Pill Dispenser & Reminder - Requirements

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Group 11

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Requirements Definition

Functional Requirements

1. The system shall consist of a pill dispenser hardware unit and a web application.
2. The system shall be capable of interfacing with a consumer or institutional version of the pill dispenser hardware unit.
3. The system shall authenticate user credentials via face ID.
4. The system shall allow users to create accounts as patients, medical professionals, or family/caregivers.
5. The web application shall display reminder notifications for all users of the instance of the system.
6. The web application shall allow users to change the amount of medication dispensed.
7. The web application shall allow users to dismiss alerts without dispensing medication.
8. The web application shall display reminder notifications for all users of the instance of the system.
9. The web application shall allow users to change the amount of medication dispensed.
10. The web application shall allow users to dismiss alerts without dispensing medication.
11. The hardware unit and websiteshall display the medication's intended recipient.
12. The hardware unit shall authenticate the alarm responder's identity via facial recognition and communicate authentication with the web application.
13. The hardware unit shall dispense the patient's medication if the responder is the patient or credentialed professional/caregiver who exists as a user in the application.

Non-functional Requirements

1. The system shall dispense medication within 20 seconds of successful authentication.
2. The system shall authenticate the user's identity using face ID.
3. The system shall record and alert authorized users that the medicine was not retrieved after 10 minutes of alerting the user..
4. The system shall interface via the Internet, with the hardware unit wireless-capable.
5. The system shall allow users to change the frequency, (and volume, and brightness, for consumer devices) of reminders.
6. The system shall record patient use statistics (dosage, frequency) and display them as graphs.
7. The system shall list medications in dispenser.
8. The system shall record & report skipped medication alert statistics.
9. The system shall display a calendar upon request of upcoming pill dispense times.

Use Case #1

- Nurse dispensing pills to individual in hospital room

Actors

- Pill Dispenser
- Nurse making rounds to distribute medication
- Individual taking pills distributed

Preconditions

- Hospital has pill dispenser installed in all rooms
- Nurse & user are in room or in close proximity to hear or see alarm
- Nurse, doctor, or pharmacist has stocked dispenser with pills to be taken
- Nurse, doctor, or pharmacist has used app or website to specify when pills are to be dispensed
- Nursing staff has set up face ID with the pill dispenser

Postconditions

- Lights flashed & the alarm sounded, telling the nursing staff to distribute the pills
- Nurse heard and/or saw it was time to retrieve the patient's pills
- Dispenser has confirmed that someone on the nursing staff is picking up the pills
- Pills have been dispensed to the user
- Dispenser confirms that pills have been retrieved

Flow of Events

- Hospital has all nurses, doctors, & pharmacists create accounts & add face IDs
- Doctor inputs prescription & pill dispersal time for each prescription (with some help for scheduling from nursing staff)
- Pharmacist adds pills to dispenser
- Dispenser confirms that it has pills to dispense
- Pill dispenser checks the time against its dispersal schedule

- Dispenser sees that it is time to disperse pills to the nursing staff & starts alerting the user it's time using an audible alarm & flashing light. User may also be alerted via app if they have it
- Dispenser confirms that it has pills to dispense
- Dispenser gives the nursing staff 10 minutes to come authenticate that they are authorized to distribute the pills
- Dispenser records if user does not come to pick up the pills
- After dispenser confirms nurse's identity, only then does it dispense the pills
- Dispenser confirms that the nursing staff has picked up pill

Use Case #2

- Individual reminding themselves to take pills

Actors

- Pill Dispenser
- Individual being reminded to take pills

Preconditions

- User has pill dispenser installed correctly in their house.
- User is in house or close proximity to hear or see the alarm.
- User has stocked dispenser with pills to be taken.
- User has used app or website to specify when pills are to be dispensed.
- User has set up face id with the pill dispenser.

Postconditions

- Lights flashed and the alarm sounded, telling user to pick up the pills.
- User heard and/or saw it was time to retrieve their pills
- Dispenser has confirmed that the right person is picking up the pills.
- Pills have been dispensed to the user.
- Dispenser confirms that pills have been retrieved,

Flow of Events

- User creates account and adds face id, pill dispersal time, and pills.
- Dispenser confirms that it has pills to dispense
- Pill dispenser checks the time against its dispersal schedule
- Dispenser sees that it is time to disperse pills the user and starts alerting the user it’s time using an audible alarm and flashing light. User may also be alerted via app if they have it.
- Dispenser confirms that it has pills to dispense.
- Dispenser gives the user 10 minutes to come authenticate that they are the desired user
- Dispenser records if user does not come to pick up pills

- After dispenser confirms users identity, only then does it dispense the pills
- Dispenser confirms that the user has picked up pills

Use Case #3

- A family member making sure that another family member has taken their needed pills

Actors

- Pill Dispenser
- Individual that is checking that their family member has taken their pills
- Individual being checked on

Preconditions

- User being checked on has pill dispenser installed correctly in their house.
- User has stocked dispenser with pills to be taken.
- User has used app or website to specify when pills are to be dispensed.
- User has set up face id with the pill dispenser
- User has authorized their family member to be able to check whether or not they took their pills, by also setting up face id for their family member

Postconditions

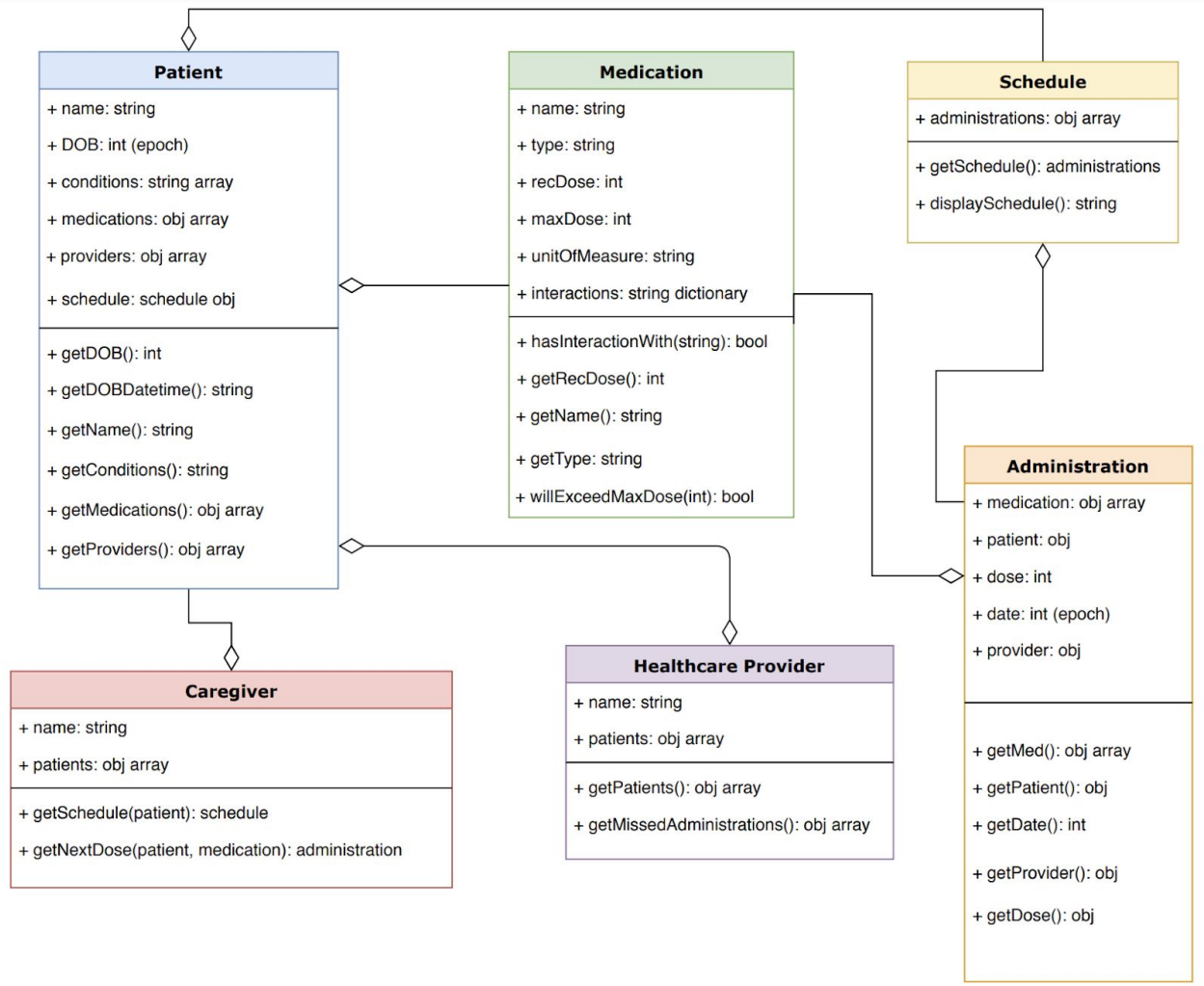
- Lights flashed and the alarm sounded, telling user to pick up the pills.
- Dispenser indicated whether or not the pills have been retrieved
- Family member checked whether or not the pills have been retrieved and reminded their relative to take the pills if the pills were not retrieved

Flow of Events

- User creates account and adds face id for both the user and a designated family member that will make sure that the user is taking their pills. User also adds pill dispersal time and pills.
- Dispenser confirms that it has pills to dispense
- Pill dispenser checks the time against its dispersal schedule

- Dispenser sees that it is time to disperse pills for the user and starts alerting the user that it is time to collect the pills, by using an audible alarm and flashing light. User may also be alerted via the pill dispenser app if they have it.
- Dispenser gives the user 10 minutes to come authenticate that they are the desired user. If, in the 10 minutes, the user successfully authenticates that they are the user intended to receive the pills, the dispenser dispenses the pills.
- Dispenser records whether or not the user picked up the pills.
- The designated family member authenticates that they are indeed the designated family member and checks whether or not the user picked up the pills.
- If the user didn't pick up the pills, the family member reminds the user to pick up their pills. If the user did pick up the pills, the family member does nothing.

UML Class Diagram



Requirements Specification

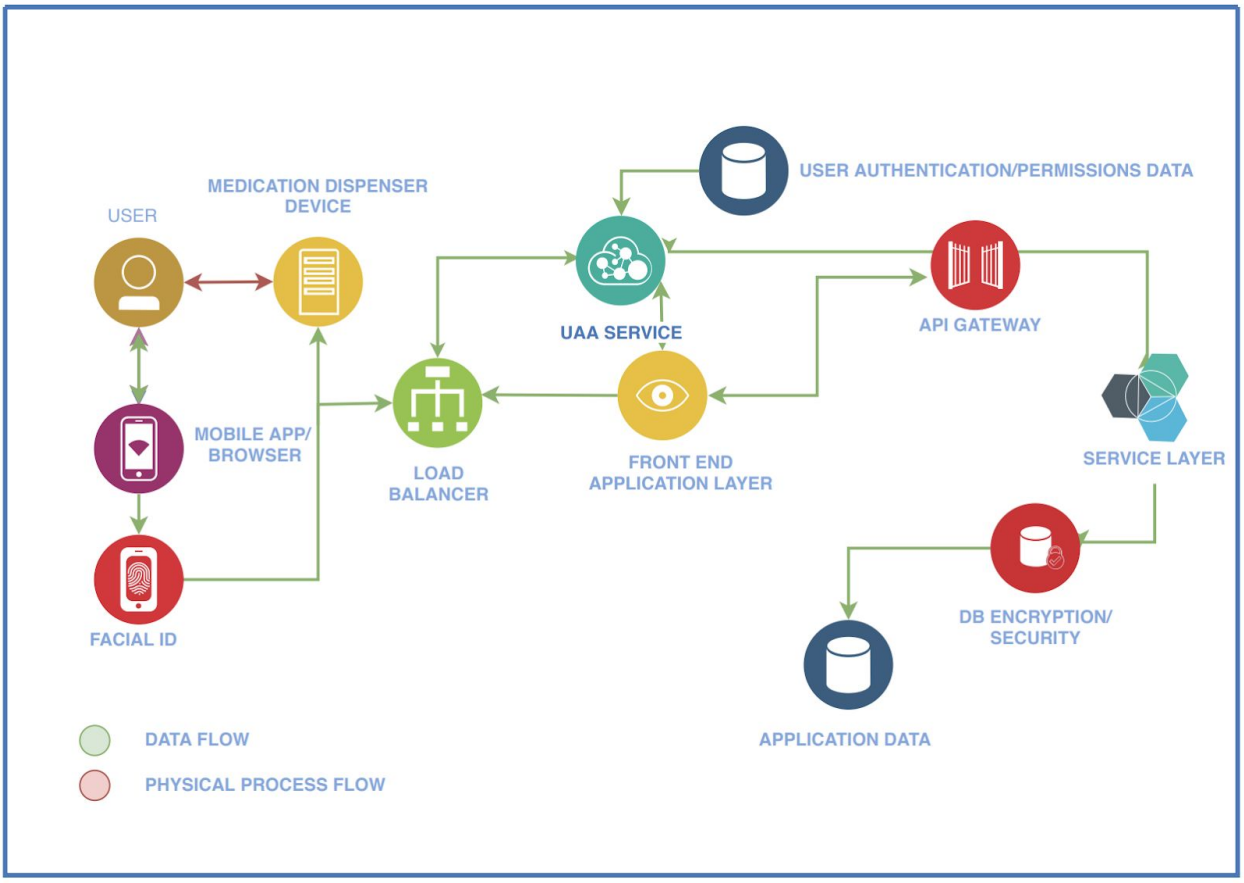
Functional Requirements

1. A User Account and Authentication (UAA) service exists that has its own secure encrypted database independent of application data.
2. The system shall dispense medication only for users that exist in the UAA service database and have the permission scope to receive medication.
3. The hardware pill dispenser shall authenticate users with facial recognition into a UAA service, and communication after authentication will be secured with web tokens.
4. A database exists to store application data (i.e., patient schedules and medications) that is encrypted at rest and in transit.
5. The front end application accesses application data through REST calls to a back end API service.
6. Communication between front end and back end services is negotiated by a secure gateway service.
7. The front end shall display which patient the medication alert is for, either visually or with a name only if the user presently logged in has the authorization scope to access the user's data.
8. The pill dispenser device shall display which patient the medication alert is for, either visually or with a name.
9. The UAA service shall authenticate the identity of the recipient as a patient or caregiver.
10. The hardware unit shall dispense pills into a holder after authentication with UAA.
11. The front end shall alert users that medication needs to be taken after querying the back end scheduler API for existing alerts.
12. The scheduler API shall allow users with the prescription scope in UAA to assign medications to hoppers for dispensing (and change assignments).
13. The back end service shall track medication frequency and amount (including skipped doses).
14. The front end will allow the user to request missed doses and display these in a schedule
15. The backend shall track prescription, dispensation, and dismissal events in the database.
16. The front end shall display tracked data as graphs, with the ability to compare over periods of time.
17. All data displayed in graphs shall be stored in an encrypted database and served to the front end through a back end service.
18. The scheduler API shall allow users to add or modify new medication reminders – the time of day, frequency, amount of pills to dispense.
19. The scheduler API shall allow alerts to be dismissed without dispensing.
20. The scheduler API shall allow users to assign medications to hoppers for dispensing (and change assignments).
21. The front end will alert users that medication needs to be taken as dictated by the scheduler API.
22. The application will allow alerts to be dismissed without dispensing.

