

Final Project Report: Mediset

A healthcare system that pre-empts double spending of prescriptions

Jay Bushan, Vrinda Khandelwal

April 2022

Introduction

The Indian healthcare system caters to billions of Indians but has still failed to create a digital infrastructure that has kept up with the current pace of technological advancement. Two major challenges that plague the current healthcare system are:

- creating a sustainable technological framework that gives patients ownership of their data, while also providing them anonymity and security
- Prevent over-medication and drug abuse by disallowing double spending of prescriptions

However, since hospitals having localised and disconnected databases with medical healthcare records of patients, hospitals and clinics have the sole ownership of patient data. Furthermore, with a dearth of interoperability amidst these systems, most Indians still rely on physical hard copies of prescriptions or pdfs of paper prescriptions to procure medications even on online e-commerce healthcare platforms. This also leads to over-medication which is a significant health challenge due to lack of regulation at most local pharmacies.

We propose **Mediset** healthcare management system, a blockchain based solution for creating, storing, and access medical documents. We believe that leveraging blockchain technology in healthcare can allow stakeholders in the ecosystem to share patient, treatment and clinical information without compromising on security by ensuring information origin as well as change tracking. Furthermore, there is an increased shift to ordering medication online and we aim to create a system that interacts with websites like 1mg to ensure that the prescription is only spent once to procure the required medication. The first version of Mediset focuses on writing medical prescriptions and verifying them. It allows doctors to fill out prescriptions online which are then stored on the blockchain. The prescription can only be accessed by the patient. Thus it

protects the identity of both the doctor and the patient while increasing transparency in the sale of prescription drugs. Mediset works to incentivise 3 parties to use the platform -

1. The Doctor : Using Mediset, doctors are assured their prescriptions are not used to obtain the same drugs multiple times from different platforms, a real concern as e-pharmacies become more mainstream.
2. The Patient : The patient is assured that their prescription would not be misused by systems that will store their data and prescriptions and can use it in a variety of privacy invading or illicit ways.
3. The E-Pharmacy : Currently in India, E-Pharmacies employ verification of prescriptions such that they check for a doctor's stamp. Such a document can easily be forged or reused on multiple platforms.

As an added benefit, such a system can be used to track the amount of prescription drugs being manufactured and prescribed, thus can be used to analyse if they are being sold without prescriptions.

Why blockchain?

Blockchain based systems can enable data security, trust, interoperability and standardization. Furthermore, immutability and verifiability can result in important health outcomes. The following are the benefits of using blockchain technology to store prescriptions:

1. Storage of such electronic health records on the blockchain can enable various medical entities to exchange relevant information easily.
2. Cryptographic measures can be taken to ensure anonymity of a patient's personal information.
3. Since the blockchain is immutable, tampering with prescriptions is prevented.
4. Patients have ownership over their medical records
5. Can be linked with medical licensing bodies and thus doesn't require any centralized body to manage.

Project Description

The goal of this project is to make sure prescriptions are spent by the right parties (while avoiding double spending) with approval from the required parties.

Mediset uses solidity to write contracts to the Ethereum blockchain. It provides anonymity, security and decentralisation to all stakeholders. The ledger consists of a world state with data from the prescriptions and a blockchain with

transactions that create and update the assets. The ethereum chaincode will allow to preserve all sensitive data. The chaincode can offers some extra features to the doctor too -

1. Automatic Renewals : The prescription can be automatically renewed after a stipulated amount of time. For example - The doctor can set the renewal time to be 1 week. After the first prescription transaction is spent, another transaction is automatically placed that created a transaction which can only be spent after a week.
2. Expiry : The prescription can be given an expiry date after which the doctor might want to meet the patient for a follow-up.

For version 1 of Mediset, we aim to create our backend application on the Ethereum blockchain and a front-end for the doctor to write a prescription and for a patient to view and spend their prescription.

Implementation

Github Repository Link :

<https://github.com/JayBhushan011/Mediset>

We can think of the operations as follows -

1. Asset Creation : An asset is created using a transaction. The asset records the details of the prescription, who create it, what patient id is it for and the time till which it can be spent. The transaction takes the following shape :

Key	Value
Txn id	Asset = [Prescription, Who wrote, For whom, State = [Unspent/Spent]]

2. Asset Checking: This operation takes place when a patient wants to spend a prescription. It is checked whether the prescription is being spent within the Time allocated to it. It is also checked whether the prescription is already spent.
3. Asset Update : An asset is updated when the txn is 'spent' or a prescription is used to make a purchase online. A timeOut value can be used after which the state is again changed from 'spent' to 'unspent' so that the prescription can be used again. This will create a new transaction.

These are some of the functions that Mediset will implement:

1. createPrescription() - This function allows doctor to create a prescription
2. spendPrescription()- This function allows a patient to order medication online through spending the prescription online.

