

# CONTRACT BOOK

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## AdhereCoin

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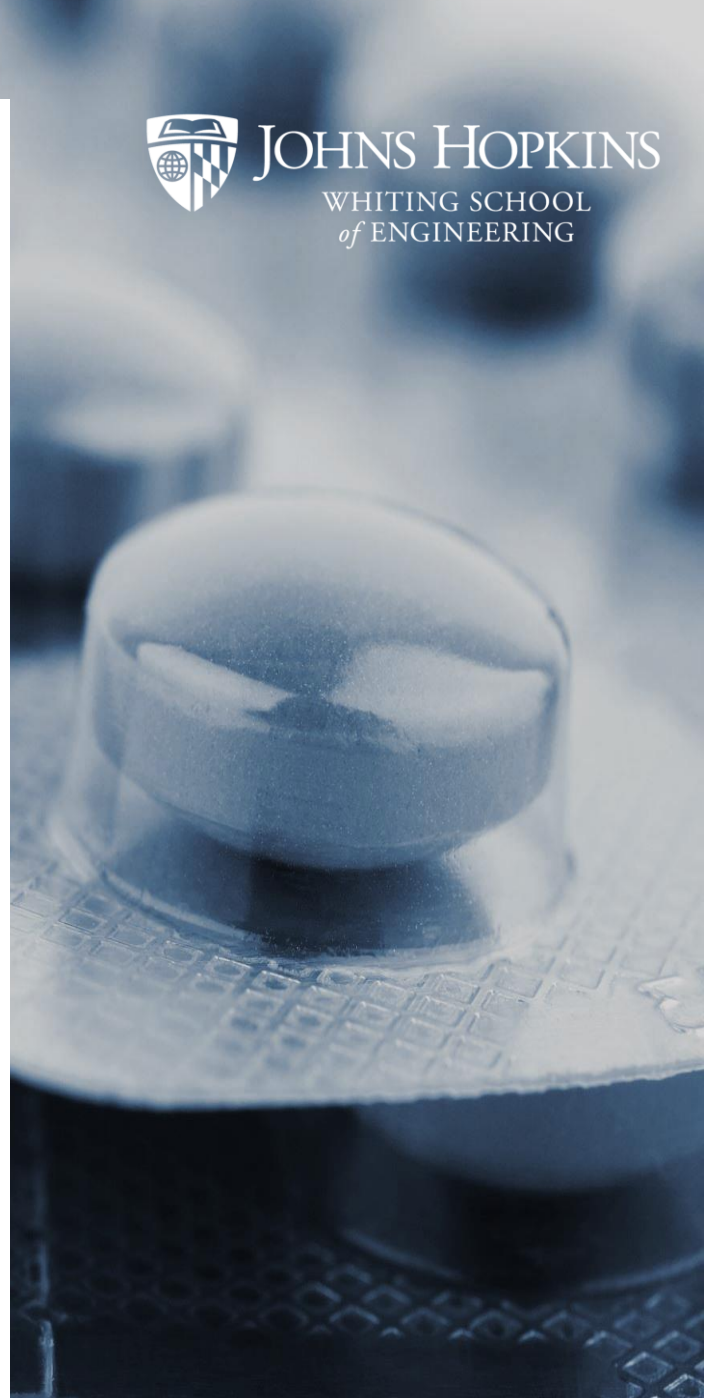
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Design of Biomedical Instruments and Systems



JOHNS HOPKINS  
WHITING SCHOOL  
of ENGINEERING



**AdhereCoin**



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# Founder

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AdhereCoin is the brainchild of Safiya Aafreen, a biomedical engineering Master's candidate in the Johns Hopkins University. She graduated with a B.E in Biotechnology from Birla Institute of Technology and Sciences, Pilani. Her experience ranges from microbiology and genetic testing to medical device development for COVID-19 diagnostics in India and the United Arab Emirates. She is passionate about disease diagnosis and is an avid thespian.



## Abstract

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AdhereCoin aims to develop a novel incentivized medication adherence device with an accompanying phone application. Sensors integrated in this portable , customizable device will track the adherence of the user and feed this data into an algorithm which will generate a fixed rate of cryptocurrency – the AdhereCoin, that can then be used for various utilities. This incentive- based methodology combined with a solution that aims to tackle all prevailing hassles to adherence faced by users is a pivotal necessity especially during the current pandemic.

