# H.T.M

**Hadassah Traffic Management**

A system that manages and optimizes work processes in the hospital in real time

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# Table of Contents

## 1. Introduction

In the following sections we will describe the problem and the goals of the system.

### 1.1. Overview

H.T.M is a system that manages and optimizes work processes in the hospital, by creating personalized queues for the medical staff to go through the patients. The system is aided by a virtual assistant and independent service stations scattered in the various departments that help reflect to the patient the processes he goes through and allow him to spend his waiting time more efficiently.

### 1.2 Problem Description and Motivation

It is a known fact that the issue of overcrowding in hospitals is one of the core problems of the Israeli health system. This problem has intensified several times during the Corona crisis. Dozens of patients wait a long time, the nurses and doctors cannot cope with the load, which directly affects the patients and the morale of the medical staff.

### 1.3 Goals

The aim is to reduce the workload of the medical staff in the different departments, clinically, logistically and the personal level.

- Calculate and display the possible patient quota for that given moment in the departments.
- Management of each patient and assisting him in orientation in the hospital area.
- Sending alerts according to the hospital's load conditions, to the relevant managers and providing recommendations for dealing directly with the load.
- Monitoring of the medical and logistical equipment, if a certain equipment is approaching a shortage, a request is sent to the warehouse or sterile supply that it is necessary to bring more equipment.
- Performing an initial diagnosis for a patient who has not yet arrived at the hospital, and passing the information on to the medical staff in the department to which he intends to go.

### 1.4 Scope

Health Care Systems

### 1.5 Glossary

- ER – emergency room is a department in the hospital that provides primary medical care to patients due to illness or symptoms that require immediate treatment.
- ERP – enterprise resource planning it is a type of information system used for administrative data processing.
- Call day/ duty day– Due to the fact that there are several large hospitals in Jerusalem, it was decided that there would be a daily shift in which each hospital would serve as a duty hospital to which all patients are transported to.
- OTP – one time password
- V.A/virtual assistant – is a software agent that can perform tasks or services for an individual based on commands or questions.
- sterile supply – an integrated place in hospitals that performs sterilization on medical devices, equipment and consumables

## 2. General description

In the following sections we will present the stakeholders, users and system components we divided the users into 3 levels: clinical, logistic and personnel.

### 2.1. User Characteristic

#### 2.1.1. Stakeholders: Client Description
Hadassah University Medical Center includes two university hospitals in Ein Kerem and Mount Scopus in Jerusalem. Owned by the Hadassah Women's Organization in America, the organization was founded on March 3, 1912 in New York.

#### 2.1.2 End-Users Description and Scenarios



**Audi**

70 years old, grandfather of 7 grandchildren and 3 great-grandchildren, retired, lives in the French Hill in Jerusalem.
Suffers from medical problems and recently had to visit the hospital many times.
Audi feels frustrated that he has to wait a long time between tests without knowing where he currently stands. and that he can't find his way around the hospital alone.
**Scenario:**

On his latest visit to the hospital Audi felt unwell and went to the ER in Ein Kerem after receiving his forms and visitor number while waiting for the doctor Audi used the newly installed self service station he entered his Personal Information and the virtual assistant popped up,
The virtual assistant displayed to Audi in which department he is right now, the current estimated wait time and where he is on his personal tracker.
the v.a then offered Audi to use the new "first diagnosis" fetcher in which The v.a asks a series of questions, at the end of which he sends the doctor a preliminary summary of diagnosis and treatment options accordingly, thus optimizing the process when Audi meets the doctor.
After a quicker than usual diagnosis from the doctor thanks to the v.a
Audi is sent to the imaging department In order to undergo an X-ray.
Audi then uses the navigation option on the self service station he then presses the desired department if he is not in that department yet a map with directions will open up, when Audi half way there, forgot the path he once again approached a nearby self service station and the system showed him the updated correct path.
once Audi is done with his visit the he then via the virtual assistant sets a new appointment for him for the continuation of his medical process.

## Amira

30 years old, married +1, lives in Rehavia. Studied medicine for 5 years in Italy and returned to Israel
This is her second year as a Hadassah intern in the emergency department
As an intern, she experiences great difficulty in shifts due to Overload of patients, long shifts and multitasking. She is looking for a way to streamline and ease her work so that she can return to her family sooner.