Non-Functional Requirements

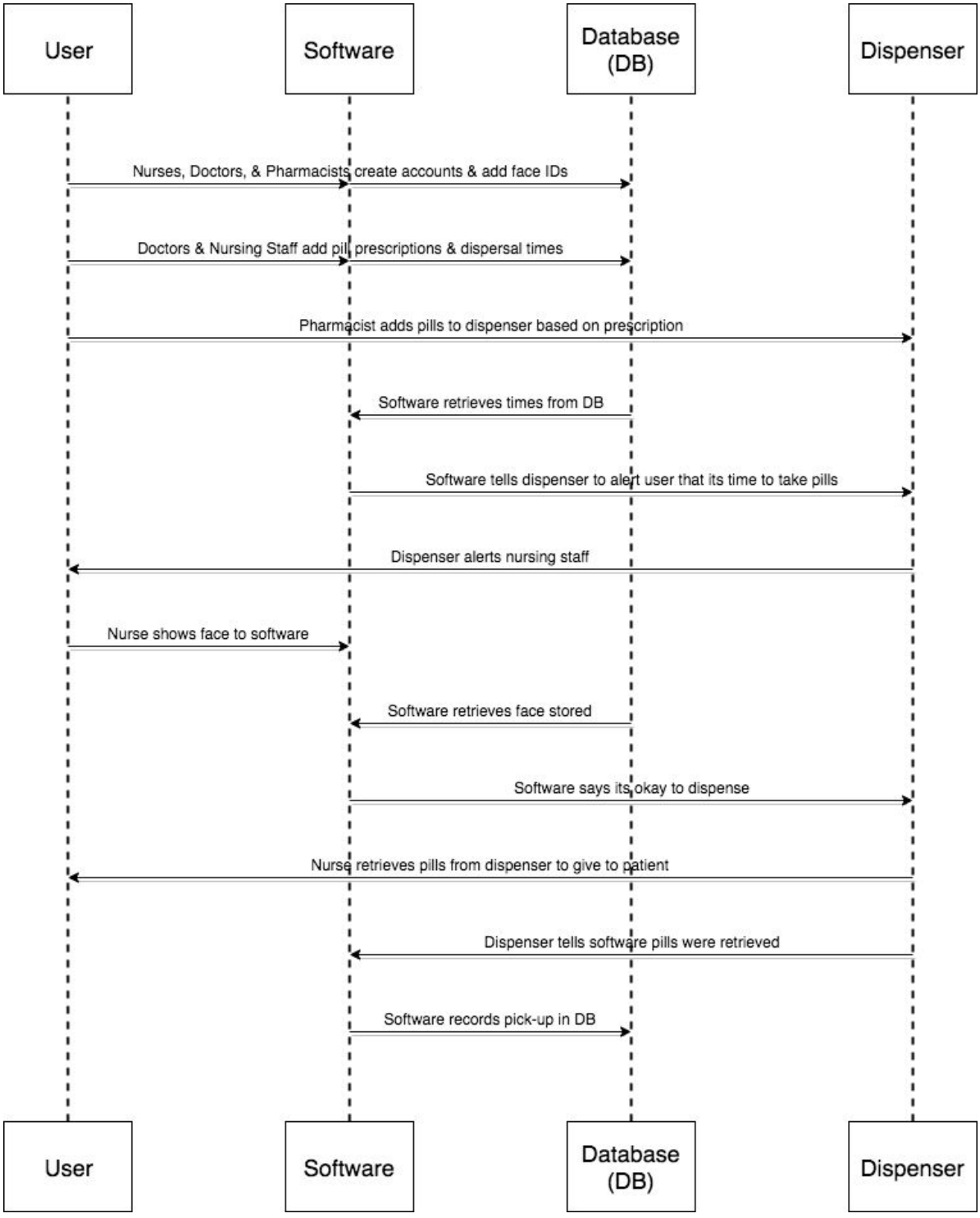
1. The system will alert the user when pill stock is low.
2. The system will access the database and respond to user authentication in 20 seconds or less.
3. The system will update the pill count in the database when pills are dispensed.
4. The system will store data over the life of the patient and sort it by month and year.
5. The system will update the database if pills were dispensed or not dispensed.
6. The system will allow the user to query the database for dispensal records/statistics and return the data within 30 seconds..
7. The system will report dispensal times.
8. The system will store in database what pills are currently in dispenser.
9. The system will access the database and respond to all queries within 30 seconds.
10. The system will only allow authorized users to access user information in database.

Data Flow Diagram

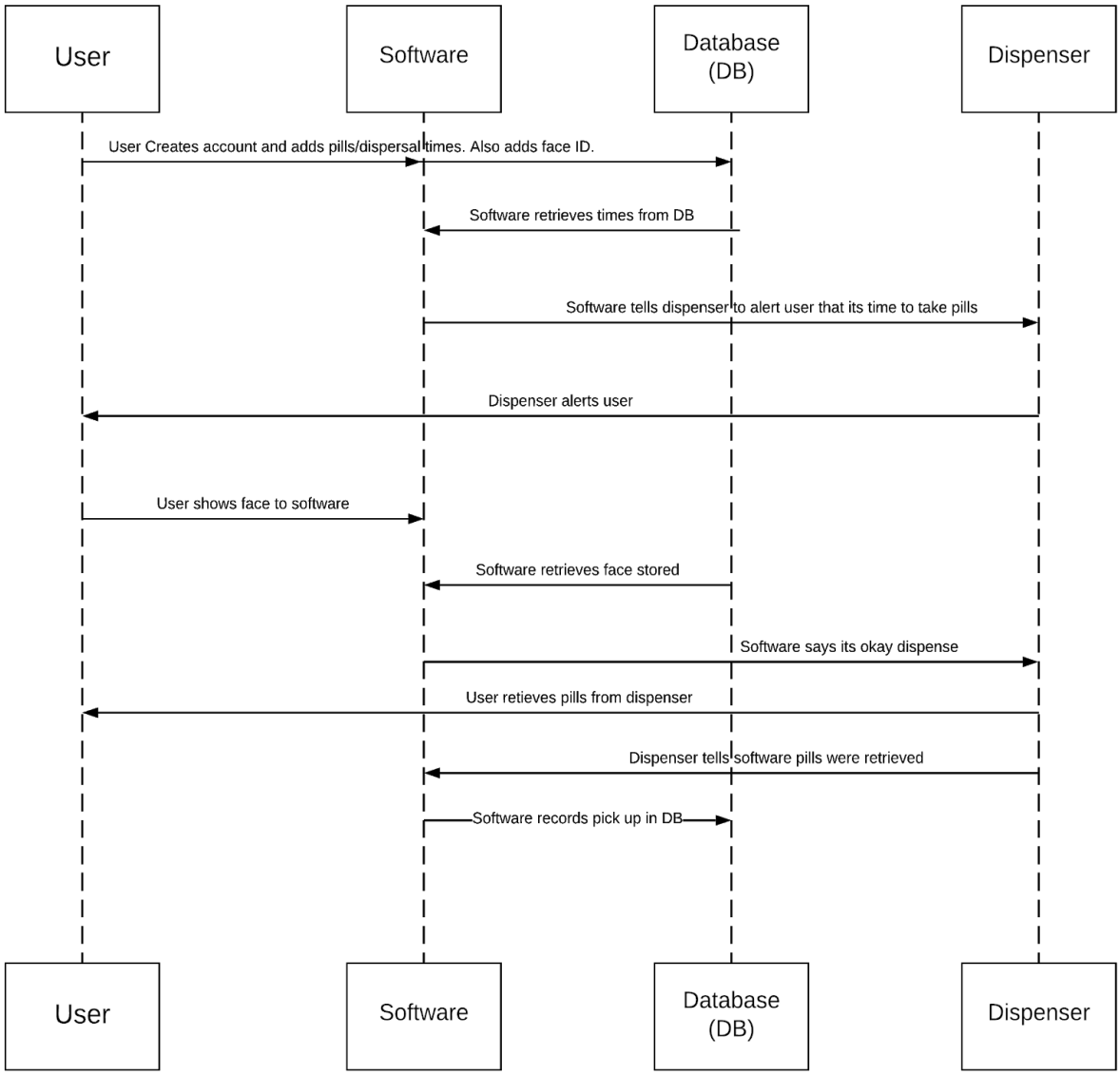


Message Sequence Charts

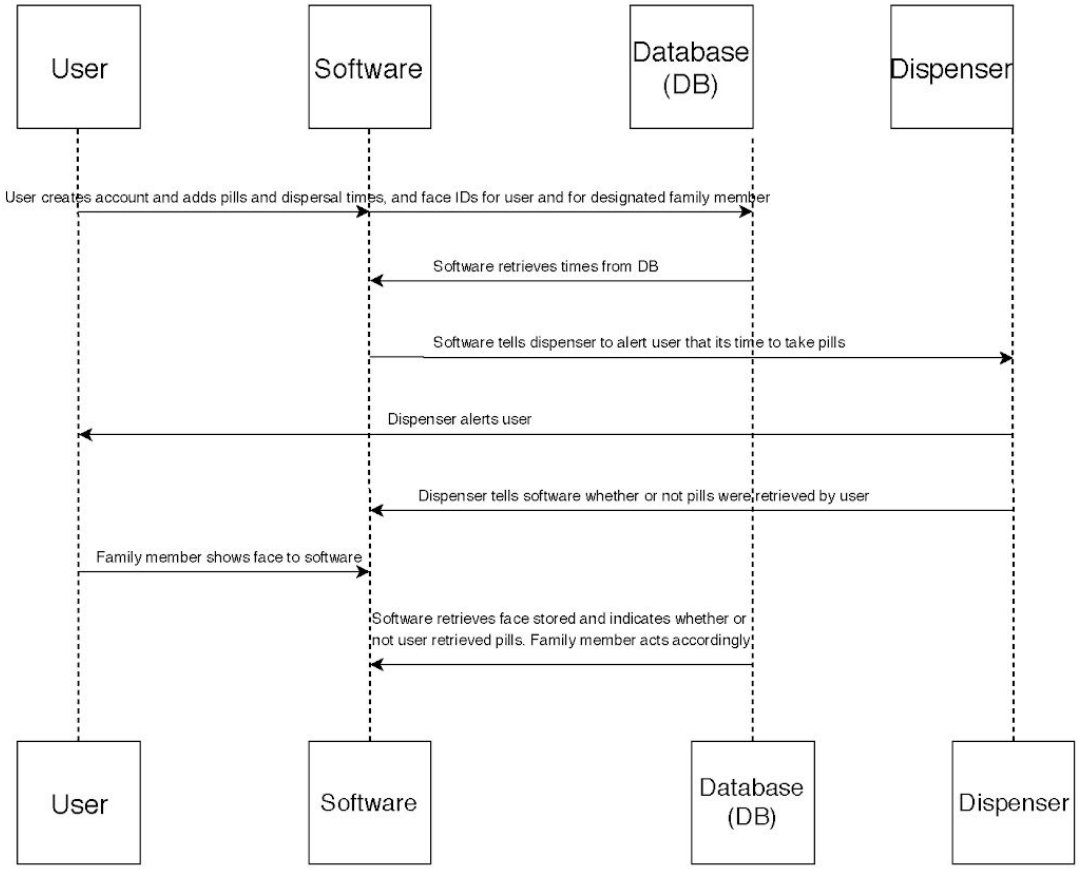
Use Case #1



Use Case #2


User
Software
Database (DB)
Dispenser
User Creates account and adds pills/dispersal times. Also adds face ID.
Software retrieves times from DB
Software tells dispenser to alert user that its time to take pills
Dispenser alerts user
User shows face to software
Software retrieves face stored
Software says its okay dispense
User retieves pills from dispenser
Dispenser tells software pills were retrieved
Software records pick up in DB
User
Software
Database (DB)
Dispenser

Use Case #3


User
Software
Database (DB)
Dispenser
User creates account and adds pills and dispersal times, and face IDs for user and for designated family member
Software retrieves times from DB
Software tells dispenser to alert user that its time to take pills
Dispenser alerts user
Dispenser tells software whether or not pills were retrieved by user
Family member shows face to software
Software retrieves face stored and indicates whether or not user retrieved pills. Family member acts accordingly
User
Software
Database (DB)
Dispenser

Changes from HW1

Definition Changes

- We updated our software to a website/web application. After receiving feedback from HW1, we decided to be less vague about the software implementation. There was some lack in clarity of whether or not we would use a mobile application or web appapplication. After some deliberation as a group & with our customer, it was decided that the Hospital Use Case was our starting point and that our other use cases would derive from turning on & off functionality from the hospital application. Also, considering our use group would likely be of an older demographic, requiring a smartphone application seemed like a limitation. We will start with the website/web application, as this will be most applicable to the tools available in the hospital setting & most usable for the older demographic that will likely be served on the consumer side.
- We also made minor adjustments to clarify the authentication & display processes. We will be requiring authentication via facial ID stored within the system. We will also be displaying alerts as notifications & displaying missed doses within a table format to help users as well as medical staff or family members to quickly & easily see when the end user has not taken their pills & communicate with the doctor on how to adjust for the missed doses.
- We removed several hardware details to narrow our scope specifically to our software system per the recommendation from our grader. The scope of the project is limited to the web application, so we will be focusing on this vs. the hardware components supported by this.

Specification Changes

- Again, we had to make some changes to the specifications to incorporate the decision to make this a website/web application. Doing this allowed us to get much more specific about other specifications within the functional requirements, as shown below:
    - We added a UAA service with an encrypted database included for the purpose of verifying users for medicine delivery. This will come into play with our facial recognition piece & will be important for authorizing who can or cannot receive the pills
    - We added info about a database specifically designed to track application data around medications, patient schedules, etc.
    - We got significantly more detailed in how the front & back end communicate with one another as well as they handle communicating data between the two. There's several more details about the system requirements in order to do some of this communication as well.

    - We added a scheduler API to support the alerts system. This application will allow users to input frequency & timing of pill dispenses.
- After showing our prototypes to our customer, we also updated the way in which missed doses would be tracked & displayed. We will now allow these missed doses to be displayed as tables. To help caregivers or family members to quickly view these missed doses, this will be listed in a table for all assigned patients for the user looking at the tables. This user will then be able to sort by patient to only see the missed doses from that individual. This is less about making up missed doses & should only be used to communicate with the patient's doctor on how best to proceed.

Customer Evaluation

Our customer participated in the week's project discussion answering several questions about prototypes and general usability of the software. He has actively helped us design the front end of the application to match his vision.

Our customer accommodated our schedules as best as he could and we had a meeting with him via Slack on Wednesday to go over our paper prototypes. He gave us useful feedback that we will make sure to implement going forward. The customer's feedback included:

- Favoring a web application over a mobile application.
- Define authentication behavior (one account per user).
- Specify how missed dosas should be displayed to the user.