# Introduction

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In the United States, while about 4 billion prescriptions are written annually, roughly one in five new prescriptions are never filled and for those filled, only about half are taken correctly. Patients over 60 years of age consume 50% of dispensed prescription drugs and as the population continues to age, chronic disease becomes more prevalent. This translates to an increase in the volume and complexity of medication regimens, increasing the risk for nonadherence. Medication nonadherence is a major cause of morbidity. Annually, medication nonadherence results in 125,000 deaths and 25% of hospitalizations. It is not only an individual patient's health problem, but also contributes up to \$300 billion of avoidable healthcare costs in the United States (US) and up to 30% of wasteful spending.

Primary factors for medication adherence include : 1) the patient does not understand the relevance of medication adherence to continued health and well-being; 2) the patient has concluded the benefits of taking medications do not outweigh the costs; 3) the complexity of medication management exceeds the information processing capacity of the patient; 4) the patient is not sufficiently vigilant; 5) the patient holds inaccurate, irrational, or conflicting normative beliefs about medications; and 6) the patient does not perceive medication to have therapeutic efficacy.

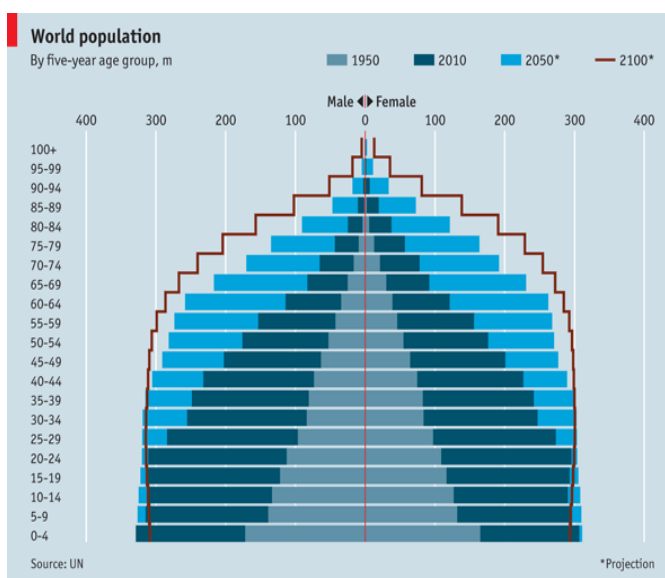
The current pandemic has compounded the issue . According to the Kaiser Family Foundation, approximately 49% of the US population has employer-based health insurance and according to the Bureau of Labor statistics, the number of unemployed persons rose to 23.1 million in April 2020. Given the number of people who have lost health insurance, this will impact adherence rates by shifting more cost onto patients. Social distancing has reduced the frequency of clinic visits and has adversely affected denizens who are dependent on a caretaker for adherence.

## Field Survey

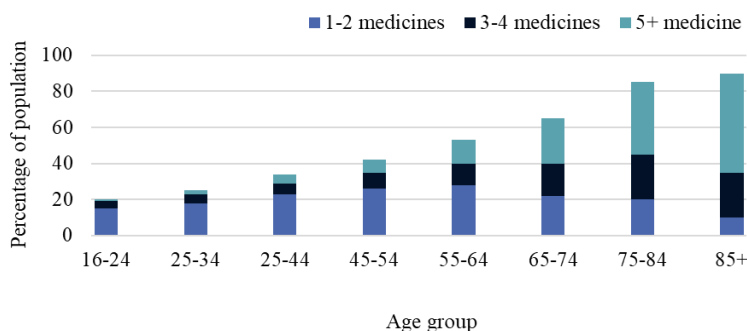
Poor medication adherence has huge repercussions, adding about \$177 billion every year to the healthcare expenditure, in the form of indirect and direct costs, but the cost of non-adherence in the times of COVID-19 pandemic has the potential to be much higher. Since medication non-adherence already accounts for 50% of the treatment failures and up to 25% of the hospitalizations each year, it has become more important than ever for physicians, pharmacists, and insurance companies to work together to keep patients adhering to their prescriptions. Such factors are driving the growth of the medication adherence industry across the globe during this COVID-19 crisis.

