research is to design an application that catered the reminder annotation of the exact dose and timing for the drug intake of the patient.

METHODOLOGY

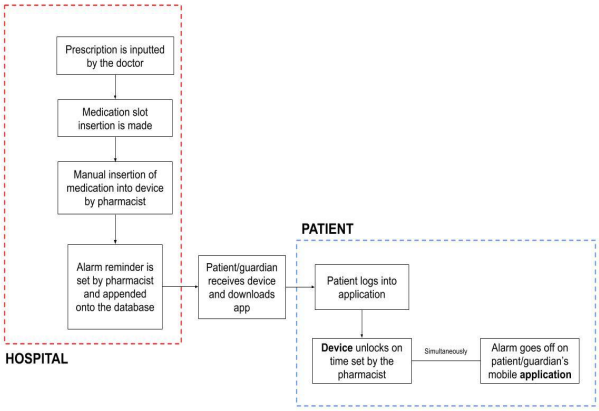

Figure 1. Flowchart of the Software Design

The system is planned to work as seen on figure 1 and as such: Prescription is made by the doctor. Medication is prepared and inputted into the device's slots (one slot = dosage of one time period) by the pharmacist. Registration of the patient to the MediTimer application done by the pharmacy. Alarm reminder and method of medication administration is set by the pharmacist into the database linked to the MediTimer application. Patient receives the device and their username and password for the MediTimer application. Patients will download the MediTimer application on their phone. Patient log in into the application. Device unlocks simultaneously on time with the alarm reminder on the MediTimer application. MediTimer Device is where the medication is put and MediTimer Application is where the reminder and how to administer the medication are.

There is a database that contains all the information about medication schedules and the patient information including time, dosage, drug amount, and others. A software applet is developed to ensure patients administer the correct medication at the right time and right dose by using Java, although from the pseudo-code, implementation in other languages will be possible (Meolic & Dogŝa, 2014). A special medical device with some partition to store the medicine and will open at a desired time. The pseudo-code of the application is devised in here:

Pseudo algorithm:

procedure **ConnecttoDatabase**

variable time= database.time

variable drug= database.drug

variable frequency= database.frequency

variable dose= database.dose

variable duration= database.duration

end procedure

Prescription to slot

([drug.1,drug.2,drug.n],[frequencyd1, frequencyd2, frequencydn], durationd1, durationd2, durationdn], [dose1, dose2, dosen])

```
    Find max.frequency*duration
    drug1=c()
    For sum(drug1)!=max.frequency*duration
        Drug1.append (1)
        Break
    Append rest accordingly
End procedure
```

Slots represented by array

Ex.

```
drug1=c(1,1,1,1,1,1,1,1)
drug2=c(1,0,1,0,1,0,1,0)
drugn=c(1,0,0,1,0,0,1,0)

Return array(c(drug1,drug2,drugn),
dim=c(max.frequency*duration, drug.n))
```

```
     [,1] [,2] [,n]
[1,]    1    1    1
[2,]    1    0    0
[3,]    1    1    0
[4,]    1    0    1
[5,]    1    1    0
[6,]    1    0    0
[7,]    1    1    1
[8,]    1    0    0
```

NFC

```
procedure NFCConnection
If rfid=get.xxxx
Transfer code
```

```
Else
sout("Not a match")
End if
end procedure

procedure timer(time)
   if time=datetime.now then //if the time equal
to the time in the phone
      return procedure NFCConnection
   end if
end procedure
```

The description and narration about each section of the psedo-code is as following:

Connect to database, this procedure is to obtain the variables value from the database. **Prescription to slot,** this procedure will append each drug name, the drug consumption frequency, duration of the drug administration, and the dose of the drug intake into an array. For example, slot 1 contains drug1, drug2 and drug3 in the prescribed amount and will be consumed on the time set in the database. **NFC,** This procedure is to send a code to the device in order to open the slot. **Timer,** this procedure explains the timing when the NFCConnection procedure will be run. Each slot will be opened based on the time stored in the database.