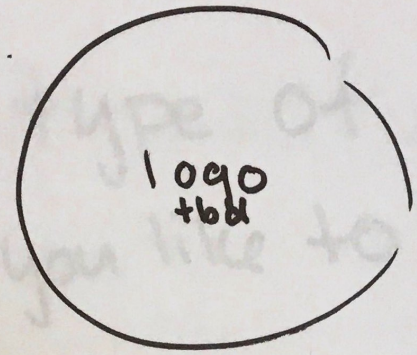
Contribution Summary

The following indicates team member contributions during the project stages leading up to & including HW2:

- All - participated in continuous communication through our Slack channel, worked with our customer to determine expectations for the project, & reviewed/edited final drafts of each individual portion of HW1 into one cohesive submission.
- Mario Bocaletti - rewrote functional requirement definitions and specifications & packaged document and prototypes for submission.
- Henry Clay - completed a set of paper prototypes
- Corey Nielsen - rewrote non-functional requirement definitions and specifications.
- Samantha Tone - completed a set of paper prototypes & documented changes to requirements
- Pavan Thakkar - completed a set of paper prototypes

Prototypes

Login



username

password

Login

Don't have an account?
Register here

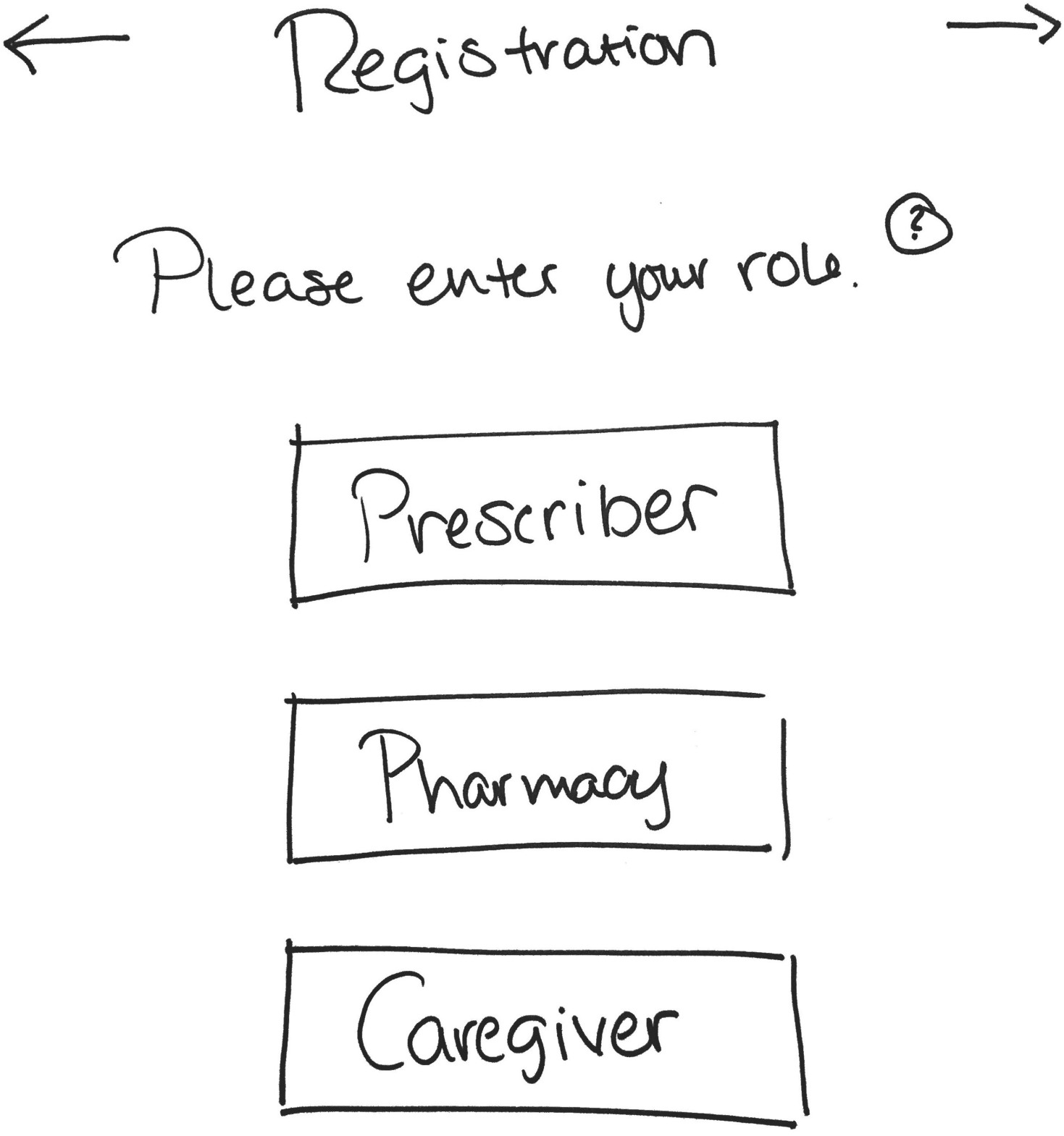
← Registration →

What type of account would you like to create? ⓘ

Hospital / Institution

Personal

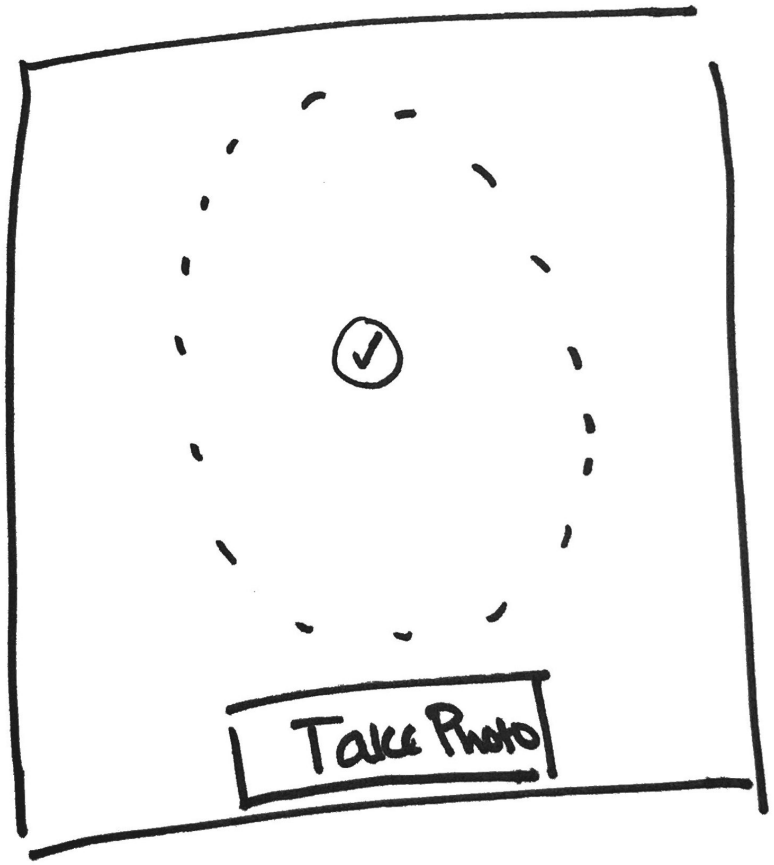
Friend / Family


Registration
Please enter your role.
?
Prescriber
Pharmacy
Caregiver


Registration
Please enter your details
username
email
password
verify password
first name
last name

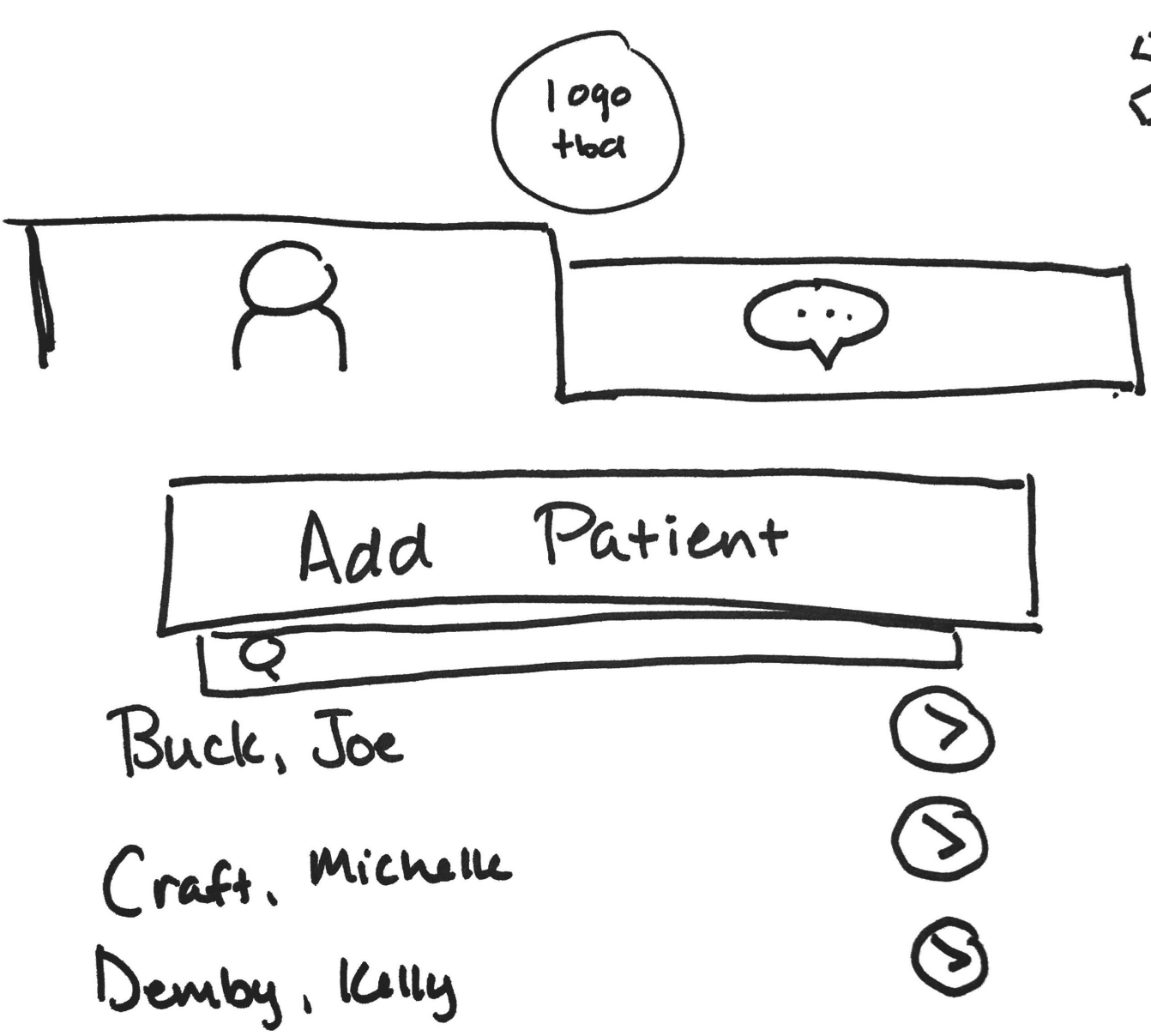
Registration

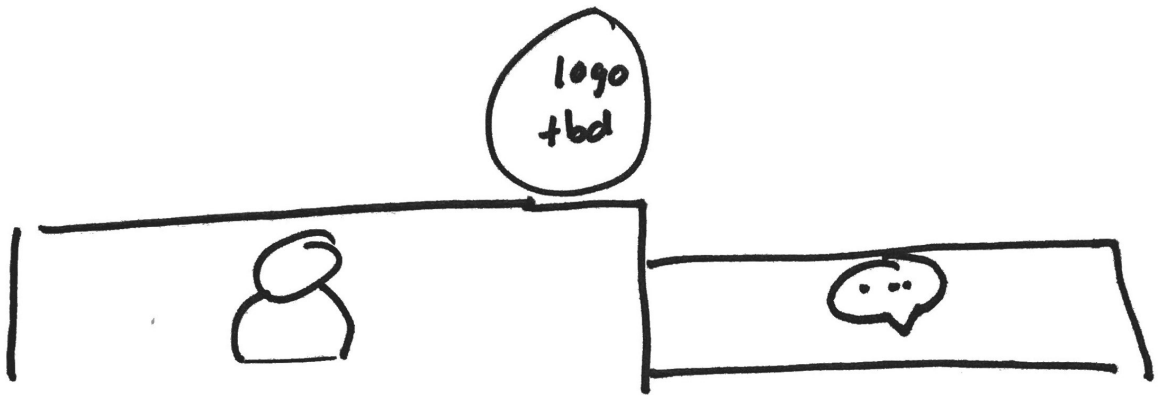
Screenshot your face for facial recognition (?)