The medical adherence market incorporates both equipment-based and programming-based frameworks. The equipment-based frameworks comprise of mechanized pill distributors, keen medicinal watches, electronic plate boxes, and wearable sensors. A majority of these are bulky devices that are not portable and have a cumbersome set up procedure. Many have restrictions in the size and type of medication that can be dispensed. Cloud-based databases, versatile medication patient programs, smartphone apps and wellbeing projects would be classified under programming-based medication adherence. Pure software-based solutions have been verified to not enhance adherence and thus, a consolidated and convenient solution is required.

The global adherence market had a size of \$2.48 billion in 2020 and is expected to reach over \$3.9 billion by 2021. In terms of region, North America is commanding the global medication adherence packaging market due to the expanding consumption on medicinal services benefits by the prevailing legislature. This large contribution is mainly driven by the increase in R&D infrastructure, growing aging population (Figure 1), expanding healthcare expenditure, and increasing prevalence of chronic diseases in the region resulting in a higher intake of medications. (Figure 2). AdhereCoin can thereby take advantage of this trend and will address the gaps in the current market which will enable us to have a large market share.



**Figure 1:** Projected distribution of global population grouped in 5-year age brackets.



**Figure 2 :** Number of medications taken by percentage of age bracket in the population.

Source : <https://www.statista.com/chart/20056/prescription-medicine-by-age-group-england/> Accessed on : 21 Dec 2020



# Patent Survey

AdhereCoin aims to incentivize medical adherence for all types of medication by backing it with a cryptocurrency model. Currently, it occupies a niche space with no competitors. An extensive patent search was conducted based on the following subdivisions using the JHU library resources. We acknowledge Dr. Sue Vazakas for her invaluable help in providing the techniques to complete this objective. The most relevant patents have been mentioned below based on the following subdivisions :

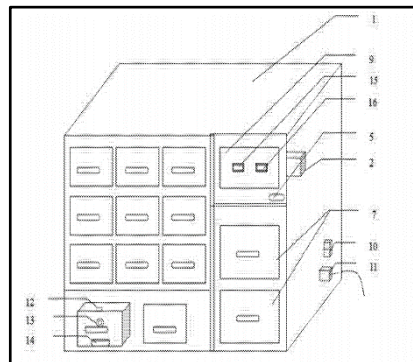


## Medication Dispensers and Monitoring System

### ● CN105533971B : Intelligent medicine box and its application method

**Status :** Published , 2017-07-28

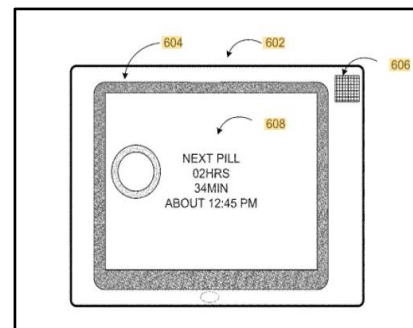
A large intelligent medicine box, including the casing with several drawer type multilayer medicine frame medicine storage storehouses, it also includes a Control unit, sensor, refrigeration temperature control unit, detection unit, man-machine interaction unit and the execution unit in casing are stated. A wireless communication unit is installed and is to be used according to bar code or Quick Response Code to obtain the parameter information of the medicine. A touch screen display for interaction. Alarm system (audio and visual ) for reminders and regulation of parameters ( weight, temperature) is also incorporated. Not portable.



### ● US9760691B2 : Interactive adherence drug dispensing and communications platform.

**Status :** Active till 2033-10-01

A pill dispenser device, comprising a memory adapted to store instructions integrated with a pill consumption detection that uses a trace diagram that includes one or more conductive ink traces printed on a pill pack configured to detect a modification to the pill pack. This includes a processor in electronic communication with the circuitry of the pill device and configured to collect pill consumption information about a user, wherein the collected pill consumption information is erasable in response to activation of a trigger, and wherein the trigger includes one or more of a compound, a chemical agent, or an electrical signal. Has to be provided by the pharmacy and cannot be used for all types of medication.



