Health Insurance Database Design

Harshitha Yerraguntla, Shreya Hagalahalli Shrinivas, Varun Potlacheruvu Sanjose State University

Keywords Definition

- **Deductible**-The amount that has to be reached by the insurance holder within the policy/plan period before the insurance company starts sharing the bill/claim.
- Co-Insurance-Once the deductible is reached ,the insurance holder pays a certain percentage of claim amount defined by co-insurance and the rest percentage is covered by the insurance company .
- Out Of Pocket Limit -This the maximum out of pocket amount spent by the insurance holder for the policy/plan period. Once this amount is reached ,the insurance company will pay the rest of the bill/claim amount.

Introduction

We are designing a Health Insurance Database System to showcase how an insurance company maintains records of its members based on their plans and corresponding hospital bills, claims from the provider.

A provider in a healthcare environment is someone or someplace that provides services to a patient. These services are billed to patients, the payments for which can be claimed from the insurance company based on the member's insurance plan.

Technologies: list of technologies are provided here

Database Engine: MySQL.

Versions: Wamp Server 3.1.9, Php 5.6.40, MySQL 5.7.26, Goo.gle chrome.

Block Diagram: Implementation of the health insurance application is displayed in Fig.1.

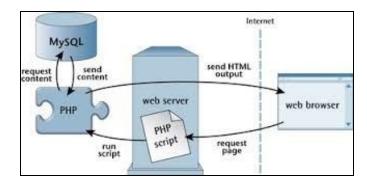


Fig.1. Health insurance application setup

Functionalities

- Members of the Insurance Company will be able to view and update their profile information view available plans and available in-network doctors associated with the insurance company.
- Members of the company are also able to view the details of their current plan consisting of their deductible amount reached, out of pocket amount reached, status of claims etc and raise claims if any
- Doctors generate claim to the members of the insurance company who seek treatment/service. The claim details are sent to the insurance provider for verification and approval/denial.
- Insurance provider will look at the claim information of the member he is assigned and process the claim. If claim is approved, the member record is updated and claim status is changed to approved from pending. If the claim is denied, the claim status is updated as denied in the claim table.
- Insurance provider is also able to update the plan information and in-network doctor information
- A statement for every claim is generated indicating the claim status and the amount covered by insurance company upon approval of the claim.

Entity Relationship Diagram:

The Entity Relationship diagram is highlighted to indicate small changes made. The Bill entity has been removed since most of its attributes were covered in the claim entity and hence redundancy has been avoided for a better Normalization. Fig. 2 displays ER diagram.

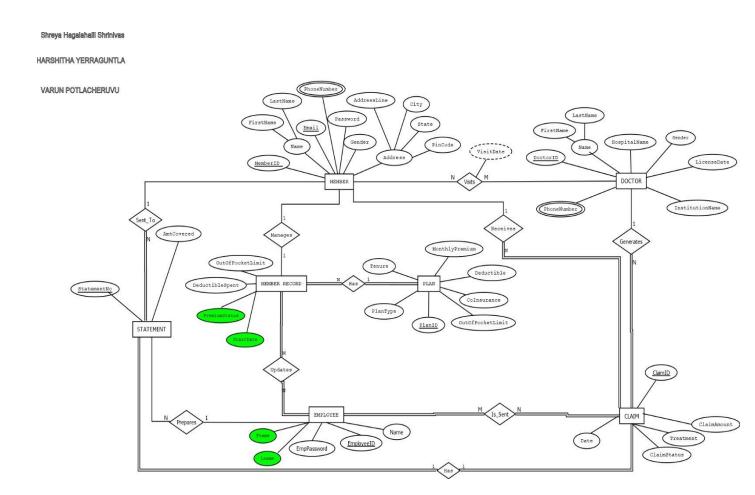


Fig.2. ERD for Health insurance database.

Specification of Database Objects (Tables and columns)

Normalization : All tables are upto 3rd NF

Member

This table contains information of all the members enrolled to suitable plans offered by the insurance company. This table enables the insurance company to have complete profile information of the members ,including name, address, contact, gender and date of birth. Each member is identified by the member Id.

Field	Data Type		Description	PK/FK
MemberId	integer	Not- Null	This field defines the unique Id of each member	PK

FirstName	varchar(20)	Not- Null	Records the first name of the member	
LastName	varchar(20)	Not- Null	Records the last name of the member	
Email	varchar(50)	Not- Null	records the email Id of the member which is required field for user login	
Password	varchar(70)	Not- Null	records the password of the member which is a required field for member login	
Gender	varchar(10)	Null	Records the gender of the member	
AddressLine	varchar(30)	Null	Records the street address of the member	
City	varchar(20)	Null	Records the city in which the member resides	
State	varchar(2)	Null	Records the state in which the member resides	
PinCode	integer	Null	Records the pincode of the member address	
DOB	date	Not Null	Records the dob of the member	

FDs: MemberId -> FirstName, LastName, Email, Password, Gender, AddressLine, City, StatePinCode, DOB

Doctor

A doctor provides service or medical treatment to patients and generates a claim to be sent to the provider. The table consists of details of the doctor consisting of name, contact, gender, the hospital or clinic name and institution name. Each Doctor is identified by doctor ID.