## Scenario:

A day before Amira starts her shifts she enters the new H.T.M system and presses on her shift chooses accompany doctor the system then asks her if she has a preference to be assigned to a particular doctor on the upcoming shift, Amira presses yes and writes the name of the doctor she wishes to be assigned to today.
After a day when Amira starts her shift she enters the new H.T.M system and get a notification that the doctor agreed.
She then enters the page that checks the percentage of capacity right now, afterword she sends a request to the system to build for her the best and most efficient way to go through the patients,
The system calculates the best possible workflow for her and displays it.
while taking care of a patient named Audi Amira uses the app to see his medical history she also sees that he used the "initial diagnosis" through the v.a, she then presses to see the v.a summary of diagnosis and treatment options accordingly, it has confirmed her suspicion and after another evaluation with the doctor Amira moved Audi through the system to the Queue in imaging department and asked him to go there in order to undergo an X-ray.
throughout her shift when a life threatening case come in the system changed Amira's current work flow accordingly.

## Hana

Married, 44 years old with 5 children, lives in Mevasheret Zion, Jerusalem
She has been working as a secretary for 12 years in the imaging department at Hadassah Ein Kerem.
Hana Finds herself in most of her working hours mainly dealing with queue management in the care of guests and visitors due to the sheer number of patients
While also needing to call and nag the other departments to bring over the patients to get an image
she is unable to access the rest of the tasks she has to take care of in her job.

## Scenario:

Hana arrives at morning to the hospital she logs in to the H.T.M system
the system checks the lists of patients that are supposed to arrive for an M.R.I, C.T and X-ray today.
in case of cancels the system rearranges the lists, and display's to Hana the new lists and whether or not she wishes to input some changes, Hana adds a few new patients for today and approves the list.
due to the hospital being on duty day today Hana enters the department capacity tab in the system and edits the quota of medical staff today, checks V on duty day and saves by doing so the system may monitor the cause of the workload and act accordingly.
In addition while Hana is busy with another assignment, the system makes sure to remind another department that they must bring a patient who is there to the MRI by sending alerts that can only be canceled when Hana has confirmed that the patient has arrived at the department.
and at the end of her shift once the Stock count of medical equipment is finished, she enters the H.T.M system how much is left and depending on each equipment threshold the system will send a notification to the warehouse or sterile supply that there is a need of more supply.

## 2.2. System Perspective
The system properties are as follow down below

### 2.2.1 Software
code, the program.

### 2.2.2 Hardware
Smartphones, Tablets, Desktop, Hospital Servers, Network infrastructure,

### 2.2.3 Data and Information

| Patients | |
|---|---|
| **Data** | **Information** |
| <ul><li>Name</li><li>ID number</li><li>A serial number given to the patient at the reception</li></ul> | <ul><li>Medical information</li><li>Queue details</li></ul> |
| Hospital Staff | |
| **Data** | **Information** |
| <ul><li>Name</li><li>ID number</li><li>shift time</li><li></li></ul> | <ul><li>Schedules</li></ul> |
| Logistics | |
| **Data** | **Information** |
| <ul><li>Sterile equipment</li><li>Medical equipment</li></ul> | <ul><li>Inventory</li></ul> |

### 2.2.4. Processes

**1. Adding to the queue**
      a. Logging to the system
      b. Selecting the desired department
      c. Enter patient details
      d. Choosing a form of admission either medical urgency or a specific time

**2. Building an optimal route for queue handling**
      a. Logging to the system
      b. Selecting the desired department
      c. Press build a work route
      d. Click edit Route
      e. Edit the route and adding breaks

**3. Patient capacity monitoring**
      a. Logging to the system with normal user or administrator in case of edit
      b. press to view the current capacity
      c. press on Edit Capacity Details accordingly
      d. press on either number of patients, number of nurses, number of
         doctors, number of interns, number auxiliary staff
      e. press yes or no if the Hospital on duty day

**4. "Initial diagnosis" with the help of a virtual assistant**
      a. On the Tablet/smartphone press v.a
      b. press on either voice option or no voice
      c. ask/press on initial diagnosis
      d. the v.a asks a series of questions, with mainly answers of yes or no
      e. the v.a asks if the patients has something else to add
      f. at the end the v.a puts in the patients personal information tab, a
        preliminary summary of diagnosis and treatment options accordingly to the
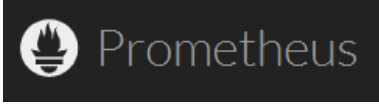        medical staff eyes only

