Medical Laboratory Information System

I. Project Description

The Medical Laboratory Information System is designed to manage patients' records, laboratory services, and results. The program will store all data in different text files (.txt) following the prescribed format. In addition, the system must be able to generate and save the laboratory results in PDF format.

II. Specification

a. Main Menu

The Main Menu must display all the primary transactions in the system. An option to select a transaction must be available in the UI, as shown in Figure 1.

```
Medical Laboratory Information System
[1] Manage Patient Records
[2] Manage Services
[3] Manage Laboratory Results

Select a transaction:
```

Figure 1: Sample Main Menu

Each primary transaction has the functionality to add, edit, delete, and search their corresponding data.

b. Manage Patient Records

```
Manage Patient Records
[1]Add New Patient
[2]Edit Patient Record
[3]Delete Patient Record
[4]Search Patient Record
[X]Return to Main Menu

Select a transaction:
```

Figure 2: Sample Manage Patient Records Menu

i. Add New Patient

- The system should ask for the following details to add a new record.

  First Name:
  Last Name:
  Middle Name:
  Birthday(YYYYMMDD):
  Gender:
  Address:
  Phone No.:
  National ID no.:
  Save Patient Record[Y/N]?

- Once the user saves the record, it will be added to the file Patients.txt with the format below.

  <Patient's UID>;<Last Name>;<First Name>;<Middle Name>;<Birthday>;<Gender>; <Address>;<Phone No.>;<National ID no.>;

Figure 3: Sample record on Patients.txt file

- Each patient must have a unique identifier generated by the program using the logic below in Table 1.

Table 1: Logic of Patient's Unique Identifier

A	B	B	B	B	C	C	D	D	D	E	E

Position	**Description**	**Logic**
A	Patient Code Identifier	'P' - Constant
BBBB	The year the patient was added to the system	Based on the local system date of the system. Ex. Jan. 1, 2022 BBBB = 2022
CC	The month the patient was added to the system	Based on the local system date of the system. Ex. Jan. 1, 2022 CC = 01
DDD	Incrementing letters of the alphabet	It starts with the value "AAA" and ends with "ZZZ". Increments if position EE has a value of 99 + 1. Example: P202201AAA98 P202201AAA99 P202201AAB00 P202201AAB01
EE	Incrementing numbers	It starts with the value "00" and ends with "99". It increments by one every time a new patient is added to the file Patients.txt.
Note: Position DDDEE resets to "AAA00" every start of the month		

ii. Search Patient's Record

- The system should be able to search the patient's record using the patient's unique identifier OR last name, first name, and birthday combination OR national ID no.
- If two or more records match the last name, first name, and birthday combination, the system should display a list of the records matching the criteria.

- The list should be displayed in this format: <Patient's UID><Last Name><First Name> <Middle Name> <Birthday><Gender><Address><Phone Number><National ID no.> with the corresponding header text. The system should then ask the user which record to display by entering the patient's UID, as shown in Figure 4.

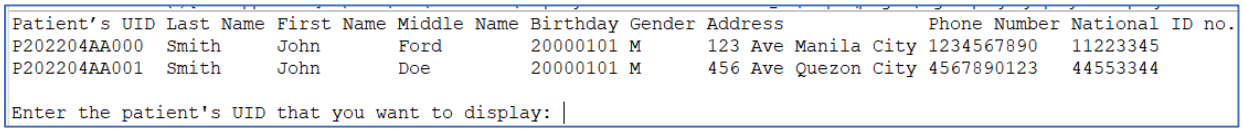


Figure 4: Sample list of multiple patients

- If the system did not find any record that matches the criteria, an information message "No record found." must be displayed on the UI, and the system should ask if the user would like to search again or return to the main menu.
- If the system was able to retrieve the data, the record must be displayed using the format below. The list of laboratory tests requested by the patient must have four header texts "Request's UID", "Lab Test Type", "Request Date", and "Result". In addition, the list must be sorted in descending order by the requested date and UID, as seen in Figure 6. The details about the laboratory request can be found in the "Manage Laboratory Request" section.

  <Patient's UID>
  <Last Name>, <First Name> <Middle Name>
  <Birthday>
  <Address>
  <Phone no.>
  <National ID no.>

Request's UID	Lab Test Type	Request Date	Result
XXXX	XXXX	XXXX	XXXX

- The value of the Lab test type will come from the service request description from file services.txt. The details can be found in the "Manage Service Request" section.
- Once the system displays the list of laboratory tests requested by the patient, the system should ask, "Do you want to print a laboratory test result? [Y/N]". If the user selected "Y", the system should ask the user to enter the Request's UID.
- Once the user enters the Request's UID, the system must generate a PDF file of the laboratory result, save it in a specified location in the local drive and display an information message "<File name> has been saved to <path>.". If the user selects "N", the system must return to the main menu.
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen. On the other hand, if there is no error, the system should ask, "Do you want to print another laboratory test result? [Y/N]". If the user selected "Y" the system must generate the PDF file using the same process or if the user selected "N", the system must return to the main menu.
- The PDF filename must follow this naming convention: <Patient's Last Name>_<Request's UID>_<Request Date>.pdf
- The PDF document must follow the layout as shown in Figure 5.