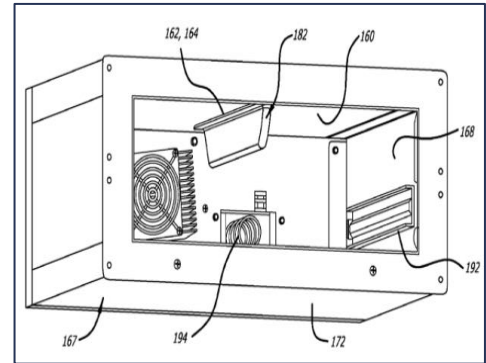


## Temperature controlled compartments

### US9492349B2 : RFID enabled cabinet having temperature-controlled drawer

**Status :** Active till 2029-12-19

A temperature control device configured to provide temperature control for a single drawer, the temperature control device mounted to at least one of: the first drawer so as to move with the drawer; and at a fixed position in relation to the first cavity. An RFID reader is present for medications disposed within the first cavity and configured to read RFID tag data from an RFID tag located within the first drawer. Alerts if a temperature-controlled item has been placed in the second drawer.

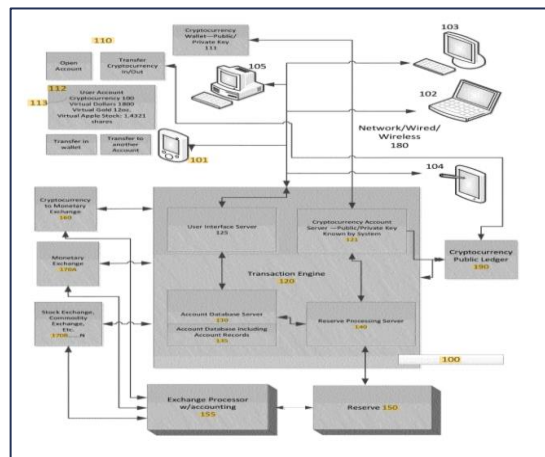


## Adherence based cryptocurrency apps

### US20150332256A1 : System and Method for Converting Cryptocurrency to Virtual Assets Whose Value is Substantiated by a Reserve of Assets.

**Status :** Pending, 2018-02-12

A user account database server configured to store data pertaining to a plurality of user accounts, wherein the data pertaining to each user account indicates an accounting of obligations of the system to the user.





# AdhereCoin

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## Elevator Pitch

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### Why do we need AdhereCoin?

Lets all reflect back on our lives for a minute. We at some point have had a cold and have been prescribed medications and gotten better. I am also sure that we or our loved ones have had to manage a chronic condition such as diabetes or cancer and have been given a cocktail of prescriptions which , if we ever did forget to intake , has led to dire consequences. We are not alone. Medication nonadherence has annually resulted in 125,000 deaths and 25% of hospitalizations and is a growing problem that has been compounded by the current pandemic especially for our elderly family. Primary factors for non-adherence include a lack of medication literacy; financial reasons which prevent regular access to a doctor and maintenance of a regimen ; lifestyle habits which cause us to forget our medication and of course the lack of a portable device that can efficiently store and keep track of every type of medication we would require.