2.2.5. **People**

The Hospital facility, The Hospital patients

**2.3 Market Survey**

There are several computerized systems for hospital management on the market

| CHAMELEON | Prometheus | הדסה שליו הייעוד הרפואי שלי |
|---|---|---|
| A system that Ichilov and Hillel Yaffe Hospitals uses<br>**Advantages:**<br><ul><li>Software that helps you manage integrated ERP in real time</li></ul> | A system that Rambam Hospital uses<br><br>**Advantages:**<br><ul><li>Prometheus is a free software application used for event monitoring and alerting</li></ul> | System for Hadassah patients<br><br>**Advantages:**<br><ul><li>Accessible to any user</li></ul> |
| **Disadvantages:**<br><ul><li>No queue management</li></ul> | **Disadvantages:**<br><ul><li>It is very broad and does nit meet the hospital specific requirements</li></ul> | **Disadvantages:**<br><ul><li>There is no dedicated app</li><li>When setting appointments, there is no estimation when my appointment will be scheduled</li></ul> |

- In addition, we found that there is a "NMR" system
  -a computerized system that assist in the management and execution of administrative and clinical operations.
  in 11 governmental hospital.

- We found an application of Hadassah called "Hadassah intra-structural navigation" – this is a terrible app for navigation, that does not meet today's standards.
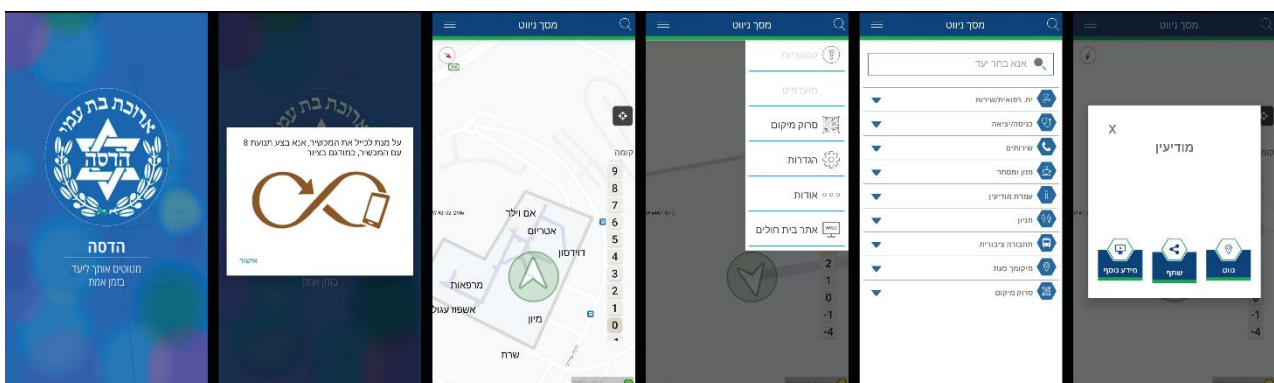


**In conclusion:**
we found many different systems, but we have not found a system that handles queue management efficiently and integrates into it all the capabilities of our system.

## 2.4. The approach

Below is our approach to the solution of the existing problem that the H.T.M system provides.

The H.T.M system is a smart system that helps to manage and optimize hospital processes mainly queue management.

- The medical team provides real-time monitoring of the patient, monitoring of logistics, monitoring of appointments.

- Patient - direct access to his medical file, making an appointment without waiting for a medical secretary to get back to him, consultation with a virtual assistant who can give an initial diagnosis as well as adequate answer also allow easy access to Navigation inside the hospital

## 2.5. Constraints

- The patient using the system should be at least once at Hadassah Hospital, whether it is in the emergency department, hospitalization or the various departments.
- The system for arranging and managing the queue will be enabled if there is at least one patient

## 2.6. Assumptions and Dependencies

- The patient's medical information exists in the system
- The virtual assistant has direct access to medical data
- All the medical equipment data exists in the system

## 3.Functional requirements

Below are the functional requirements in the system, the requirements are divided according to the types of users in the hospital and marked by their importance using the MoSCoW system.

### <u>Hospital staff</u>

<u>M - logging in to the system:</u>

- Enter the user information
    - ID Number
    - Phone Number
    - receive an OTP
- In case of wrong details an error message will be displayed
- In case the user does not exits an error, message will be displayed

<u>M – Adding to the queue:</u>

- Press choose a department
- toggle the list of departments and press the desired one
- set the patient name
- set the patient age
- set the reason for arrival
- set arrival time and date
- generate a specific patient number
- press medical urgency
- toggle between High, Mid, Low and press the appropriate choice
- calculate queue position based on above details

<u>M – queue edit:</u>

- Press the department button
- toggle the list of departments and press the desired one
- press the display the queue
- press on one of the slides in the queue to display the patient information
- press edit
- set the patient new medical urgency
- press on move to another department queue
- choose between a complete move or for a limited time
- toggle the list of departments and press the desired one