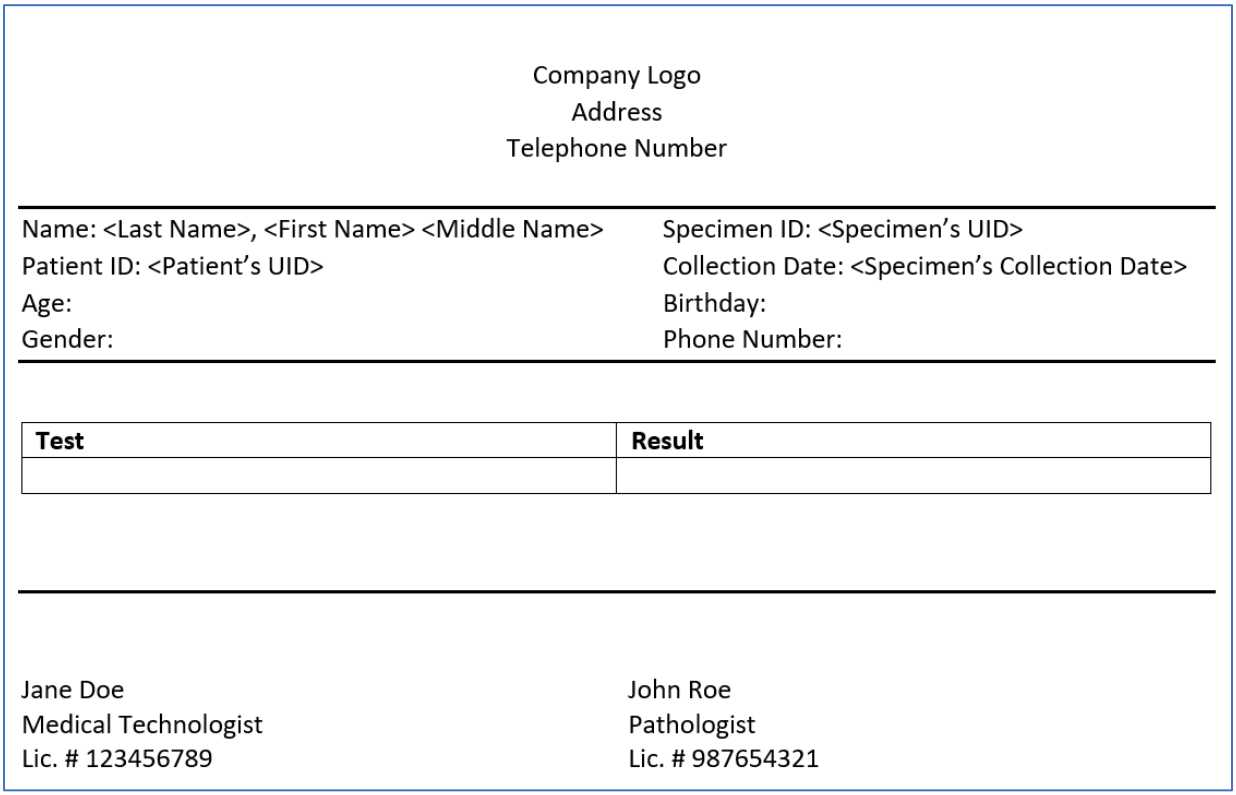


Figure 5: PDF Layout of the Request

Note: You may use any company logo, address, and telephone number.