### What is AdhereCoin?

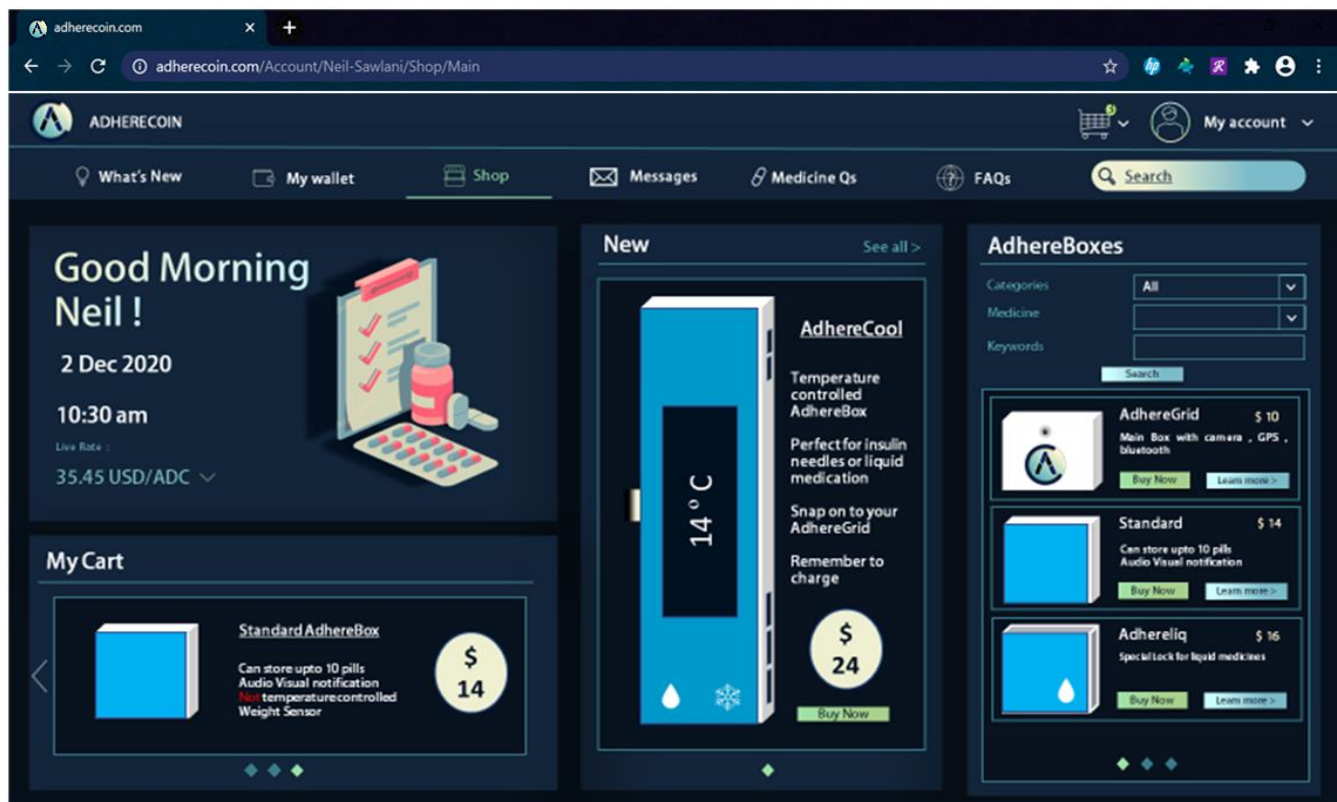
AdhereCoin aims to provide an incentivised solution in the form of a portable , customised medical adherence device with an accompanying app. The device can house any type of medication including liquids and those requiring temperature control such as insulin and chemotherapy drugs. It will have audio – visual notifications set according to the regimen that can be remotely set up you or a caretaker. The mobile app contains information of the prescription for you to quell any doubts and enhance adherence. Notifications of dosage schedule and missed doses will be provided to both the user and anyone else assigned as caretakers. The novelty of the app is the accompanied Adherecoin – a cryptocurrency generated based on your adherence pattern which can be used to pay off future refills for prescriptions , telemedicine charges or anything you desire!

### What sets us apart?

Apart from providing an incentive we aim to close the gap in the market in several ways . The current market is flooded with devices that are not user-friendly , have limited features, highly expensive, inefficient and in most cases bulky and require a constant power source. They do not offer to store liquid medications or those that require temperature control and have no means of tracking the amount taken. To reiterate AdhereCoin will be your constant health companion that can be with you no matter where you go and motivates you to boost your health!

# How does AdhereCoin Work?

**Step 1 :** Get your customized AdhereBox from our website.



**Figure 3 :** AdhereCoin website concept

Users can register on the website ( not functional as of yet and will be deployed soon) and will simply have to enter their medication. Our database contains medications and their specific storage conditions based on which the website will suggest the Adherebox (Figure 4) you require , which will be one of the three : Standard ; AdhereCool or Adhereliq. Based on the different medications the user will require , they can purchase the same amount of boxes and attach it to the main AdhereGrid that controls the functioning of the attached boxes. The first 4 compartments will be attached by AdhereCoin and additional units can be attached by the user as simply as fixing a LEGO™ toy.