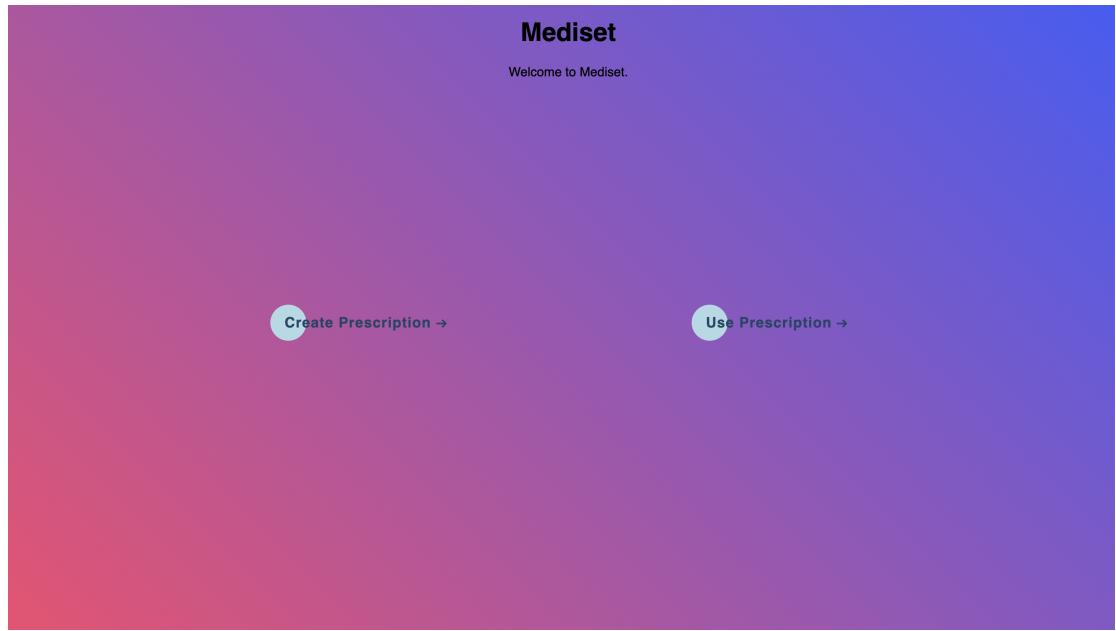
3. checkPrescription()- This function checks the status of a patient's prescription to see whether it is spent or unspent and check if the prescription has expired or not - i.e. the date of spendPrescription() > date mentioned in the Asset.

FrontEnd Implementation Details

Mediset uses a React Front-end to provide a seamless user interaction. The user interaction can be broken down into different types of users -

1. The Doctor : The doctor can create a prescription for a given patient. They can create an asset by entering prescription details, the Expiration Date, and the current status of the prescription.
2. The Patient : The patient can view their prescription and spend it with an e-pharmacy. The prescription needs to be unspent and the expiration date should not be passed.
 - (a) Using the prescription at a physical store - The patient can simply scan the store's QR and make the purchase at a store. Once both the parties agree that the exchange has taken place, the transaction is marked as spent.
 - (b) Using the prescription at an online pharmacy - As Mediset becomes more mainstream, patients will be able to directly place orders via Mediset such that their data remains private. They will only have to add a delivery address after which our APIs will place an order for them.

The homepage gives two options- to create and spent prescription.
This is what the homepage of the current application looks like:



When you click on create prescription, the application takes you to the following page, where you enter patient ID and medicine details along with the expiration date.

BackEnd Implementation Details

Mediset uses the Ethereum Rinkeby Test Network where the Smart Contracts are uploaded.

Current Implementation Details Currently, Mediset can upload a prescription linked to a Patient ID. The Metamask account of doctor assessing the application is charged for the transaction. The prescription can also be viewed using the Patient ID. Thus, both reading from the contract via different users and writing to it via different users is possible. The anonymity of the users are protected since they are represented by unique IDs. However, the kinds of transactions and the data is on the blockchain, thus public. Thus analysing prescription data is already possible without invading privacy.

Future Goals

Future goals include making the contract smarter with expiry and auto-renewals. Also making it more efficient using templates for contracts and auto-generation of contracts for each doctor. On the doctor-UI side, a bunch of templates for prescriptions will be provided to the doctor's interface. Moreover, we look forward to verification of doctors on Mediset using government license to practice, using a parser for physical prescriptions and tie ups with online pharmacy stores

to allow a seamless experience. Finally, we can extend Mediset to include other medical documents too.

Benefits

There are several benefits to implementing Mediset -

1. Transparency about prescription drugs which are susceptible to misuse.
2. Actual verification of prescriptions in the online pharmacy space.
3. Anonymity of patients to ensure rightful ownership of data.
4. A distributed blockchain allows interoperability in a space occupied by various players.
5. A distributed blockchain also ensures transparency between these players while ensuring reduced server costs and increased efficiency