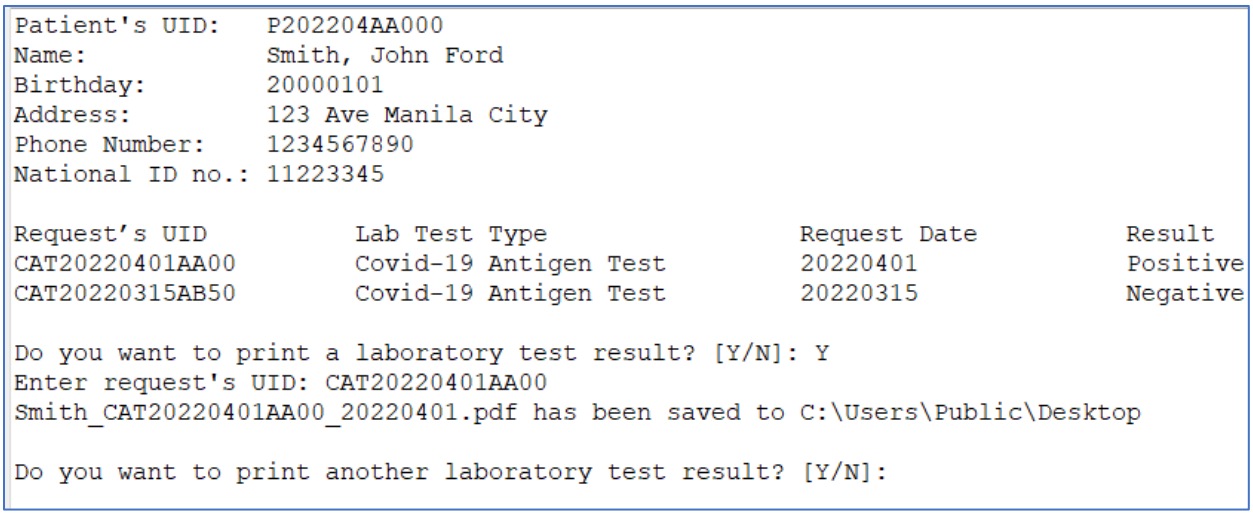


Figure 6: Sample UI of Search Patient Record

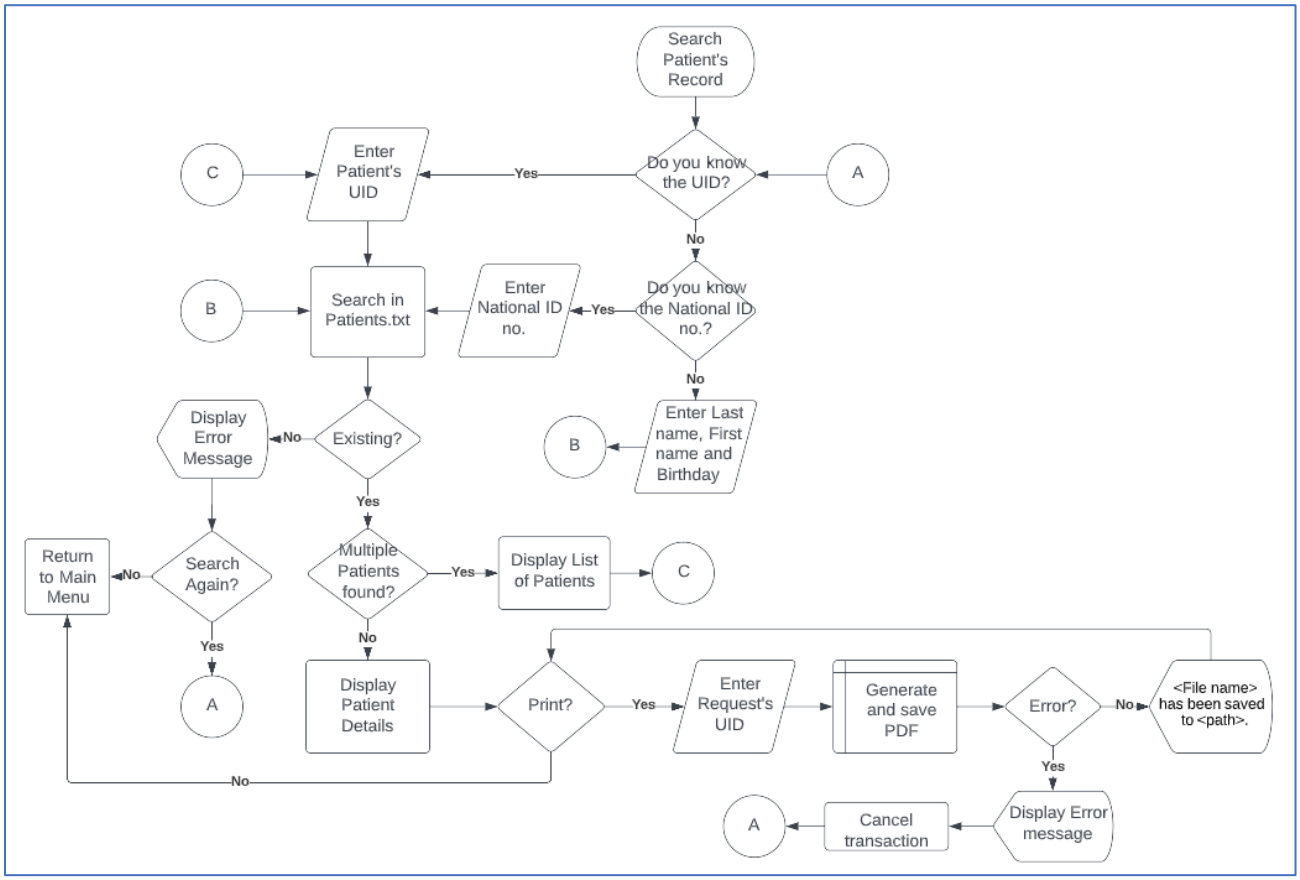


Figure 7: Flowchart of Search Patient Record

iii. Delete Patient's Record

- The patient's record cannot be permanently deleted from the system and must only be updated with the deletion indicator and the reason for deletion.
- If the user selects the "Delete Patient's Record" menu option, the system will first search the patient's record using the patient's unique identifier OR last name, first name, and birthday OR national ID no.
- If there are two or more records that match the last name, first name, and birthday combination, the system should display a list of the records matching the criteria. The list should be displayed in this format: <Patient's UID><Last Name><First Name> <Middle Name> <Birthday><Gender><Address><Phone Number><National ID no.>. The system should then ask the user which record to delete by entering the patient's UID.
- If the system did not find any record that matches the criteria, an information message "No record found." must be displayed on the UI, and the system should ask if the user would like to search again or return to the main menu.
- Once the user enters the patient's UID, the system must ask for the reason for deletion.
- The system must update the corresponding entry in the file Patients.txt with the deletion indicator "D" and the reason for deletion using the format below, as seen in Figure 8.
  <Patient's UID>;<Last Name>;<First Name>;<Middle Name> <Birthday>;<Gender>;<Address>;<Phone Number>;<National ID no.>;<Deletion Indicator>;<Reason for Deletion>