RESULTS AND DISCUSSION

This project aims to reduce medication errors, particularly incorrect timings and doses, by scheduling medication reminders. Additionally, the application will later on gives information regarding the nearest hospital and pharmacy installation with leveraging GPS feature(Paramonov, Vasilyev, & Timofeev, 2016).

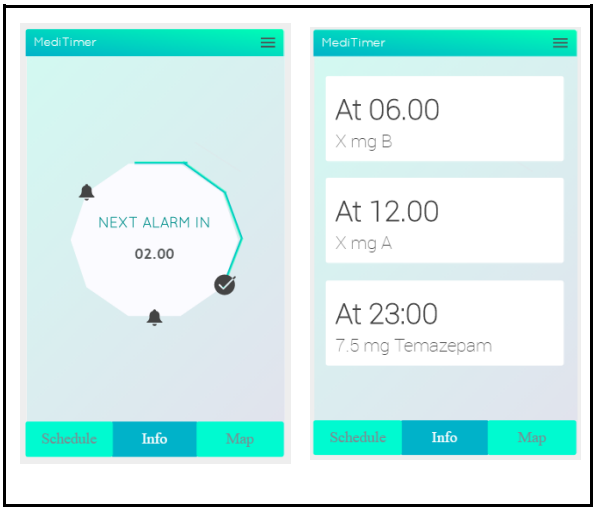

Figure 2. MediTimer User Interface.

Each patient will be given a username and password to login to the mobile application that on the later stage could be downloaded from Google store or App store (Figure 2). The application will show when will the next reminder for medication intake, if the time comes then the alarm will go off and the device will be unlocked allowing the patient to take the medication at that specific slot. There is also a schedule menu where all the schedule information is shown and a map menu that shows the nearest pharmacy or hospital to refill the drugs.

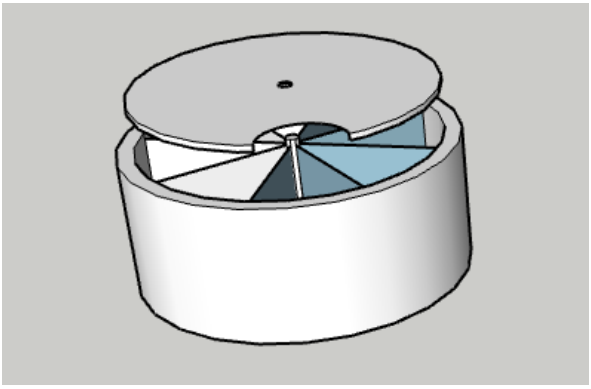

Figure 3. 3D render of the medication container with its respective compartments

Along with the application, each patient will also receive a medication container (Figure 3). With its slot size and quantity dependent on the amount of medication a certain patient is prescribed. These containers will have all the appropriate medication and its doses for the right consumption time in each slot. In parallel to the application at the set hours the container will rotate/open to allow access to the right medication and dose at the right time. At the same time, because it opens exclusively to its set time, it prevents the abuse of drugs by limiting the patient's control over the amount of medication to be consumed. The possible future enhancement of this application will be providing remote access for the healthcare professional in order to facilitate finer grained dosage advice to the patients(Lee Ventola, 2014).

Furthermore, with better integration of pharmaceutical, hospital and other parties this device can become the standard to medicinal containers along with the possible of Internet of Things (IoT) integration (Jamil, Ahmad, Iqbal, & Kim, 2020). In addition to reducing waste, given its reusable nature. The meditimer can provide better monitoring and prevention of medicinal errors and improved antibiotic disposal and tracking.

CONCLUSION

MediTimer is an innovative solution to prevent potential harm that is caused by medication error. Java software is developed to ensure that the medication is taken at the correct time and correct dosage by making a mobile app that can connect to a device to keep the user in track. Possible future enhancement will be the incorporation of IoT, and remote access for healthcare professional.

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