<u>M – release from the queue:</u>

- Press the department button
- toggle the list of departments and press the desired one
- press display the queue
- press on one of the slides in the queue to display the patient information
- press edit
- press release from queue
    - notification if you are sure you want to remove the patient

M – patient capacity monitoring:

- Press the department button
- toggle the list of departments and press the desired one
- press the capacity button
    - press show current patients
    - press show current medical staff
    - display doctors, nurses, interns, support teams

M – patient capacity editing:

- Press the department button
- toggle the list of departments and press the desired one
- press the capacity button
- press edit
    - edit the patient's capacity
    - edit staff capacity
        - doctors, nurses, interns, support teams
    - press duty day
        - press yes or no on hospital duty day
    - calculate the threshold levels based on details above
    - press edit threshold alert
        - write notifications that will pop up when a level is passed
        - write options for ways to deal with the current level that was passed
    - press create template
        - save each configuration to a day of the week
        - save each configuration to specific times of the day

S – Build an optimal work path:

- Press the department button
- toggle the list of departments and press the desired one
- Press shift
- Press build workflow
- The system will display the queue of that particular department on the screen, while presenting the patients details as slides from top to bottom

S – Treatment of patients on the work path:

- Press workflow to see the current one
- In case one was not built show an error message
- After treating a patient put V on "continue check" to move the patient in the queue to the last place and advance the one before him in the queue
- press "forward" and toggle a list of department queues the patient will be moved to
    - press yes or no on either the patient returns to the current queue later

C – medical history and recommendation from the virtual assistant pre diagnosis:

- Press the department button
- toggle the list of departments and press the desired one
- press the display the queue
- press on one of the slides in the queue to display the patient information
- press on view medical history
- press on view virtual assistant "diagnosis"
  - in case the patient did not use the virtual assistant, the button should not appear

C – analysis recommendation during diagnosis:

- press on analysis recommendations
- choose from a created template the best suited one
- choose other in case that no analysis suits the current patient
- write the needed treatment
- press save analysis to templates

C – treatment recommendation post diagnosis:

- press on treatment recommendations
- choose from a created template the best suited one
- choose other in case that no treatment suits the current patient
- write the needed treatment
- press save treatment to templates

M – Adding medical equipment:

- Press the department button
- toggle the list of departments and press the desired one
- press medical equipment
- press add
- choose the type of equipment (sterile equipment, medical machine)
- write how many you add
- save

M – remove medical equipment:

- Press the department button
- toggle the list of departments and press the desired one
- press medical equipment
- press removed
- choose the type of equipment (sterile equipment, medical machine)
- write to each equipment the number that was used
- save

M – editing medical equipment:

- Press the department button
- toggle the list of departments and press the desired one
- press medical equipment
- press set threshold
- choose the type of equipment (sterile equipment, medical machine)
- set the minimum amount that a warning will be sent if a medical equipment counter fell over
- set on which equipment an alert should be sent to the warehouse and sterile department when it drops below the threshold
- save

S – view data and workloads:

- Press the department button
- toggle the list of departments and press the desired one
- press show workload statistics
- choose between dates
- the system will display data analysis summary report
- press watch view as a graph

C – safety button in case the hospital staff feel they are in a hostile company:

- press safety button
- an alert will be sent to all the security teams in the area
- the system will send the location from which the alert came

C – Request for placement with a doctor:

- press shift button
- select a specific date
- toggle a list of doctors working on that date and choose one
- get a notification if either the doctor agreed or not

## **Patients**

M - logging in to the system through the phone:

- Enter the user information
    - ID Number
    - Phone Number
    - receive an OTP
- In case of wrong details an error message will be displayed
- In case the user does not exits an error, message will be displayed

M - logging in to the system through the tablet:

- Enter the user information
    - ID Number
    - number received by the reception
- In case of wrong details an error message will be displayed
- In case the user does not exits an error, message will be displayed

C – virtual assistant:

- the system will ask if the user wishes to use a virtual assistant
- press use virtual assistant
- press use voice command
- the system will provide use of the all the functional requirement through voice command

S – Personal tracking:

- press personal tracking
- a flow displaying where the patients is currently in their process
- pressing further on each process show the current average wait time in each department

C – "initial diagnosis" while waiting:

- while waiting the system will suggest you will use its "initial diagnosis"
- you can say agree or press yes
- if the patient agreed the system will start a series of questions either through voice or chat
- at the end of the questions the system will search through its data base for optional diagnosis and send it to the patient's information for the medical team to evaluate