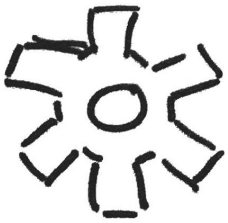


For best recognition

- good lighting
- align face to circle
- wait for ✓


logo
tbd
Add Patient
Buck, Joe
Craft, Michelle
Demby, Kelly

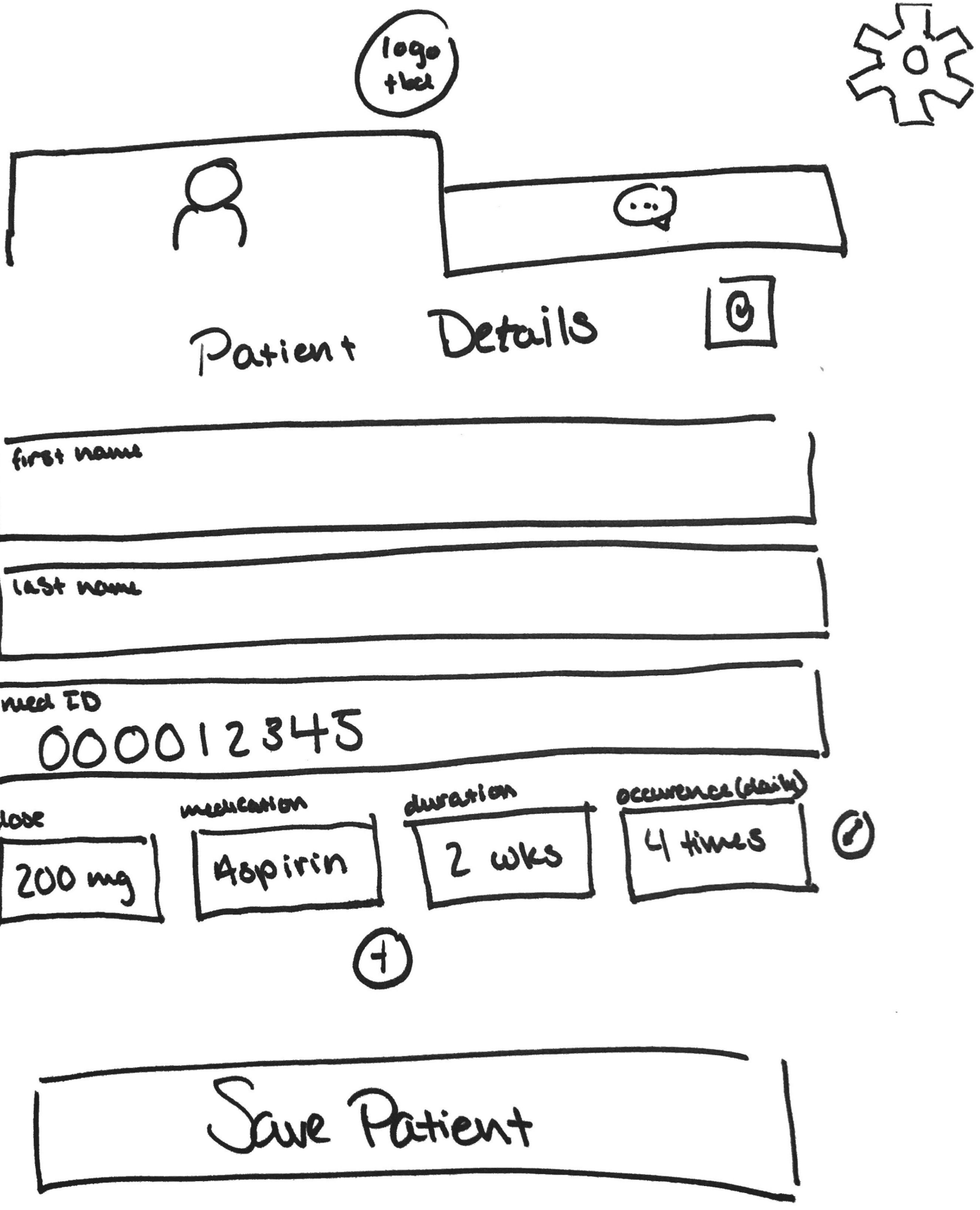


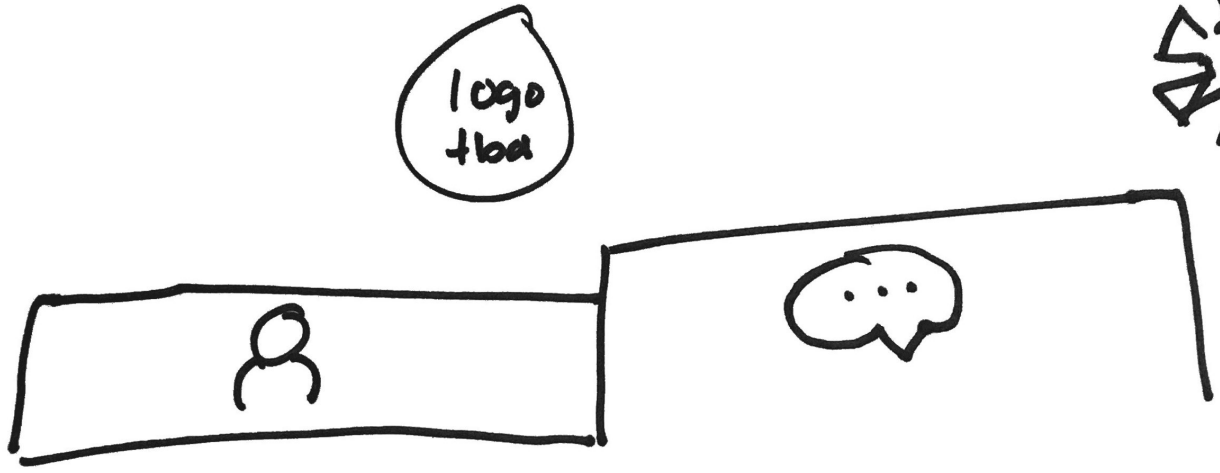


Buck, Joe

Add Medication

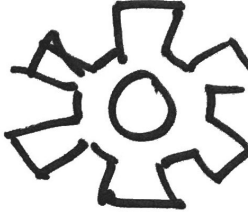
200mg Aspirin 4 days 4 times daily

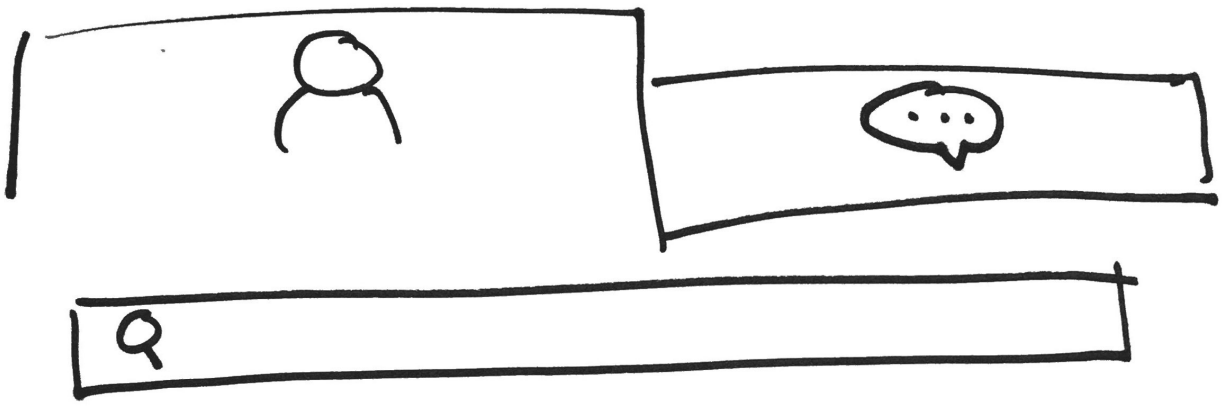

logo
that
Patient Details
first name
last name
med ID
0000012345
dose
200 mg
medication
Aspirin
duration
2 wks
occurrence (daily)
4 times
Save Patient



- Buck, Joe will have an Aspirin prescription expiring on 11/11/19. Would you like to update his prescription? (X) (>)

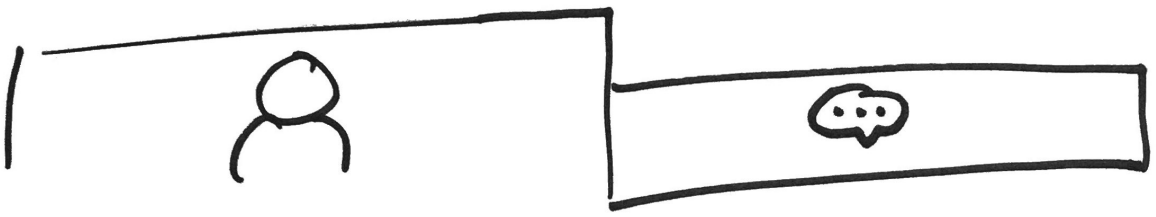
- Craft, Michelle will not be able to fill here prescription Penicilin. Would you like to recommend a different medication for her? (X) (>)





Buck, Joe
Craft, Michelle
Dewley, Kelly

logo tbd



Buck, Joe

200 mg Aspirin

10:10 | 12:10 | [redacted]:10 | [redacted]:10

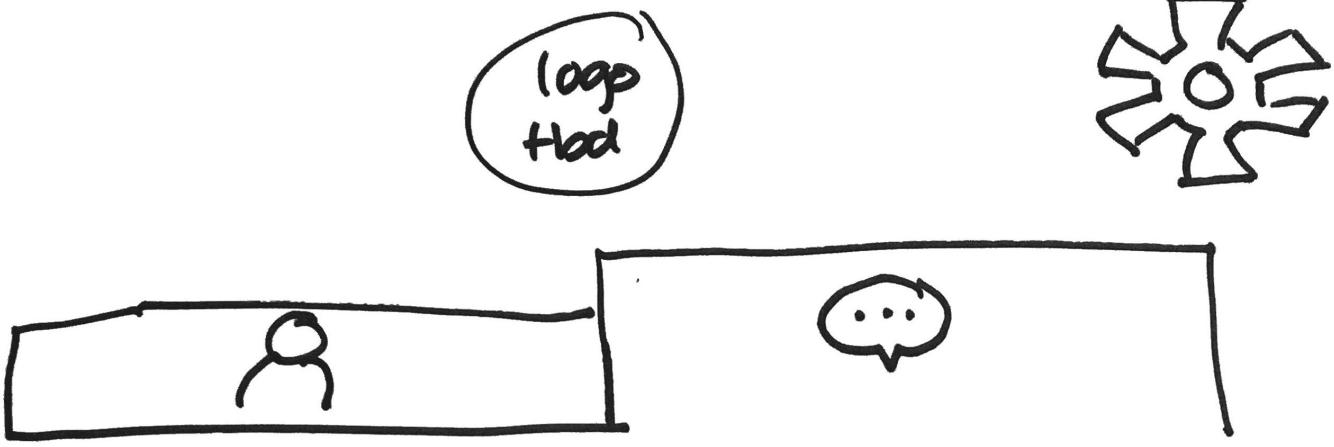
100 mg Penicilin

10:10 | 4:10

50 mg Tylenol

? | ? | ?

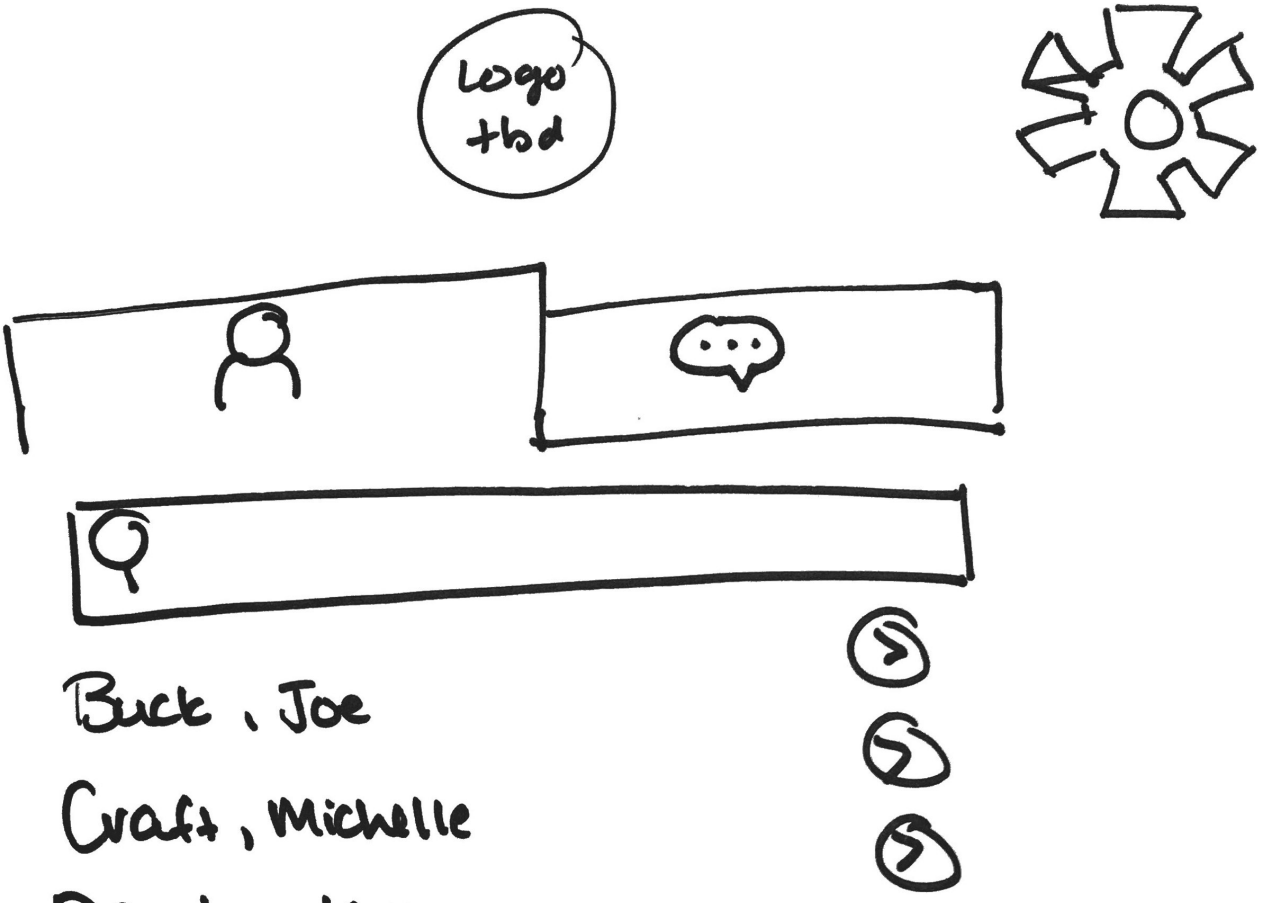
Enter Pill Dispenser ID

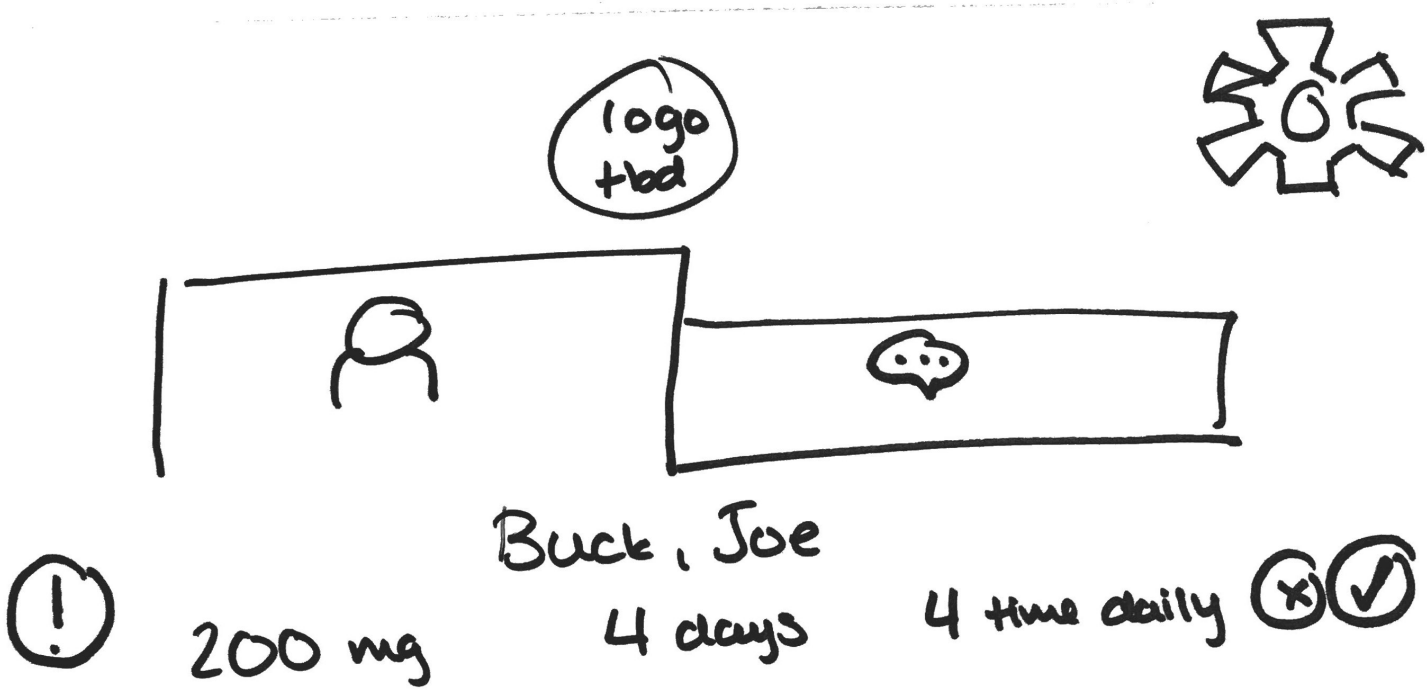


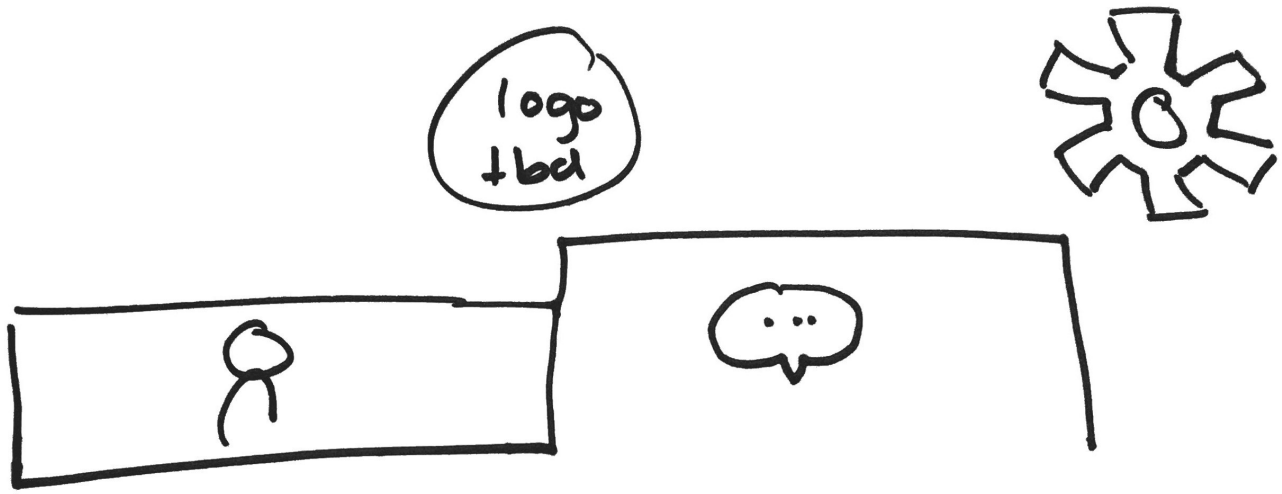
- Buck. Joe has been given a new prescription. Please add delivery time