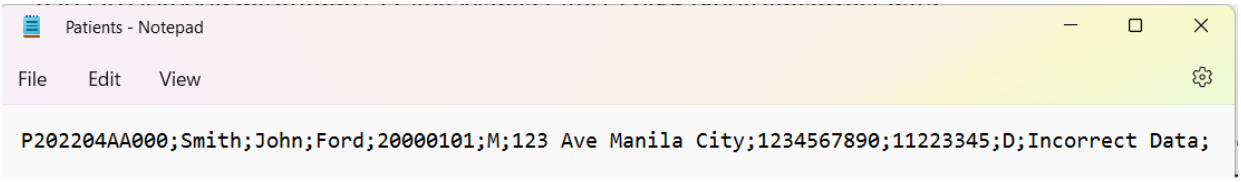


Figure 8: Sample record deleted on Patients.txt file

- Once the data has been deleted, the system should display “Data of patient <Patient’s UID> has been deleted.”.
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen, cancel the transaction, and return to the first step of the transaction. On the other hand, if there is no error, the system should ask, “Do you want to delete another patient record? [Y/N]”. If the user selected “Y”, the system must follow the same process in deleting data, or if the user selected “N”, the system must return to the main menu.

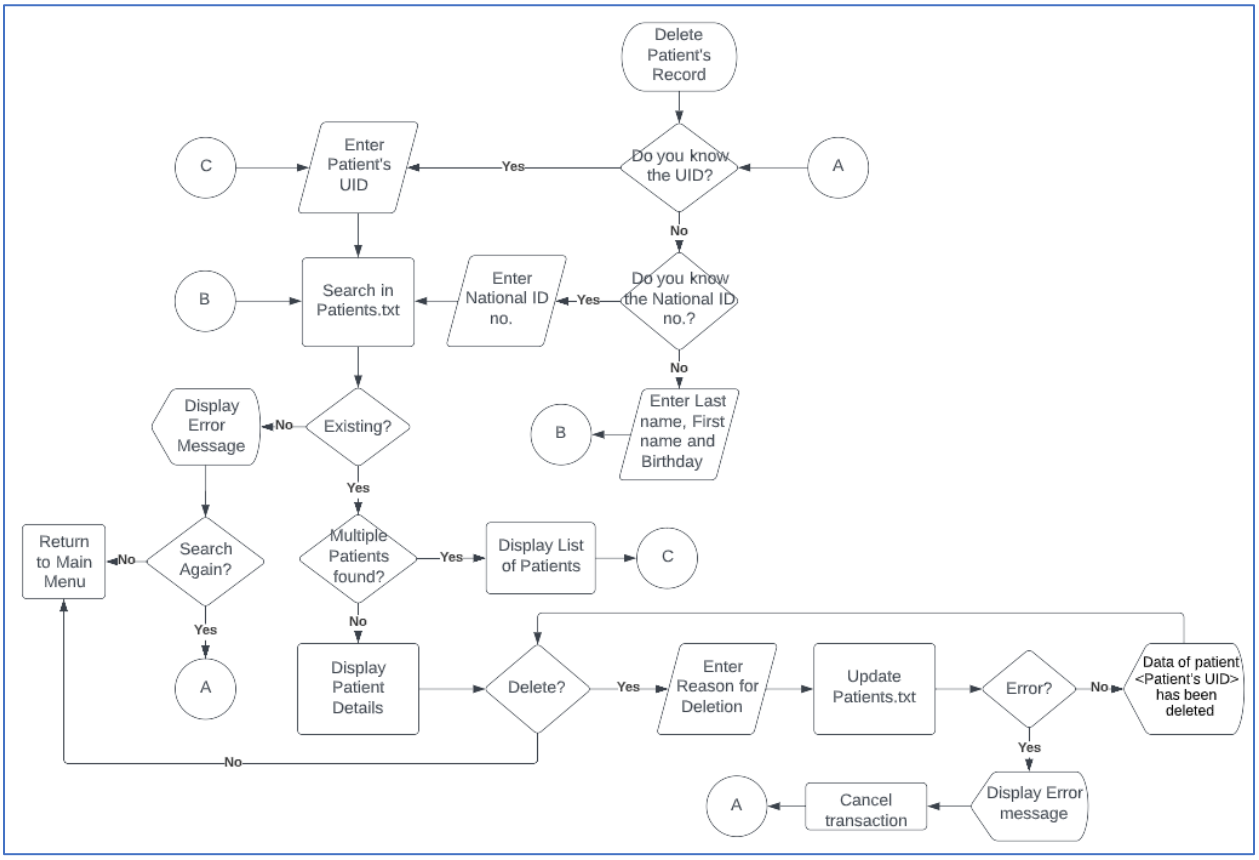


Figure 9: Flowchart of Delete Patient Record

iv. Edit Patient’s Record

- The system should be able to update only the address and phone number of the patient. The program must not be able to edit any other patient data.
- If the user selects the “Edit Patient’s Record” menu option, the system will first search the patient’s record using the patient’s unique identifier OR last name, first name, and birthday combination OR national ID no.
- If there are two or more records that match the last name, first name, and birthday combination, the system should display a list of the records matching the criteria. The list should be displayed in this

format: <Patient's UID><Last Name><First Name> <Middle Name> <Birthday><Gender><Address><Phone Number><National ID no.> with the corresponding header text. The system should then ask the user which record to edit by entering the patient's UID.