The main AdhereGrid houses the microprocessor ; an Arduino Beetle BLE for Bluetooth sharing and setting up the dose regimen ; a VGA CMOS Camera Image Sensor for facial recognition that ensures that the caretaker or user is replacing / intaking the medication ; a Nano GPS click chip that will help you locate the device ; a Sound Module IC chip which will be used for audio notifications which can be a tune or a voice message based on the user's preference ; and a USB charge port for charging the device for a while before carrying it wherever the user may wish to go throughout the day.

The Standard AdhereBox can house a week's dose and contains an Arduino load cell weight sensor for detection of the amount of medication in the compartment and will also be able to track if the medication has been removed on time by the user . It can weigh from 10µg to 500g with a sensitivity of 3µg at an

operable temperature of  $-5^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  and thus is very appropriate for the device. The box will also have a smart lock and inbuilt LEDs that can notify the user which compartment to take the medication from, and the associated dose required.

The Adhereliq box is for housing liquid medications and will be provided with a biodegradable syringe for extracting the medication. The AdhereCool will be equivalent to the length of three AdhereBoxes and will be temperature controlled so as to keep insulin shots secure throughout the week.

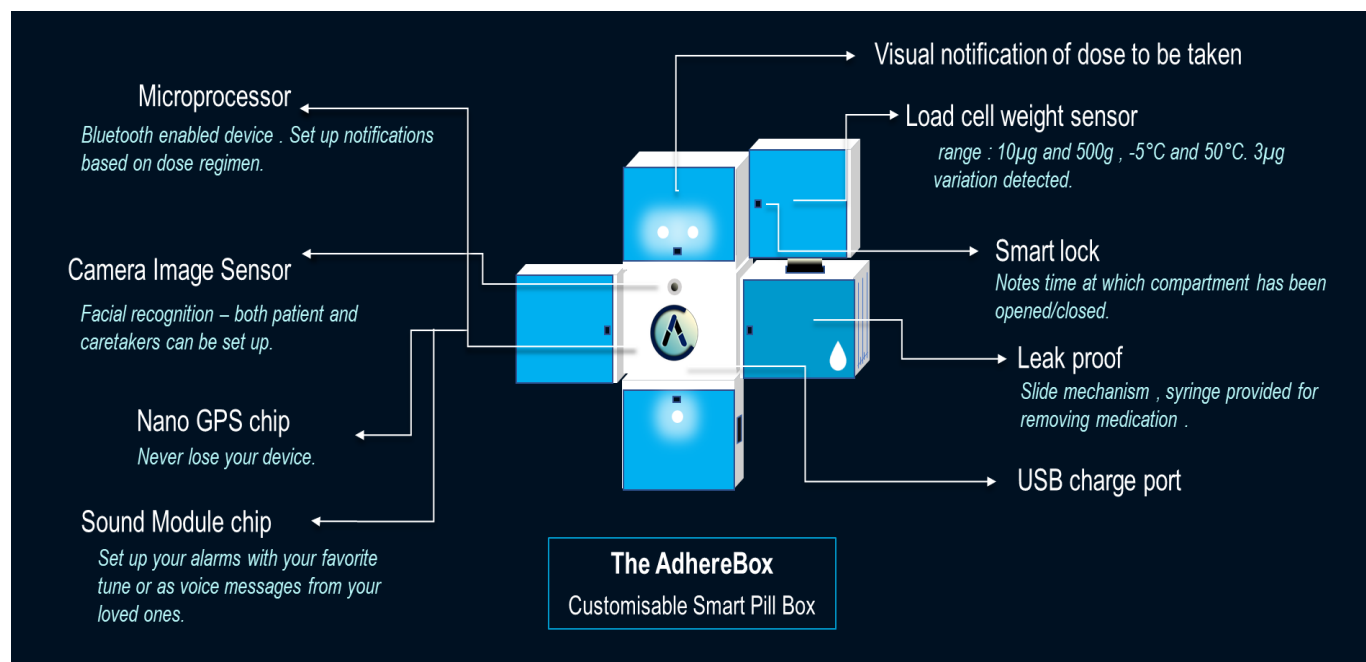


Figure 4 : AdhereBox Design Concept with associated features

## Step 2 : Download our App.



Figure 5 : AdhereCoin app screenshots

Using the app, the user or a caretaker can set up the dose regimen and personalized alarm systems for each adherebox attached which will seamlessly sync with the device. The app can be used to quell medication doubts, locate the user's device and purchase additional adherebox units.