- Craft. Michelle missed her 10:15 200 mg Penicilin

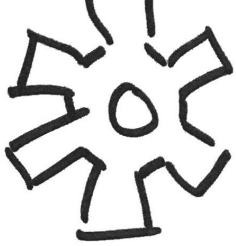
- Demby. Kelly has been added to a pharmacy queue. Please add pill dispenser


Logo
tbd
Buck, Joe
Craft, Michelle
Demby, Kelly


logo
+bcd
Buck, Joe
200 mg
4 days
4 time daily



- Prescription submitted for Buck, Joe. Please deliver to Pill Dispenser #1 0000054891 (X) (✓)



ALERT!

Delivery for Buck, Joe

- 200 mg Aspirin

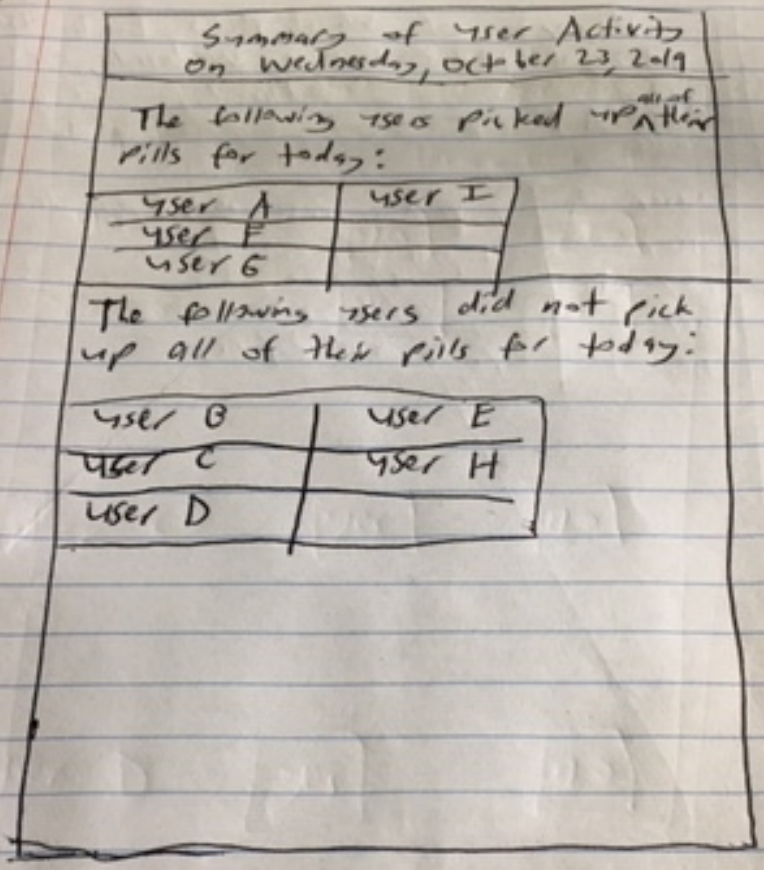
Pill Dispenser #0000004561

Confirm with Facial Scan

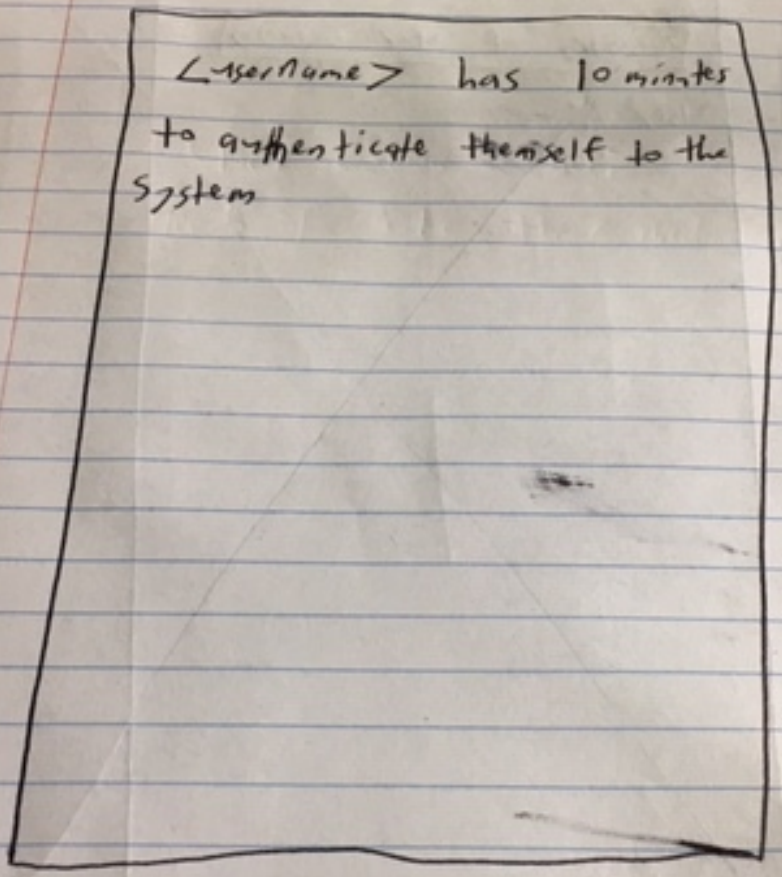
Report of which pills Each user Forgot to collect on wednesday, October 23, 2019

User B	2 pills metaformin, 1 pill advil
user C	4 pills vitamin d
user D	5 pills xyz, 1 pill blahblah
user E	1 pill lipitor
user H	3 pills amlodipine

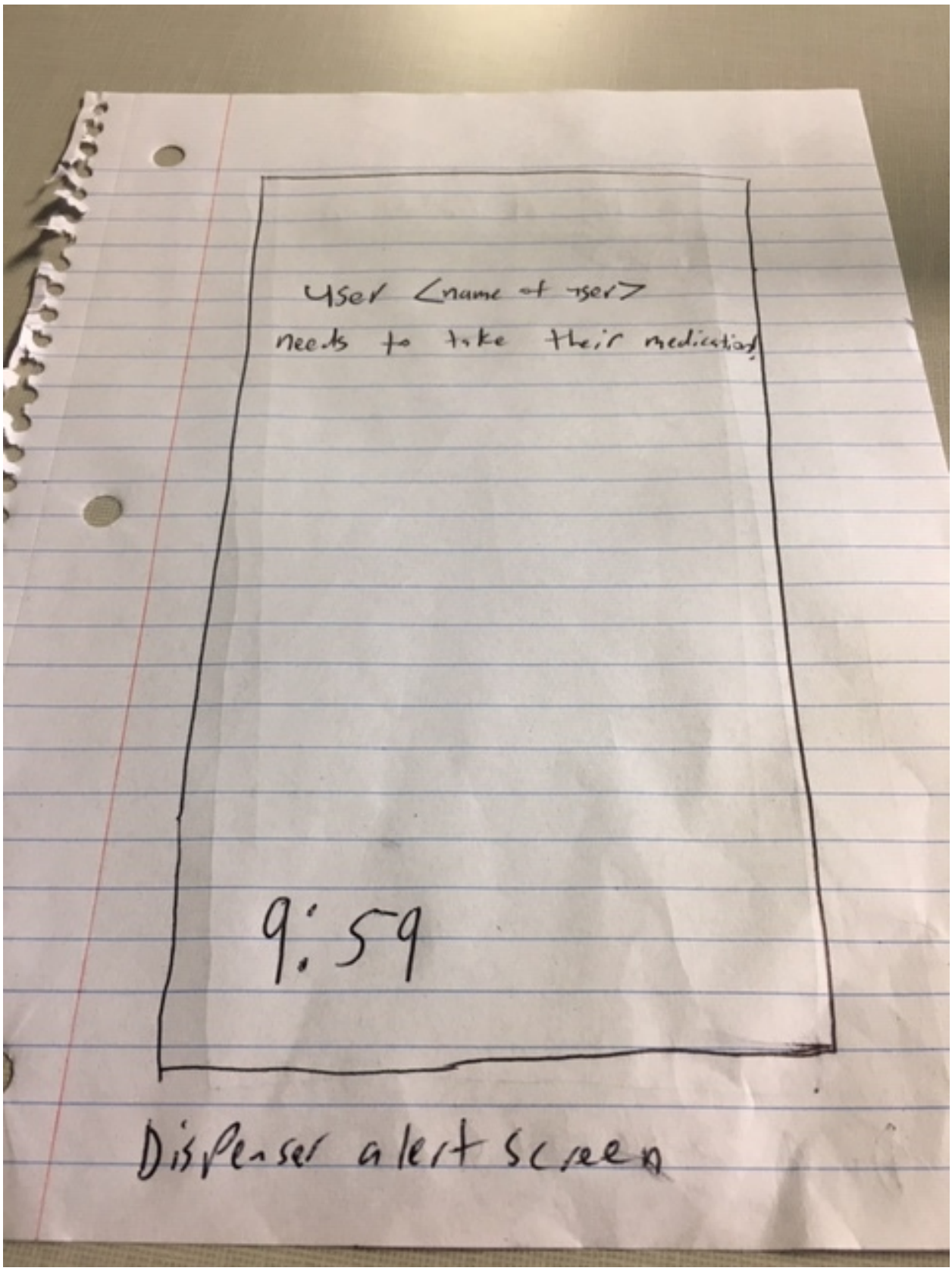
Dispenser reporting what pills still needed to be taken by users who forgot to pick up pills from the dispenser. This is accessible to both the users and their designated family members



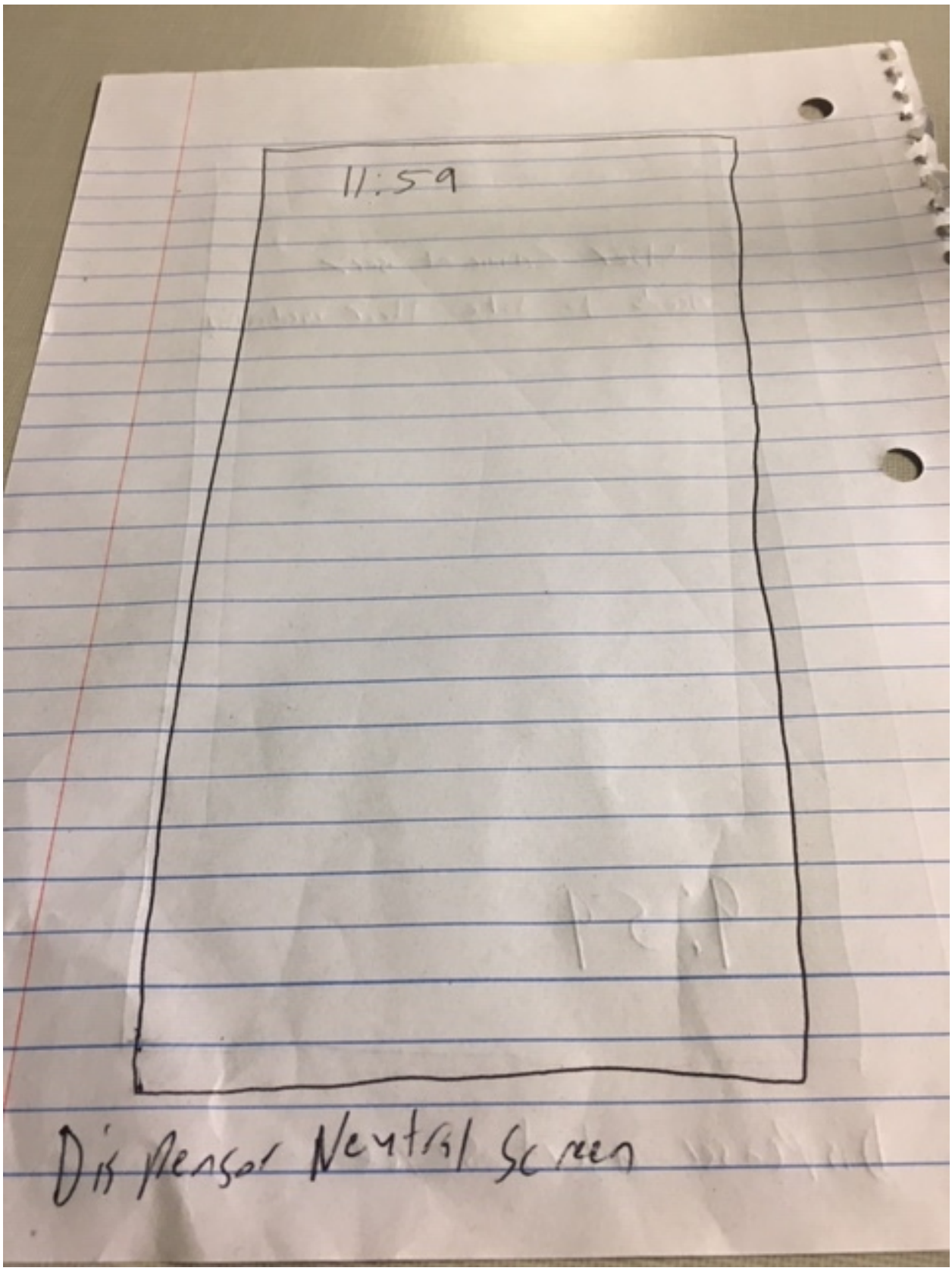
Dispenser's recordings of whether or not users picked up all of their pills for the day. This is available to both the users and their designated family members once authentication is provided