- If the system did not find any record that matches the criteria, an information message "No record found." must be displayed on the UI, and the system should ask if the user would like to search again or return to the main menu.
- If the system finds a match, it should ask which data the user would like to update.
- If the user selected either address or phone number, the system should ask for the new address or phone number of the patient and should update the corresponding entry in the file Patients.txt
- Once the data has been updated, the system should display "The Address/Phone Number of patient <Patient's UID> has been updated.".
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen, cancel the transaction, and return to the first step of the transaction. On the other hand, if there is no error, the system should ask, "Do you want to edit another patient record? [Y/N]". If the user selected "Y", the system must follow the same process in editing data, or if the user selected "N", the system must return to the main menu.

c. Manage Services

i. Add New Service

- All the services offered by the laboratory are maintained in file services.txt in this format: <Service Code>;<Description>;<Price>
- Currently, the laboratory offers the services listed in table 2.

Table 2: Services offered by the Laboratory

Service Code	Description	Price
CRP	Covid-19 RT-PCR	2000
CAT	Covid-19 Antigen Test	1000
CBT	Covid-19 Antibody Test	500

- The program should ask for the preferred unique 3-character Service Code, Description, and Price to add a new service to the file.
- The system must update the file services.txt using the correct format.
- If the Service Code already exists in the file, the system should inform the user, ask for a new service code and update the file.
- Once the data has been added, the system should display a message "<Service Code> <Description> has been added.".
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen. On the other hand, if there is no error, the system should ask, "Do you want to add another service? [Y/N]". If the user selected "Y", the system must follow the same process in adding a service, or if the user selected "N", the system must return to the main menu.

ii. Search Service

- The system should be able to search services using the service code OR a keyword that matches any of the words in the service description.
- If the system was able to retrieve the data, it must display the list in this format: <Service Code> <Description> <Price> with the corresponding header text.
- If there are two or more records that match the keyword, the system should display a list of the services that match the criteria. The list should be displayed in this format: <Service Code> <Description> <Price> with the corresponding header text. Also, the list must be sorted in ascending order by the Service Code.
- If the system did not find any record that matches the criteria, an information message "No record found." must be displayed on the UI, and the system should ask if the user would like to search again or return to the main menu.

iii. Delete Service

- The services cannot be permanently deleted from the system and must only be updated with the deletion indicator and the reason for deletion.
- The program must first search for the service using the same process from the "Search Service" transaction.
- The system should be able to search services using the service code OR a keyword that matches any of the words in the service description.
- If two or more records match the keyword, the system should display a list of the services that match the criteria and ask the user which record to delete by entering the service code.
- If the system did not find any record that matches the criteria, an information message "No record found." must be displayed on the UI, and the system should ask if the user would like to search again or return to the main menu.
- Once the user enters the service code, the system must ask for the reason for deletion.
- The system must update the corresponding entry in file services.txt with the deletion indicator "D" and the reason for deletion using the format below, as seen in Figure 10.

<Service Code>;<Description>;<Price>;<Deletion Indicator>;<Reason for Deletion>

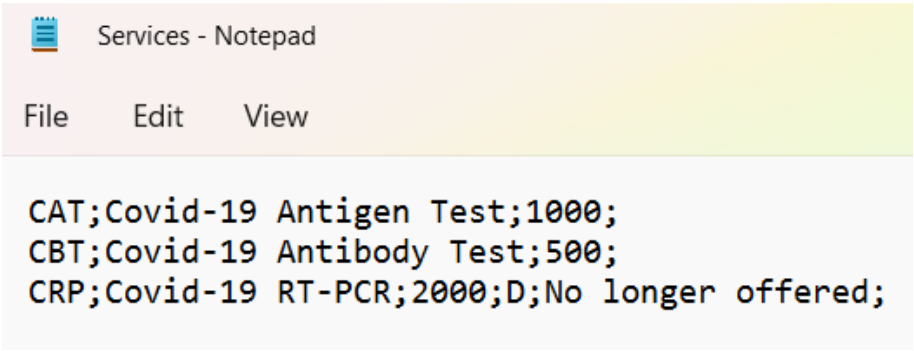


Figure 10: Sample record deleted on Services.txt file

- Once the data has been deleted, the system should display a message "<Service Code> <Description> has been deleted.".
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen, cancel the transaction, and return to the first step of the transaction. On the other hand, if there is no error, the system should ask, "Do you want to delete another service? [Y/N]". If the user

selected “Y”, the system must follow the same process in deleting a service, or if the user selected “N”, the system must return to the main menu.

iv. Edit Service

- The user should not be able to edit the services maintained in the file services.txt.
- If the user wants to edit a service, the service will first be deleted from the file, and after that, the system will ask the user to add a new service.
- If the user selects the “Edit Service” menu, a description of this option must appear on the screen and should ask if the user would like to proceed.“The services cannot be edited. If you would like to edit an existing service, the service will first be deleted, and new service will be created. Would you like to proceed? [Y/N] ”
- If the user entered “Y”, the system should ask for the service code or a keyword.
- The system should follow the process of the “Delete Service” transaction. However, the message “Do you want to delete another service? [Y/N]” should not be displayed anymore.
- If the service has been deleted successfully, the system should proceed to the “Add Service” transaction. However, the message “Do you want to add another service? [Y/N]” should not be displayed anymore.
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen, cancel the transaction and return to the first step of the transaction. On the other hand, if there is no error, the system should ask, “Do you want to edit another service? [Y/N]”. If the user selected “Y”, the system must follow the same process in the editing service, or if the user selected “N”, the system must return to the main menu.