When the user adheres to his regimen, an algorithm based on the dose required and adherence rate will determine a fixed reward to be given to the user in the form of a unique cryptocurrency – the AdhereCoin. The AdhereCoin will be based on the ERC20 ethereum smart contract and will act as a typical cryptocurrency – a digital asset that can be exchanged for fiat cash. AdhereCoin will obtain partners providing various commodities from retail, entertainment, and pharmaceutical sectors that will entice all age brackets. The AdhereCoin can then be exchanged for cash and be perceived as coupons by the users without the partner making any losses.

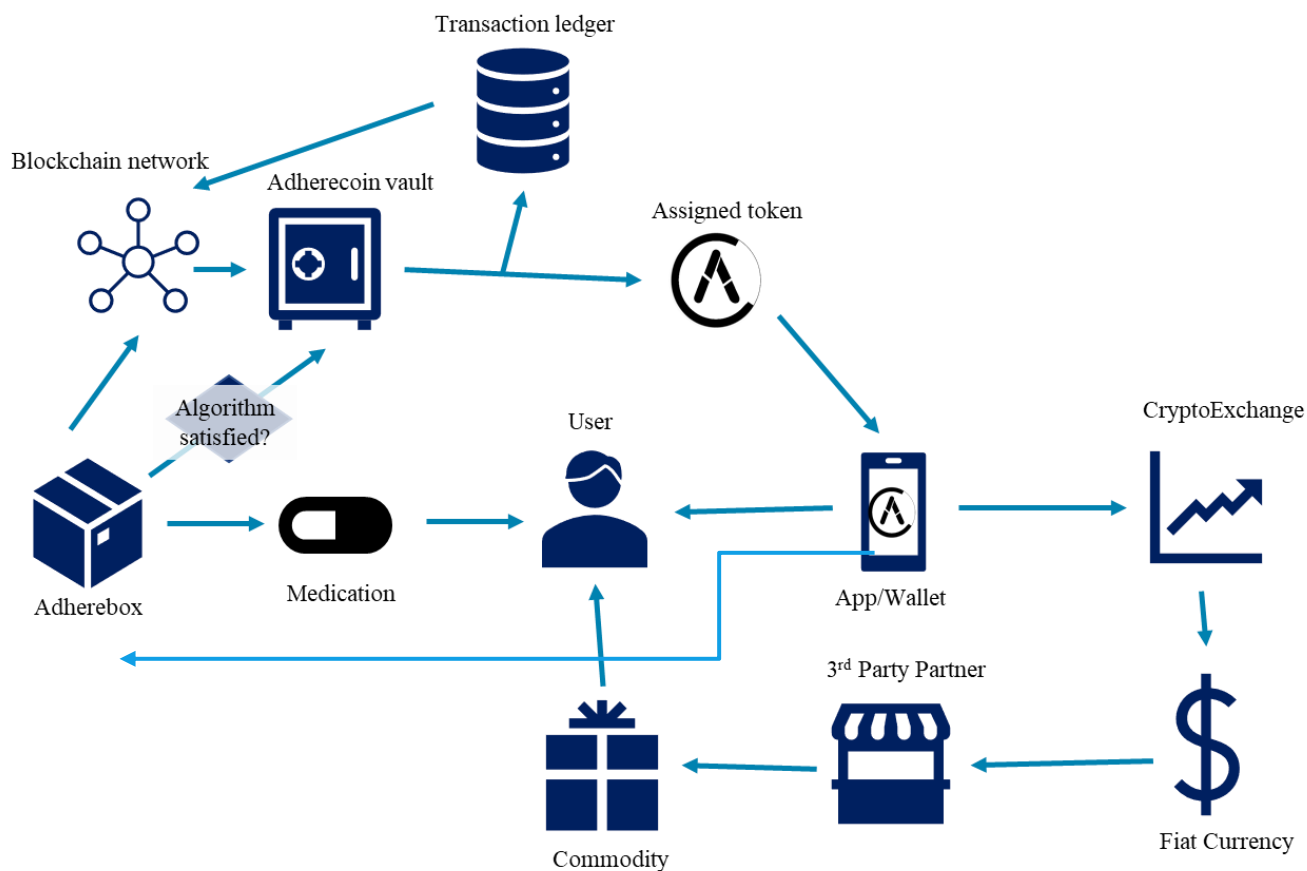


Figure 6 : Process flow for each user



## Regulatory Issues

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The AdhereBox can be classified as a class 1 device under the Food and Drug Administration (FDA) guidelines ( product code : NXB – Dispenser) and is thereby exempt from a premarket notification requirement or a FDA clearance. The sale of AdhereCoin does not include any asset that falls under security as determined by the state or Federal law and currently does not have any regulation requirements. The only offices AdhereCoin will need to contact is the US Patent and Trademark Office (USPTO) and the FDA for the device registration.

Medical Adherence Devices as of yet are not covered under any insurances and thereby there will not be any reimbursement code associated with AdhereCoin.



## Our Business Model

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A three-part business model will be implemented for the mobile application ,the device and the cryptocurrency.

The utility token business model will be employed for AdhereCoin wherein a consumer who obtains a utility token ( Adherecoin) supports the network stability and liquidity. The more purchases and sales of services or goods that happen in the network via transactions with 3<sup>rd</sup> party vendors, the more effective the network will be. The use of utility tokens by new users increases the value of the tokens and consequently the investment value of the other users. More importantly, an investor using the utility token will increase the value of its investments while providing a better network for another user. Therefore, the distinction between stakeholders will fade: a customer will be an investor and vice versa. Such a business company based on utility tokens will potentially be favoured by a positive escalation effect where use of tokens will benefit users and a platform that has a self-enforcement mechanism will originate. Revenue generated from these transactions will be derived from the conversion fee.