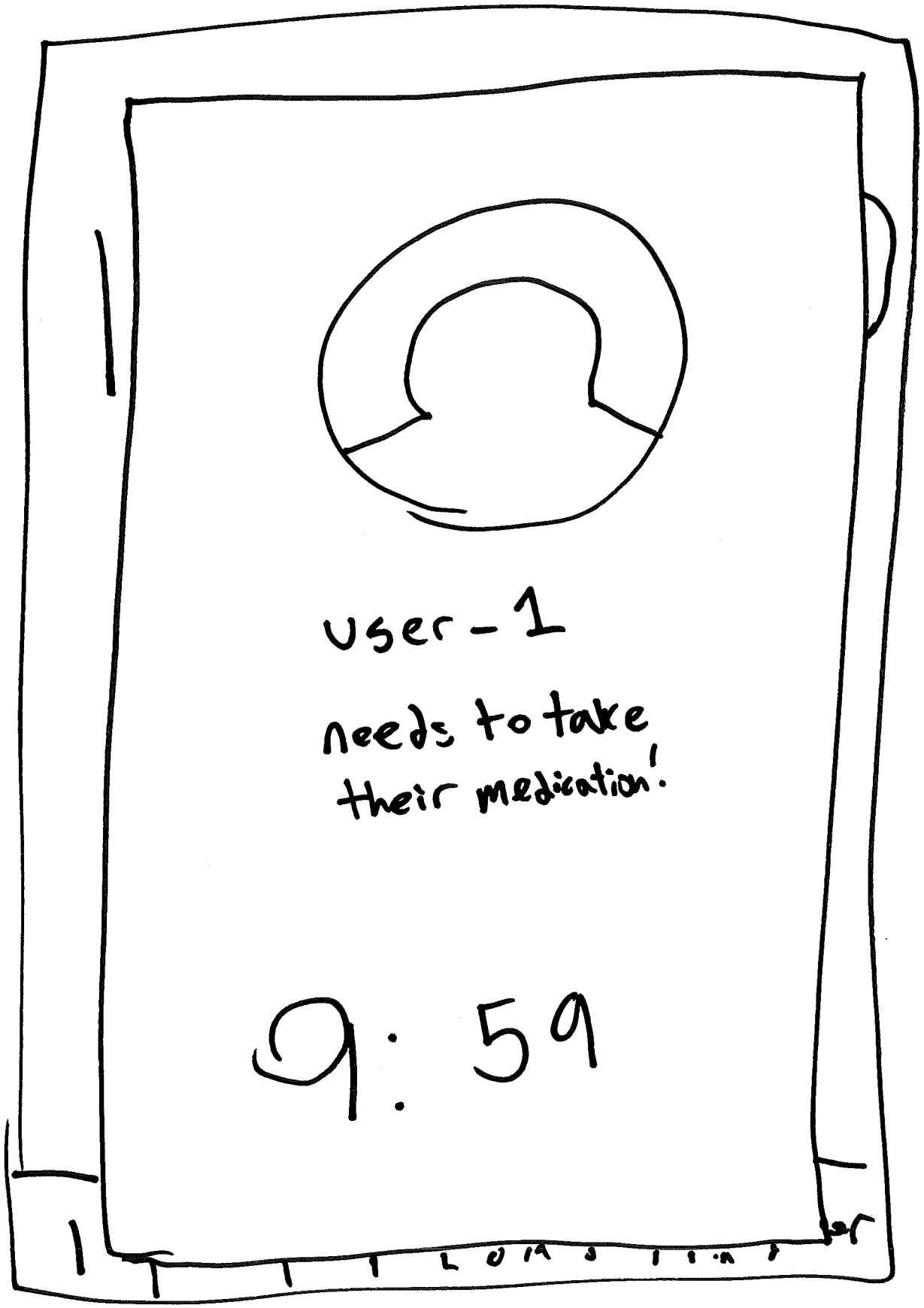


Dispensor time countdown, starting at 10 mintes, for user to authenticate that they are the person intended to receive the pills