C – navigation:

- press navigation
- a map will be displayed showing where you are right now and where you need to go with including detailed directions
- if the patient is using the tablets throughout the hospital, when he arrives at another tablet the system will tell him if he is there and if not show him direction

S – setting an appointment:

- press set new appointment
- choose desired date
- if the date is taken show close by dates that are free
- select the time options that appear
- send a reminder to the patient cell phone

C – view tests:

- press view tests
- select the between two dates
- the system will show all the tests taken between those two dates
- press the wanted test
- the system will display information from the test

C – general information:

- press general information
- toggle the list of departments and press the desired one
- the system will show general information about that specific department

4. **Non-Functional requirements**
   Below are the non-functional requirements of the system

- **Security -**
  the system will secure the patient's medical and personal information, as well as allow access only to the medical staff of Hadassah hospital.
  the information will be displayed according to each individual permission level.
- **Reliability -**
  A system that deals with patients in hospital must be extremely reliable and work with no hitch.
- **Usability -**
  By providing a virtual assistant and a self-service station we allow people like the elderly or Jewish Orthodox with no smartphone which make about a 1/3 of Jerusalem to have higher accessibility to the hospital.
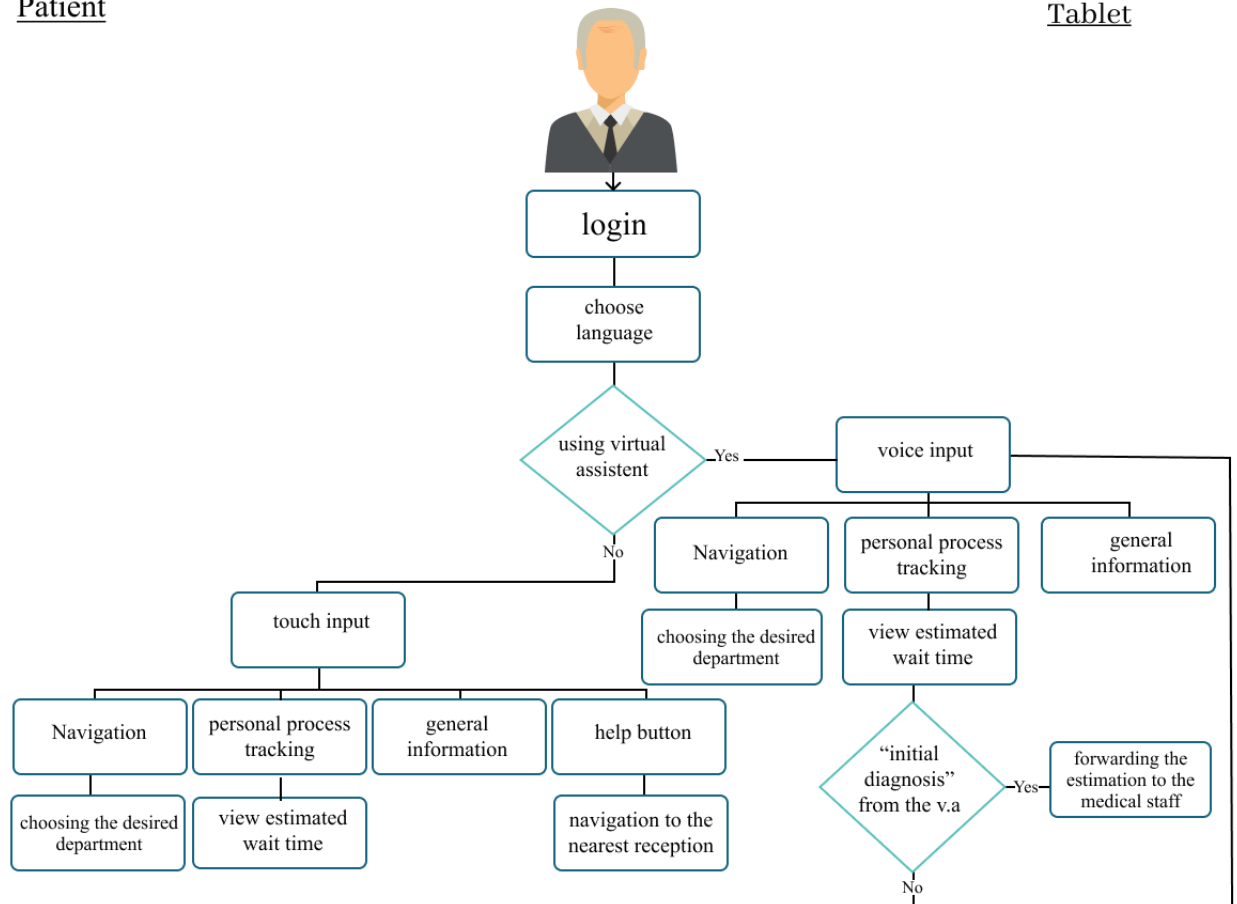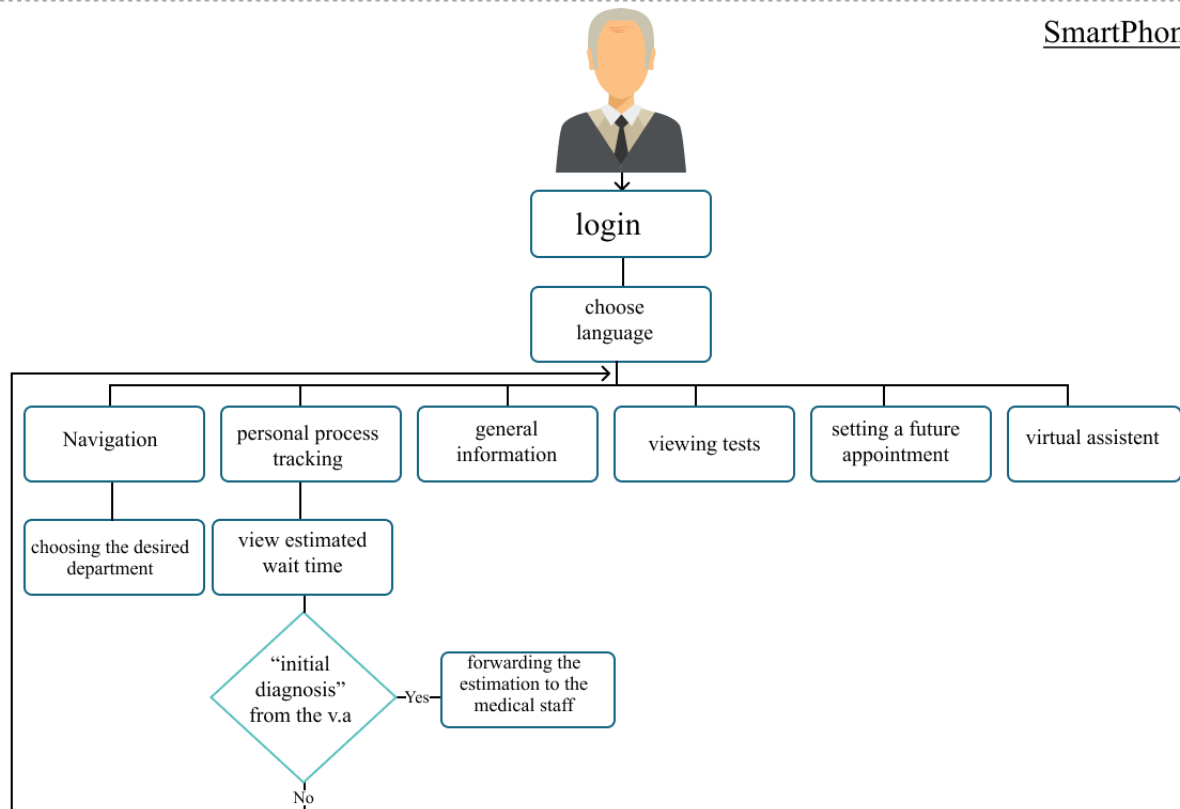
5. **System flows**
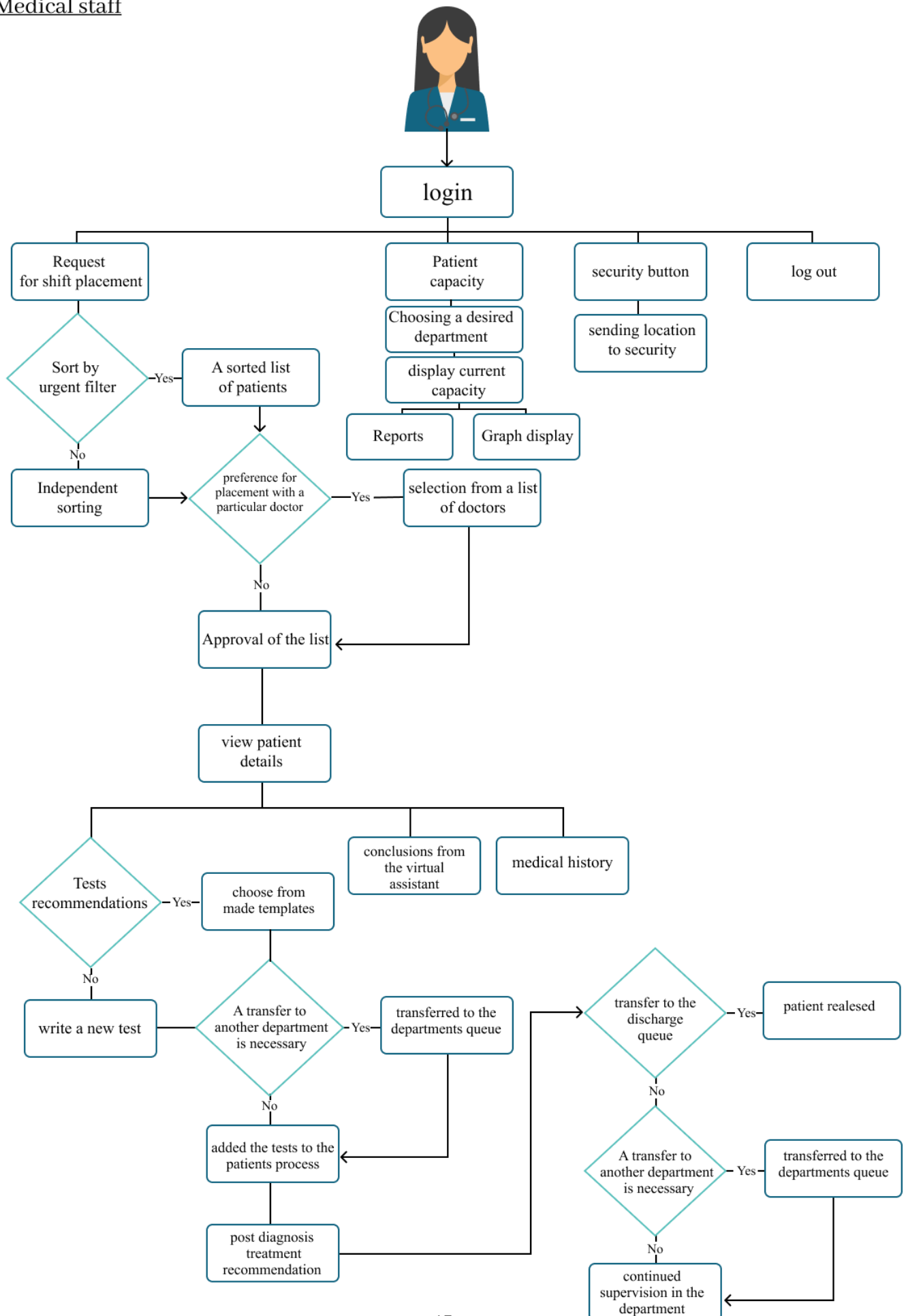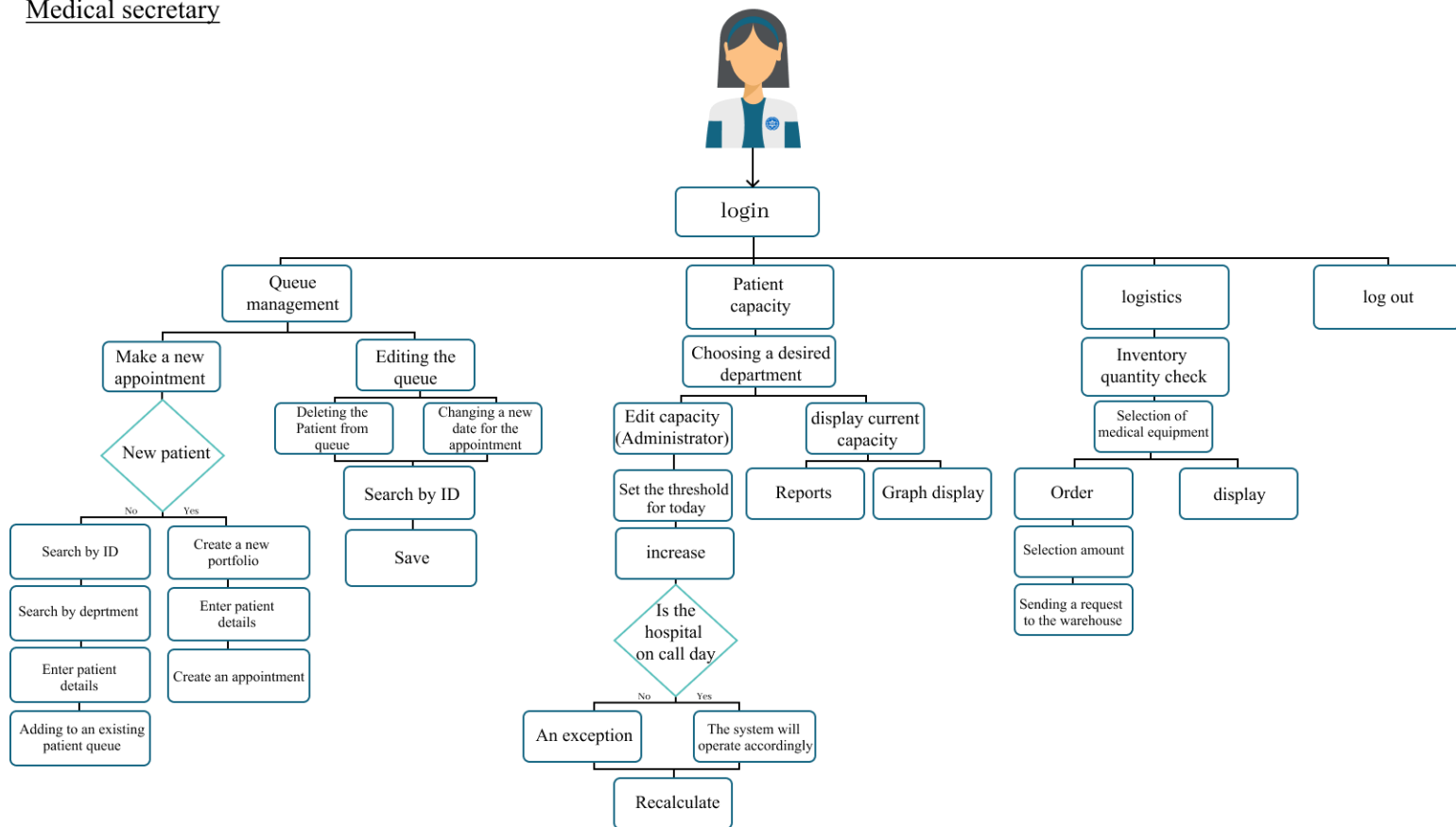   below is the system flow diagram for the users