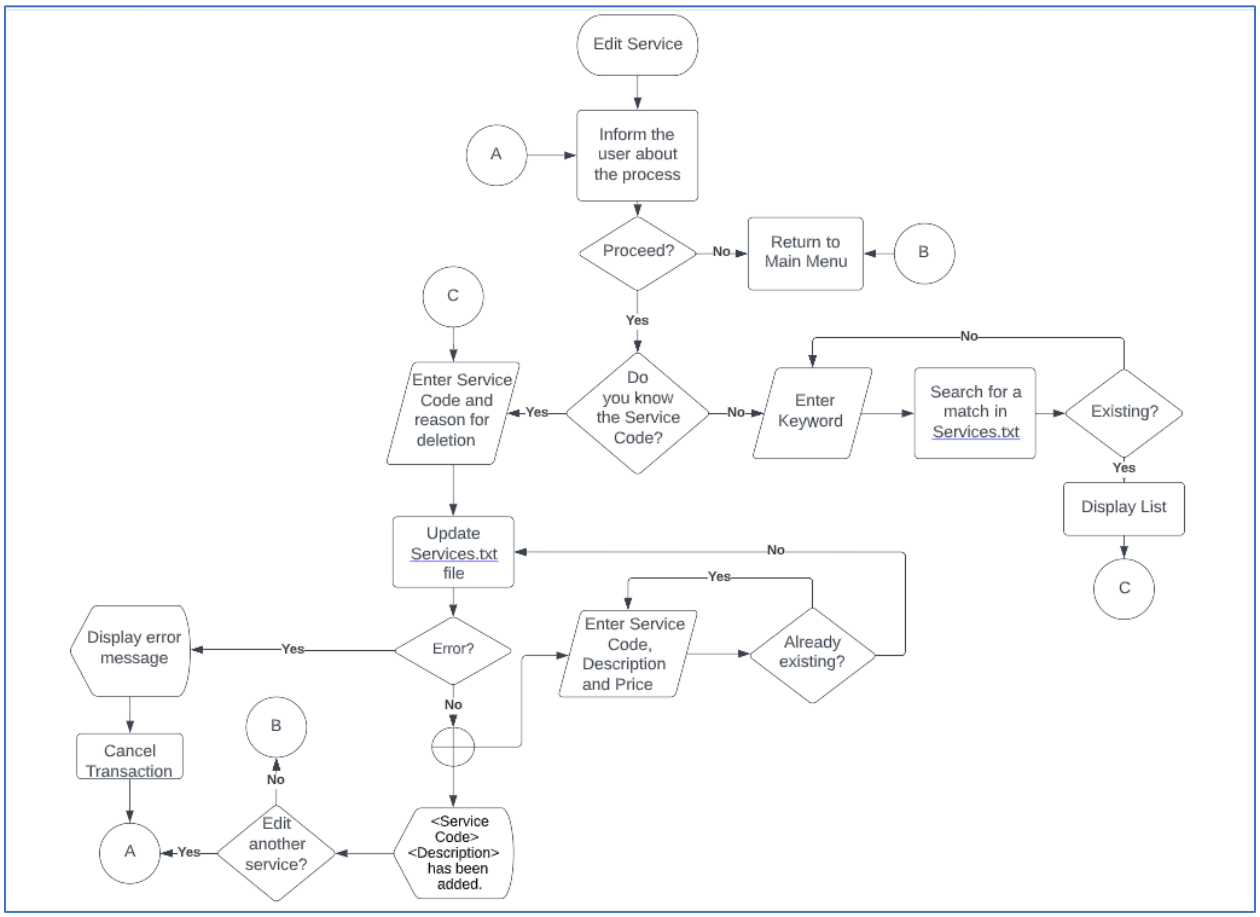


Figure 11: Flowchart of Edit Service

d. Manage Laboratory Request

i. Add New Laboratory Request

- The laboratory requests are maintained in different files depending on the service code. The filename has a naming convention of <Service Code>_Requests.txt
- Example:
  - CRP_Requests.txt
  - CAT_Requests.txt
  - CBT_Requests.txt
- Each laboratory request is added to the corresponding file using this format:
- <Request's UID >;<Patient's UID>;<Request Date (YYYYMMDD)>;<Request Time (HHMM)>;<Result>
- The collection date and time must come from the current local system date and time when the laboratory request is being added to the system.
- The system should ask only for the Patient's UID and Service code to add a new laboratory request.
- The Patient's UID and service code entered by the user must match an existing Patient's UID and service code maintained in the files patients.txt and services.txt. If the system did not find a match, an error message must be displayed on the UI, and the system should ask if the user would like to search again or return to the main menu.
- If the system finds an existing service code, the system should assign a unique identifier for each laboratory request using the logic in table 3.