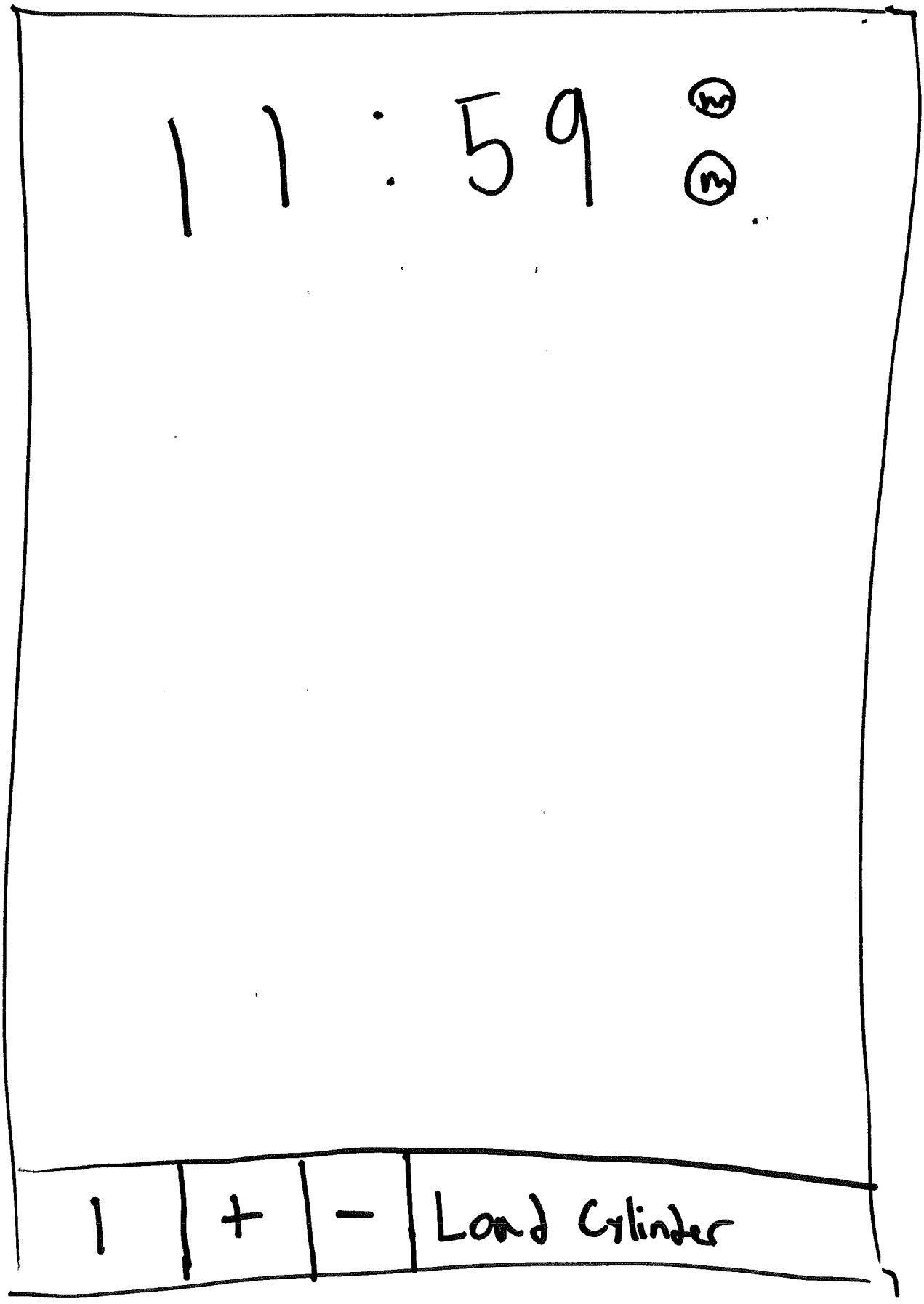


Dispenser alert screen

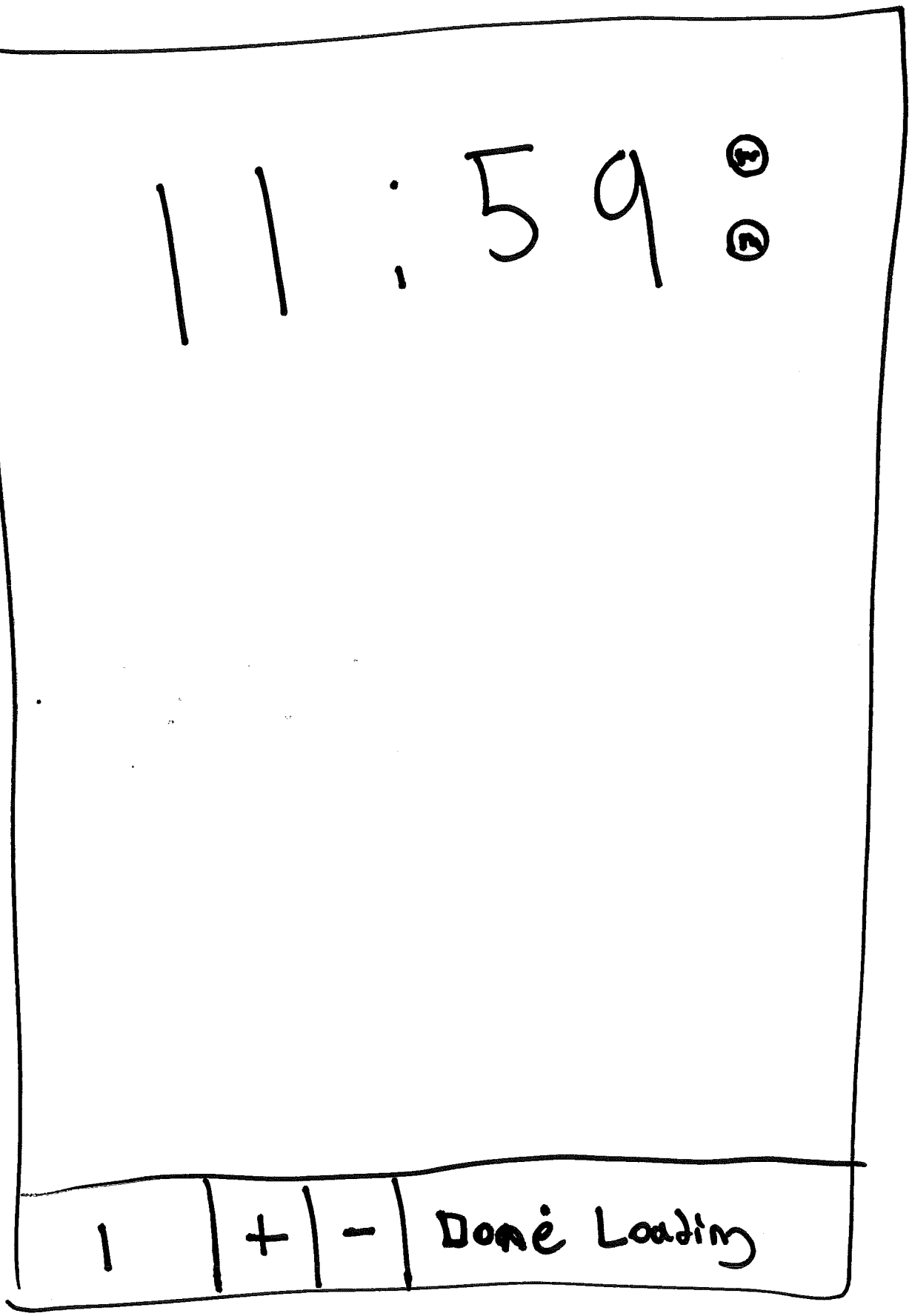

11:59
Dispensor Neutral Screen



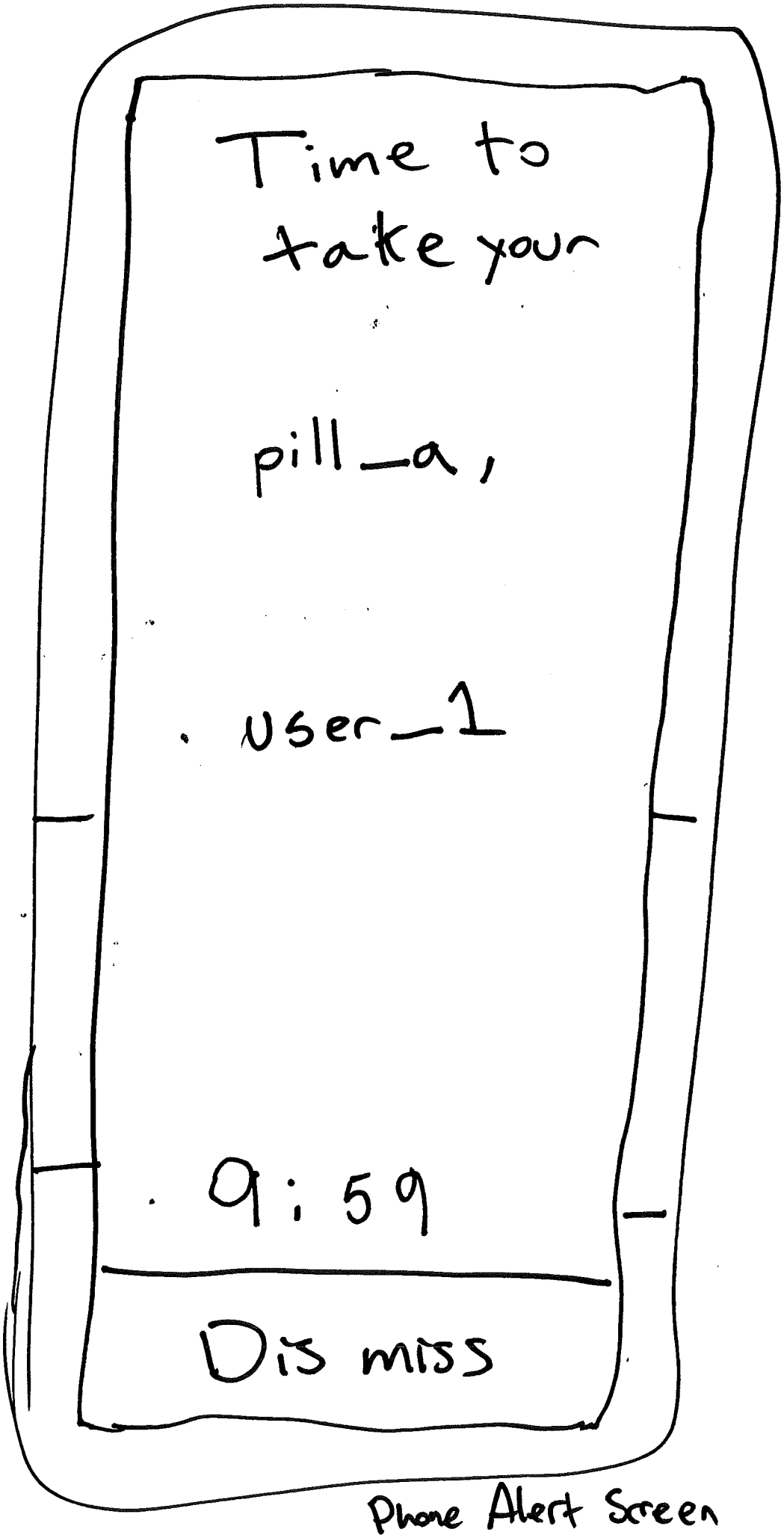
Dispenser Alert Screen



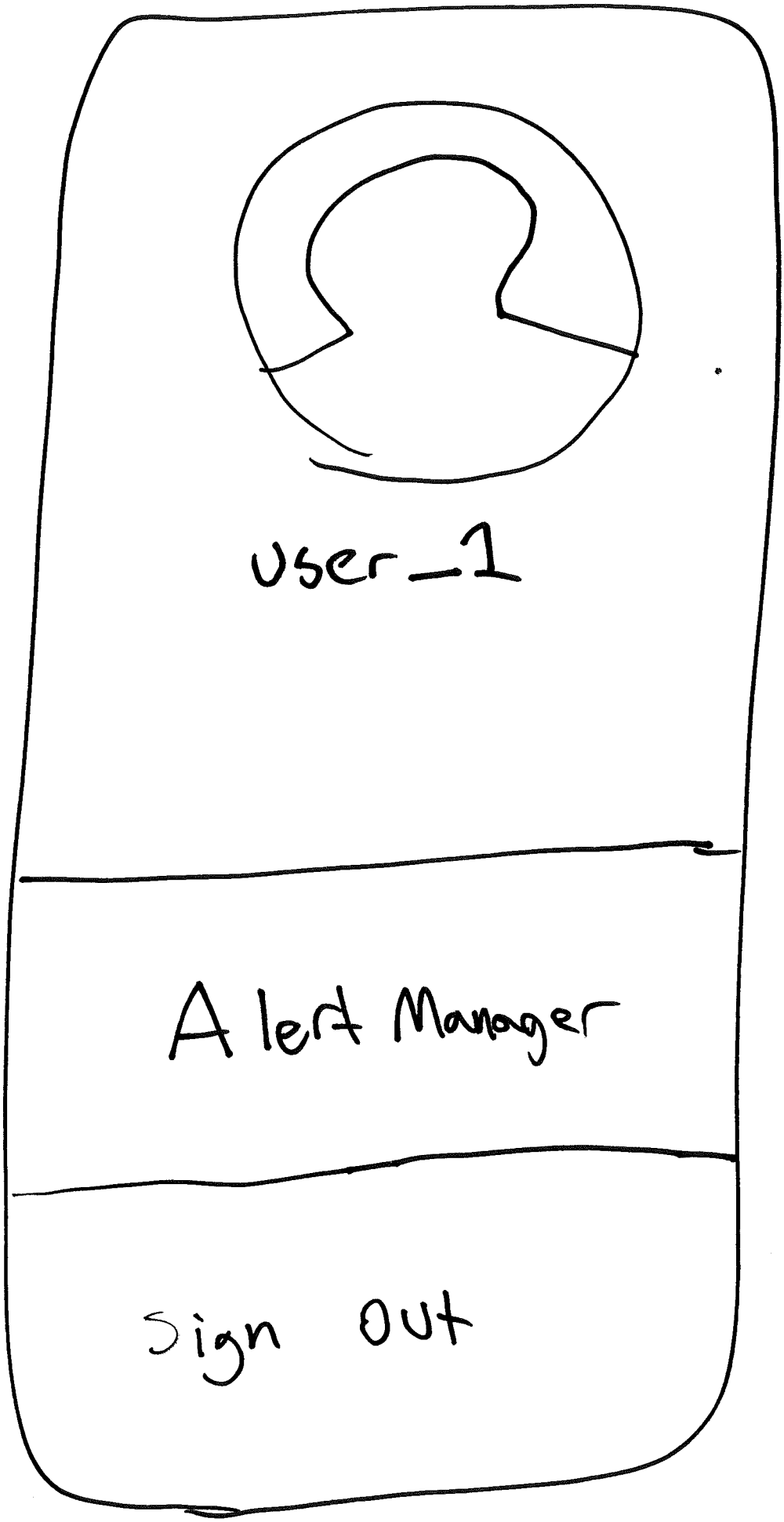
Dispenser Neutral screen



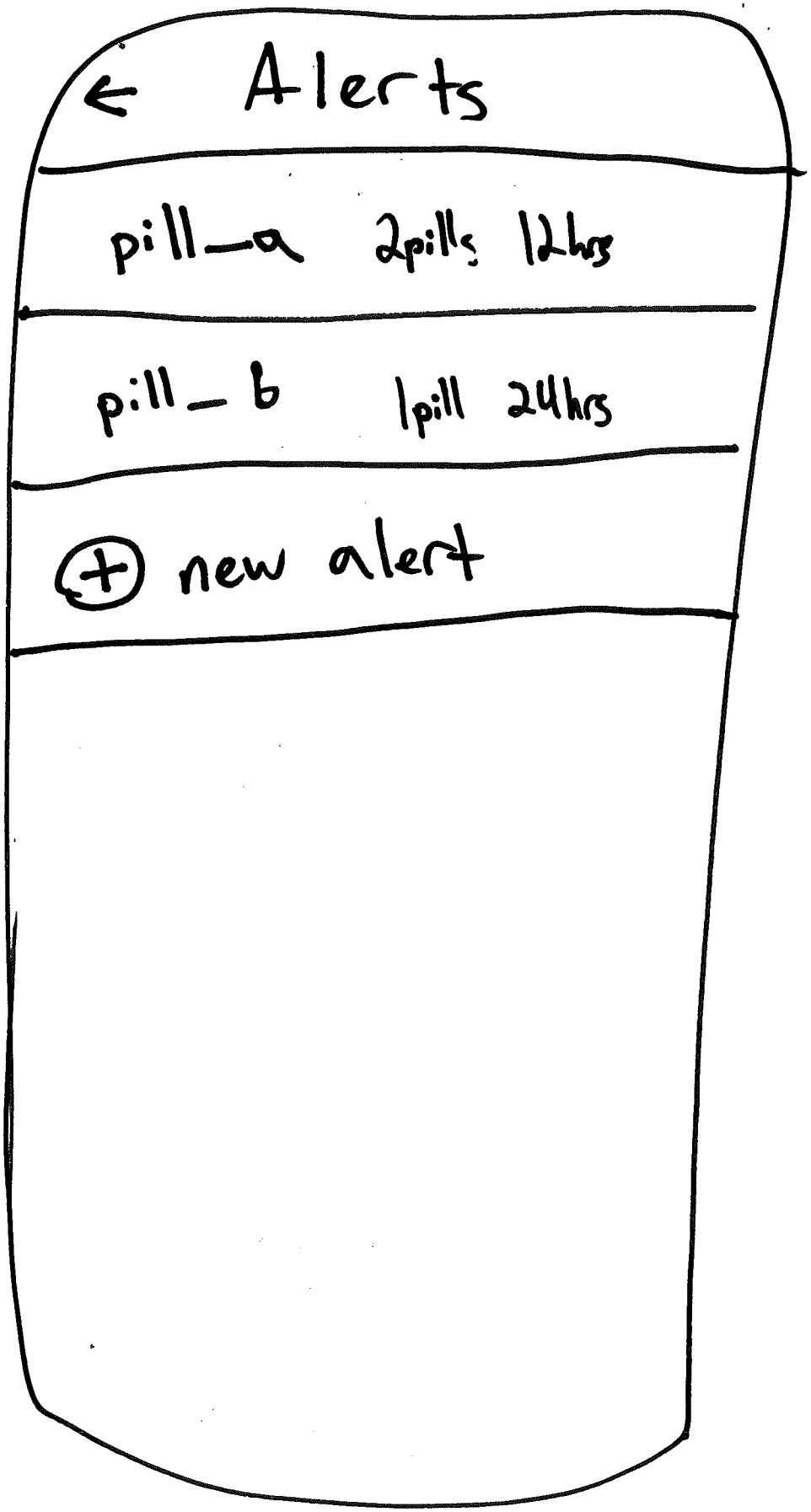
Dispenser load pills screen



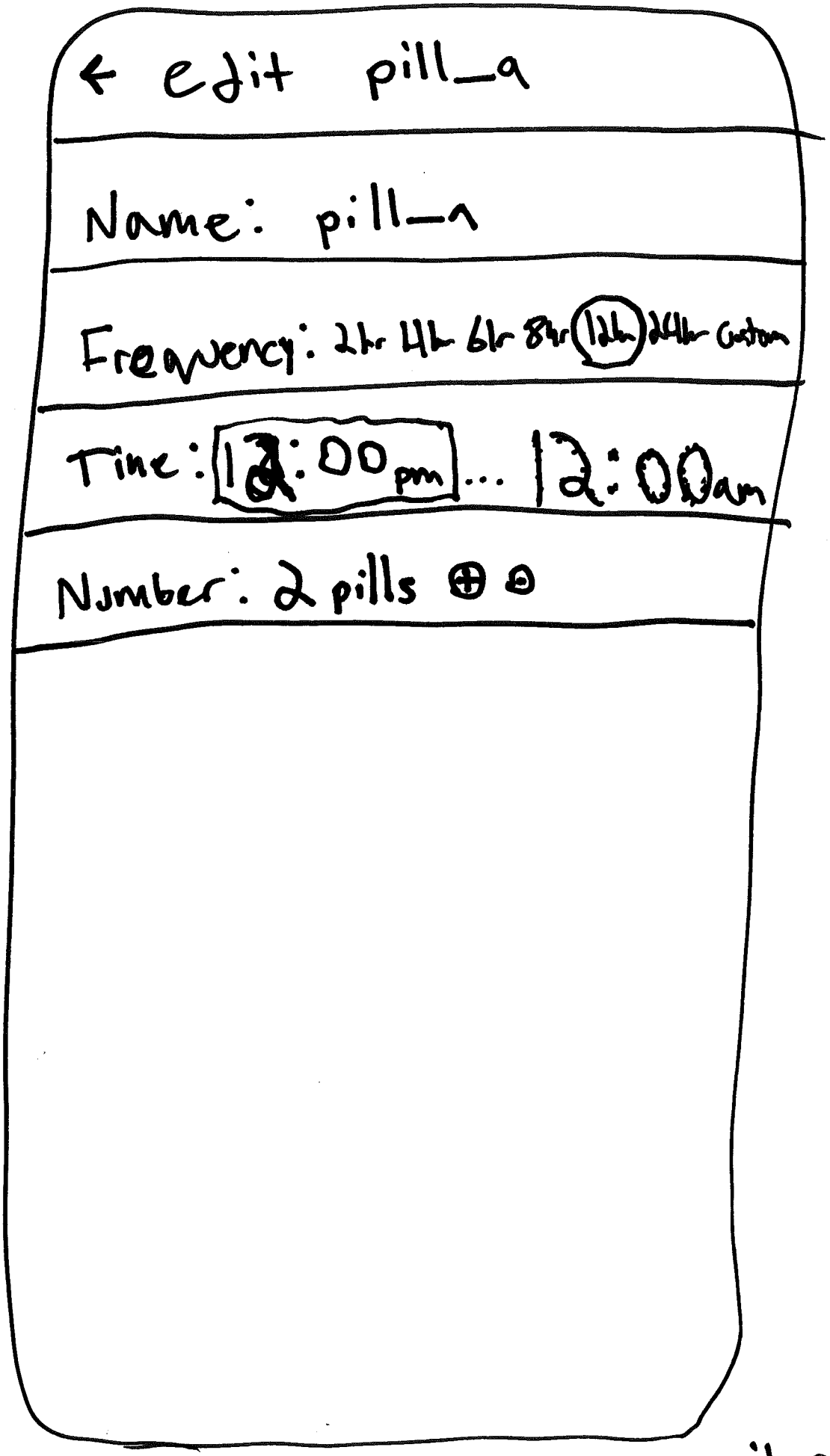