<u>Patient</u>

<u>Tablet</u>



<u>SmartPhone</u>

Medical staff

Medical secretary



login

Queue management

Patient capacity

logistics

log out

Make a new appointment

Editing the queue

Choosing a desired department

Inventory quantity check

New patient

Deleting the Patient from queue

Changing a new date for the appointment

Edit capacity (Administrator)

display current capacity

Selection of medical equipment

No          Yes

Search by ID

Set the threshold for today

Reports

Graph display

Order

display

Search by ID

Create a new portfolio

Save

increase

Selection amount

Search by deprtment

Enter patient details

Is the hospital on call day

Sending a request to the warehouse

Enter patient details

Create an appointment

No          Yes

Adding to an existing patient queue

An exception

The system will operate accordingly

Recalculate

6. **Risk management**
   the risks that exit in our system

   ▪ **<u>Theft of medical information:</u>** unauthorized access by unwanted identities in the system can lead to leak of extremely sensitive information of many hospitals visitors.

   <u>Risk level:</u> very high

   ▪ **<u>Multitasking overload:</u>** A possibility that the number of patients will increase several times more than the number of medical staff, in an unusual case of an epidemic like the corona virus.

   <u>Risk level:</u> medium

   ▪ **<u>Virtual assistant sending misinformed data to the doctors:</u>** An option the patient will provide information to the virtual assistant during the initial diagnosis that he believes to be true but will turn out to be false and may mislead the medical team. Even so the medical staff must always exercise professional judgment, the system did not come to replace them, only to help ease the burden.

   <u>Risk level:</u> low

7. **System main screen specifications**

   **H.T.M** is designed to work on smartphones, tablets and desktop

8. **Non-goals**
   The topics that will not be included in the project

   ▪ the system does not manage bed occupancy
   ▪ the system does not allow bypassing other patients in the queue without medical urgency
   ▪ the system does not handle payments

9. **Open issues**
   the open issues that the system does not resolve

   ▪ The system does not recognize information entered onto the system as incorrect information
   ▪ The system does not know how to handle a patient that was transferred to the wrong queue

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