Table 3: Logic of Request's Unique Identifier

Z	Z	Z	Y	Y	Y	Y	M	M	D	D	A	A	B	B

Position	**Description**	**Logic**
ZZZ	Service Code	Service Code entered by the user
YYYYMMDD	Year, month, and date of the requested date	Based on the local system date. Ex. Feb. 1, 2022 20220201
AA	Incrementing letters of the alphabet	It starts with the value "AA" and ends with "ZZ". Increments if position HH has a value of 99 + 1. Example: CRP20220201AA99 CRP20220201AB00 CRP20220201AB01
BB	Incrementing numbers	It starts with the value "00" and ends with "99". Every time a laboratory request is added to the system for the same service code, it increments by 1.
Note: Position AABB resets to "AA00" at every start of the day.		

- The system must update the corresponding file <Service Code>_Requests.txt using the correct format.
- Once the data has been added, the system should display a message “Laboratory Request <Request’s UID > has been added to file <Service Code>_Requests.txt.”.
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen, cancel the transaction and return to the first step of the transaction. On the other hand, if there is no error, the system should ask “Do you want to add another Laboratory Request? [Y/N]”. If the user selected “Y”, the system must follow the same process in adding a service, or if the user selected “N”, the system must return to the main menu.

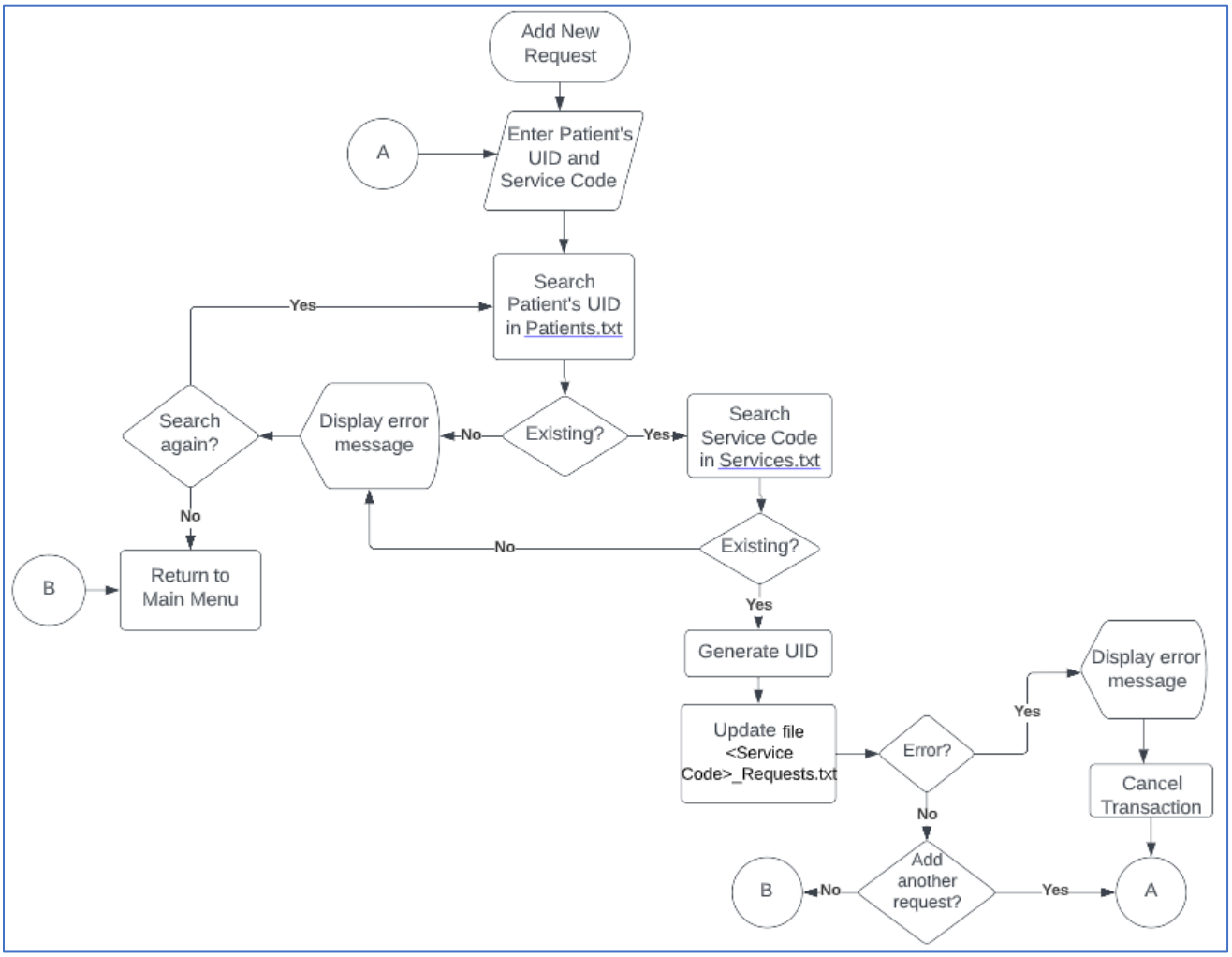


Figure 12: Flowchart of Add New Request

ii. Search Laboratory Request

- The system should be able to search the laboratory request in the laboratory request files using the request’s UID OR the patient’s UID.
- If there are two or more laboratory requests with the same patient’s UID, the system should display a list of the records. The list should be displayed in this format: <Request’s UID><Lab Test Type><Request Date><Result> with the corresponding header text.
- If the system did not find any record that matches the criteria, an information message “No record found.” must be displayed on the UI, and the system should ask if the user would like to search again or return to the main menu.