Phone Alert Screen



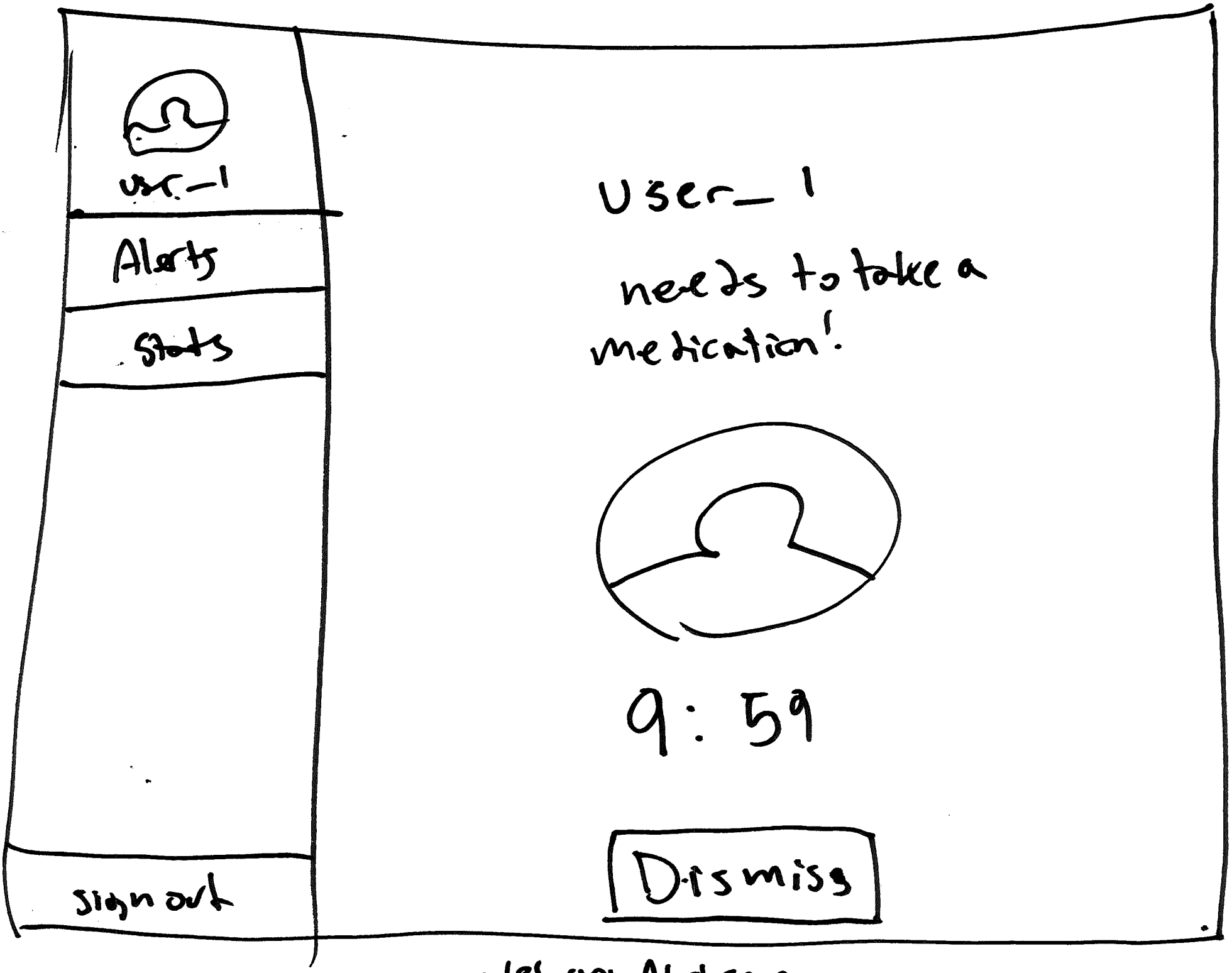
Phone App Home



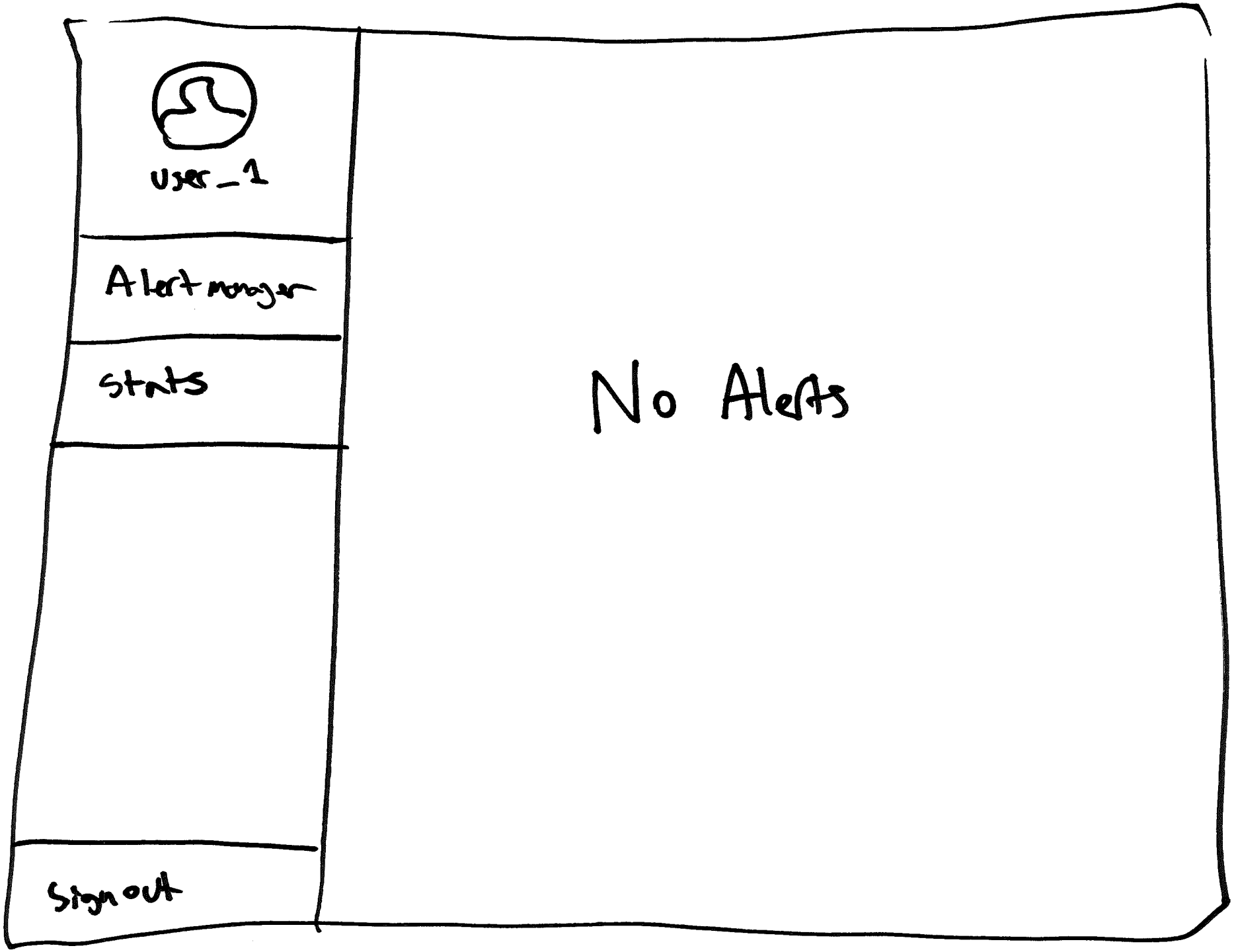
Alerts ~~edit list~~ Screen



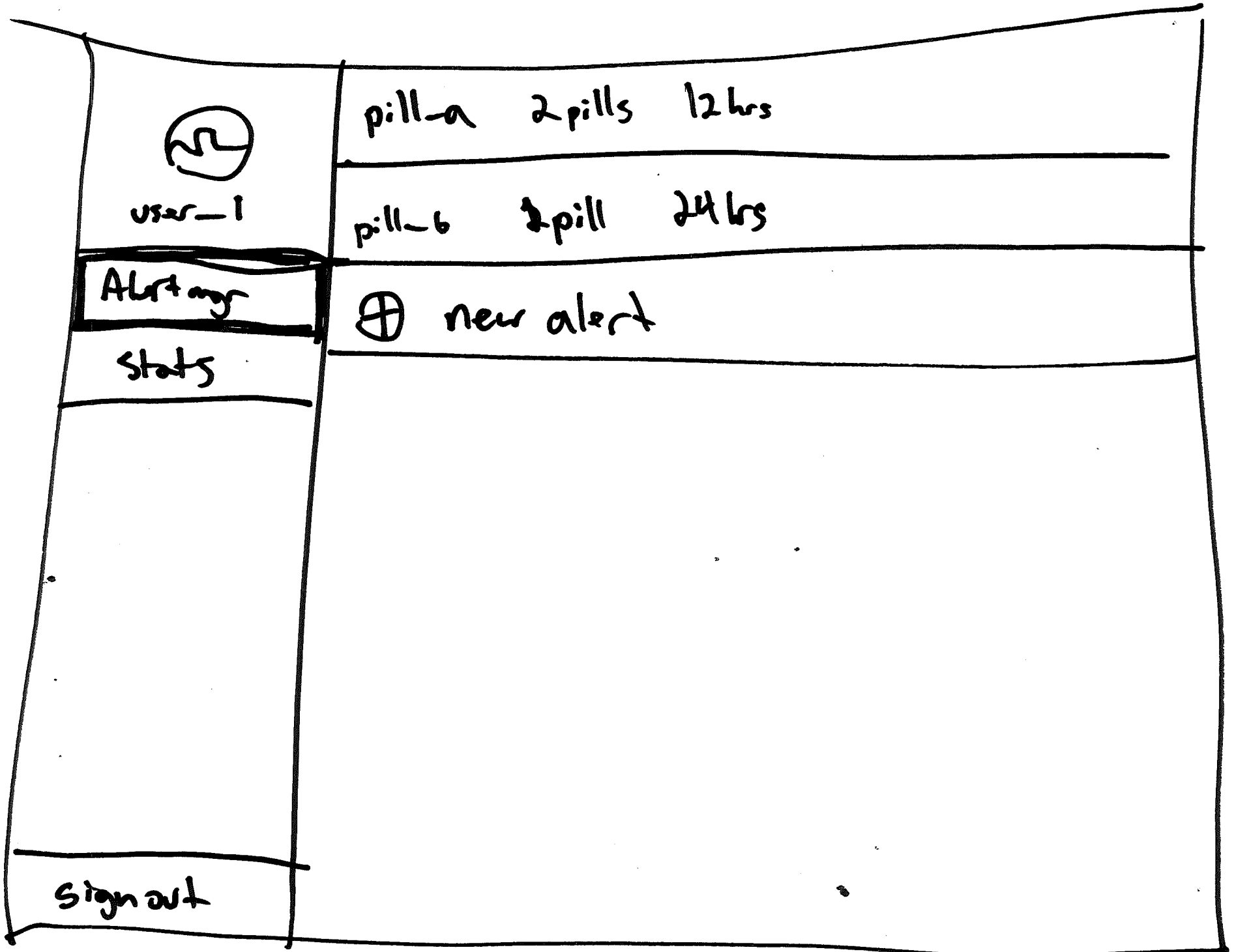
medication alert editor



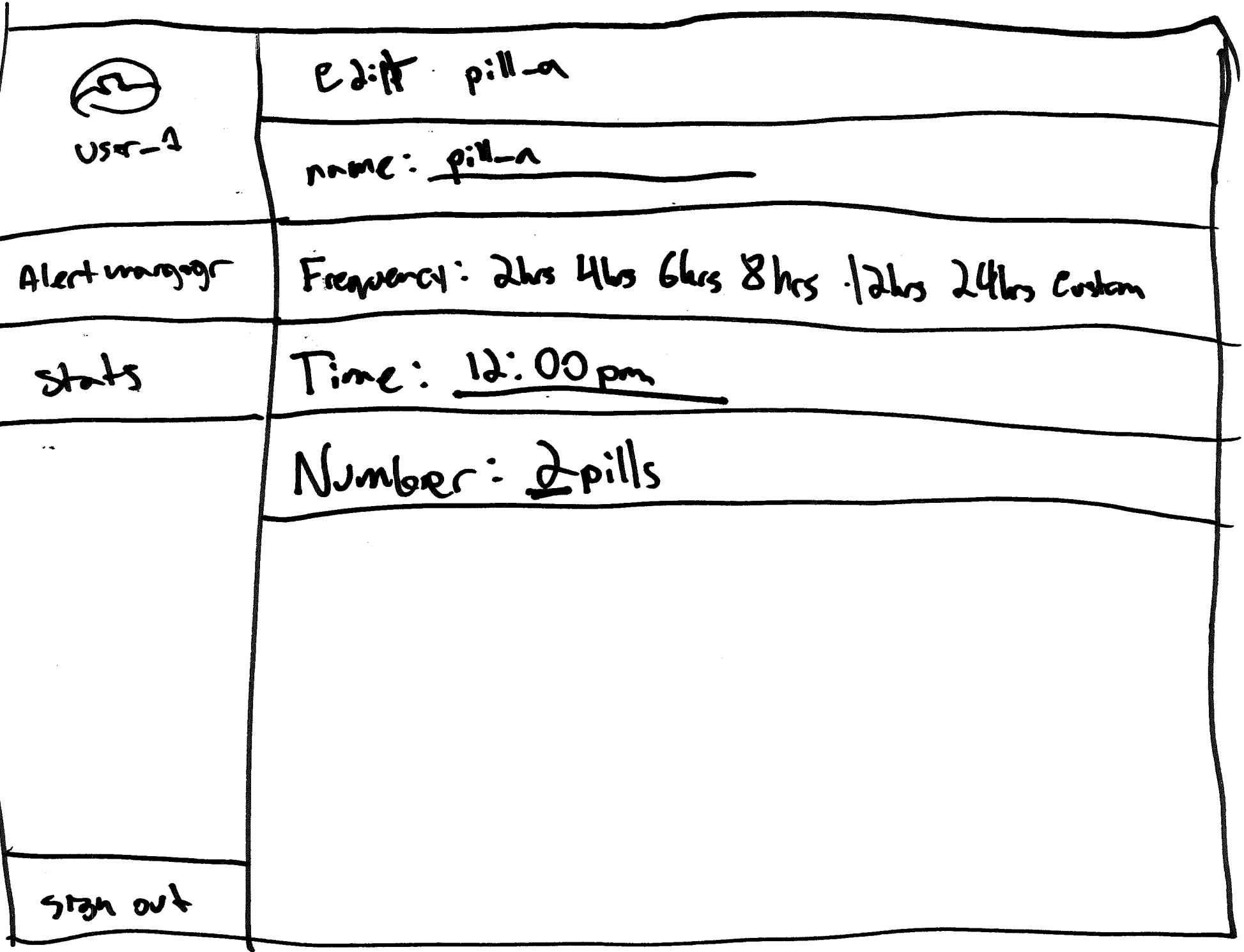
web app Alert screen



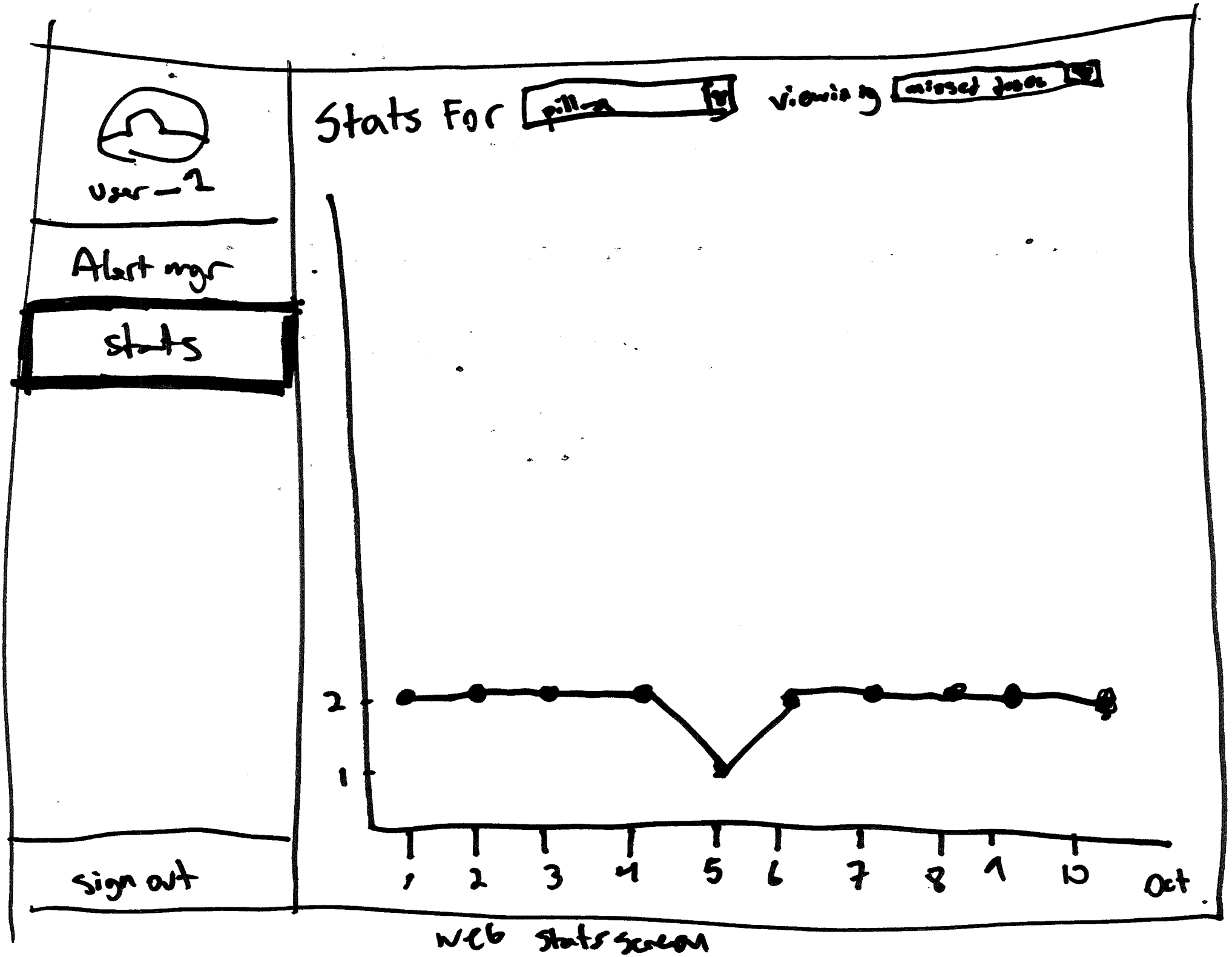
web app home



web app alert list screen



web edit screen



Web stats screen