Adherecoin is a B2C business and the sale of the device will work on the basis of the typical manufacturer business model wherein a flat fee – cost will be applied at the time of purchase from the web portal. The app will follow a freemium business model and will be funded through ads, and users may opt to buy a “premium” version that allows for uninterrupted usage.



## Financials

Expense Calculator	Amount/year	Quantity
	(\$)	
<b>Development</b>		
Equipment	200,000	1000
Blockchain	2500	1
App	1000	1
<b>Running &amp; Maintenance</b>		
Salary		
Hardware Engineer	96,850	1
Blockchain & Web Developer	150000	1
Business Consultant	47200	1
Office Space	25000	1
Office Supplies	20000	1
Office utilities	2000	1
<b>Growth</b>		
Patent Application	20000	1
FDA Registration	6000	1
Testing & R&D	2000	1
Advertising	15000	1
Emergency fund	10000	1
<b>Total</b>	<b>597,550</b>	



The US market share was 40% of the total Medical Adherence market in 2020 ( \$2.48 Billion) which amounts to \$992 Million. At least 44% Americans take 1 prescription pill each day which equates are target population to be around 145 Million people. Assuming a penetration rate of 5% for a new product which appears to cover gaps in the medical adherence market and being the first to incorporate a cryptocurrency, our market volume would be :

$$\begin{aligned} &\text{Number of target customers x Penetration Rate} \\ &145 \text{ M x } 0.05 \\ &= \mathbf{7.26 \text{ Million}} \end{aligned}$$

Breakdown of Expense :

Equipment : Arduino Beetle BLE ; VGA CMOS Camera Image Sensor ;Nano GPS  
click ; Sound Module IC chip ; Arduino load cell weight sensor = 200\$

Salaries are based on national average salaries for the specified occupations.

Office space has been estimated based on the average 2019 location cost for a space in Baltimore, MD.

Office supplies include 3 chairs , a 3D printer , 2 laptops ; utilities include electricity and internet bills which have been estimated based on national averages for the same.



## Summary

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AdhereCoin is a novel consolidated solution that will enhance medication adherence across all ages and every type of disease. The app and device have been designed keeping in mind the target patient group who require the most assistance and are the least compliant to a medication regimen – our geriatric and pediatric patient cohort. This incentivized solution has been presented to few investors who have stated their interest in it and will be attractive to many major pharmaceutical and wellness – based companies who will aid in galvanizing its development and boosting the world's health.