- If the system was able to retrieve the data, the record must be displayed using the format below. The list of laboratory tests requested by the patient must have four header texts “Request’s UID”, “Lab Test Type”, “Request Date”, and “Result”. In addition, the list must be sorted in descending order by the requested date and UID.

Request’s UID	Lab Test Type	Request Date	Result
XXXX	XXXX	XXXX	XXXX

- The value of the Lab test type will come from the service request description from file services.txt.

iii. Delete Laboratory Request

- The laboratory request cannot be permanently deleted on the system and must only be updated with the deletion indicator and the reason for deletion.
- The system should be able to search the laboratory request using the same process as the “Search Laboratory Request” transaction.
- If there are multiple entries, the system should ask the user which laboratory request will be deleted by entering the Request’s UID.
- Once the user enters the Request’s UID, the system must ask for the reason for deletion.
- The system must update the corresponding entry in file <Service Code>_Requests.txt with the deletion indicator “D” and the reason for deletion using the format below.
- <Request’s UID>;<Patient’s UID>;<Request Date (YYYYMMDD)>;<Request Time (HHMM)>;<Result>;<Deletion Indicator>;<Reason for Deletion>
- Once the data has been deleted, the system should display a message “<Request’s UID> has been deleted.”.
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen. On the other hand, if there is no error, the system should ask, “Do you want to delete another laboratory request? [Y/N]”. If the user selected “Y”, the system must follow the same process in the laboratory request, or if the user selected “N”, the system must return to the main menu.

iv. Edit Laboratory Request

- The program must be able to edit only the “Result” part of the laboratory request that does not have results yet.
- If the user selects the “Edit Laboratory Request” menu option, the system will first search the patient’s record using the same process as the “Search Laboratory Request” transaction.
- If the system finds a match, it should ask which laboratory request the user would like to edit and should update the corresponding entry in the file <Service Code>_Requests.txt
- Once the data has been updated, the system should display “The Laboratory Request <Request’s UID> has been updated.”.
- If the system encounters an error while processing the transaction, the error message must be displayed on the screen. On the other hand, if there is no error, the system should ask, “Do you want to edit another laboratory request? [Y/N]”. If the user selected “Y”, the system must follow the same process in editing data, or if the user selected “N”, the system must return to the main menu.

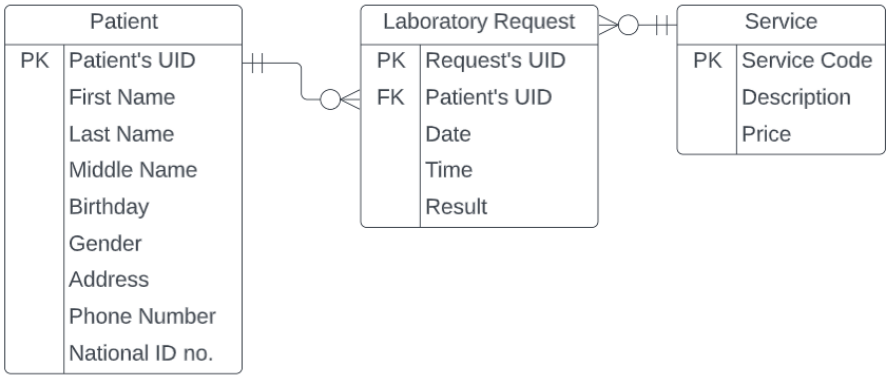
e. General Functionality:

- All the transactions must have an option to return to the Main Menu.
- If the text file does not exist yet, the program must be able to create it with the correct naming convention.
- If no data were found using the selection criteria, an information message “No record found.” must be displayed on the UI, and options must be given to the user to search again or return to the Main Menu.

- The system must show a success message every time an item has been added, updated, or deleted successfully on the files. If the user encounters an error with any of the transactions, the system must display the error message, cancel the transaction, and return to the first step of the transaction.
- All the items on the files can only be deleted by adding the deletion indicator “D” and a reason for deletion. The program cannot delete any item on the file permanently.
- All items with deletion indicators should not appear in any transaction.
- The program cannot reuse all the unique identifiers/service codes from the deleted items.

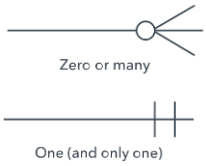
Appendix

1. Entity Relationship Diagram



Legend:
PK – Primary Key
FK – Foreign Key

Cardinality:



Example:
Request CAT20220401AA00 is requested by one (and only one) patient P202204AA000, which exists in the Patients.txt file. In addition, the requested service “CAT” exists in the Services.txt file.