Field	Data Type		Description	PK/FK
DoctorId	integer	Not- Null	This field defines the unique Id of each doctor	PK
FirstName	varchar(20)	Not- Null	Records the first name of the doctor	
LastName	varchar(20)	Not- Null	Records the last name of the doctor	
HospitalName	varchar(30)	Null	Contains the hospital/clinic name where he is currently working	
AddressLine	Varchar(30)		Contains the address of his place of practice	
Gender	Varchar(10)	Null	Records the gender of the doctor	
LicenseDate	Date	Not-Null	Contains the date of license owned by the doctor	

InstitutionName	varchar(40)	Null	Contains the name of institution from where the doctor graduated	
-----------------	-------------	------	--	--

FDs: DoctorId ->

First Name, Last Name, Hospital Name, Address Line, Gender, License Date, Institution Name, Last Name, Last

Plan

Plan table contains the details of the available plans in an insurance company .Each plan is identified by its plan Id.

Field	Data Type	Description	PK/FK
PlanId	integer	This field defines the unique Id of each plan	PK
PlanType	varchar(30)	Contains the name of the plan	
MonthlyPremium	decimal(10,2)	Contains the monthly premium amount	
Deductible	decimal(10,2	Defines the deductible limit to be reached for the plan	
Co-Insurance	integer	Defines the co-Insurance percentage for the plan type	
OutOfPocketLimit	decimal (10,2)	Defines the maximum out of pocket limit for the plan type	

Tenure	integer	Defines the tenure period for which	
		the plan is valid.	

FDs: PlanId -> PlanType,MonthlyPremium,Deductible,Co-Insurance,OutOfPOcketLimit,Tenure

Employee

This table provides details of the employees in an insurance company. Each employee is identified by his employee Id. Employees of the insurance company verify and process the outstanding claims of members enrolled in a plan in an insurance company.

Field	Data Type	Description	PK/FK
EmployeeID	integer	This field defines the unique Id of each employee	PK
Fname	varchar(10)	Records the first name of the employee	
Lname	varchar(30)	Records the first name of the employee	
EmpPassword	varchar(100)	records the password of the member which is a required field for employee login	

FDs: PlanId -> EmployeeId,Fname,Lname,EmpPassword

Claim

The claim table defines claim tables consisting of claim claim Id,Status,Amount and treatment .Claims are sent by the doctor to the insurance provider of the member who seeks treatment.

Field	Data Type	Description	PK/FK
ClaimId	integer	This field defines the unique Id of each claim	PK
MemberId	integer	This field defines the Id of the member who upon which the claim has to be processed	FK
DoctorId	integer	This field defines the Id of the doctor who issues claim	FK
ClaimStatus	varchar(20)	Defines the status of the claim(Pending,approved,Denied)	
BillAmount	decimal(10,2)	Defines the amount billed for the service/Treatment	
Treatment	varchar(50)	Defines Name of the treatment	
ClaimDate	Date	Records the claim date	

FDs: ClaimId ->ClaimId,MemberId,DoctorID,ClaimStatus,BillAmount,Treatment,ClaimDate

MemberRecord

This table defines the current details of the member plan consisting of member's deductible amount reached, out of pocket amount reached, member's monthly premium status and start date of the plan.

Field	Data Type	Description	PK/FK

RecordNo	integer	Defines the record number of the members	PK
MemberId	integer	Defines the memberId	
PlanId	integer	Defined the plan Id on which the member is enrolled	FK
DeductibleSpent	decimal(10,2)	Records the deductible amount reached by the member	
OutOfPocketSpent	decimal(10,2)	Records the out of pocket amount reached by the member	
StartDate	Date	Defines the start date of enrollment to the plan	
PremiumPaymentStatus	Enum	Contains the monthly premium status(paid and unpaid)	

Fds:

 $\textbf{RecordNo,} \textbf{MemberID-} \verb|>| PlanId, Deductible Spent, Out Of Pocket Limit, Start Date, Premium Payment Status$

Statement

This table defines the statement to be given to the member consisting of information on the amount covered by insurance for the particular claim associated with member.

Field	Data Type	Description	PK/FK
StatementNo	Integer	Defines the unique number for each statement	PK
MemberId	Integer	Defines the unique Id of the member	FK

EmployeeId	Integer	Defines the unique Id of each employee	FK
AmountCovered	Decimal(10,2)	Records the amount covered from insurance provider for a particular claim	

Fds:StatementNo ->MemberId,EmployeeId,AmountCovered

IsSent

This table defines the unique combination of claim Id with corresponding employee Id

Field	Data Type	Description	PK/FK
ClaimId	integer	Contains the unique Id for each claim	PK,FK
EmpId	integer	Contains the unique employee Id for each employee	

Visits: This table defines the visit date of member with unique Id to the doctor with unique Doctor Id.

Field	Data Type	Description	PK/FK
MemberId	integer	Defines the unique Id for each member	PK,FK
DoctorId	integer	This field defines the unique Id of each doctor	
VisitDate	Date	Records the date of visit by to member to the doctor for a service/treatment	

FDs: -> MemberId, DoctorId -> VisitDate

Has: This table defines the unique statement number for each claim Id

Field	Data Type	Description	PK/FK
ClaimId	integer	Contains the unique Id for each claim	PK,FK
StatementNo	integer	Defines the unique number for each statement	

Updates

This table defines the member Id's with corresponding employee Id's.

Field	Data Type	Description	PK/FK
MemberId	integer	Defines the memberId	PK,FK
RecordNO	integer	Defines the record number of the members	
EmpId	integer	Contains the unique employee Id for each employee	

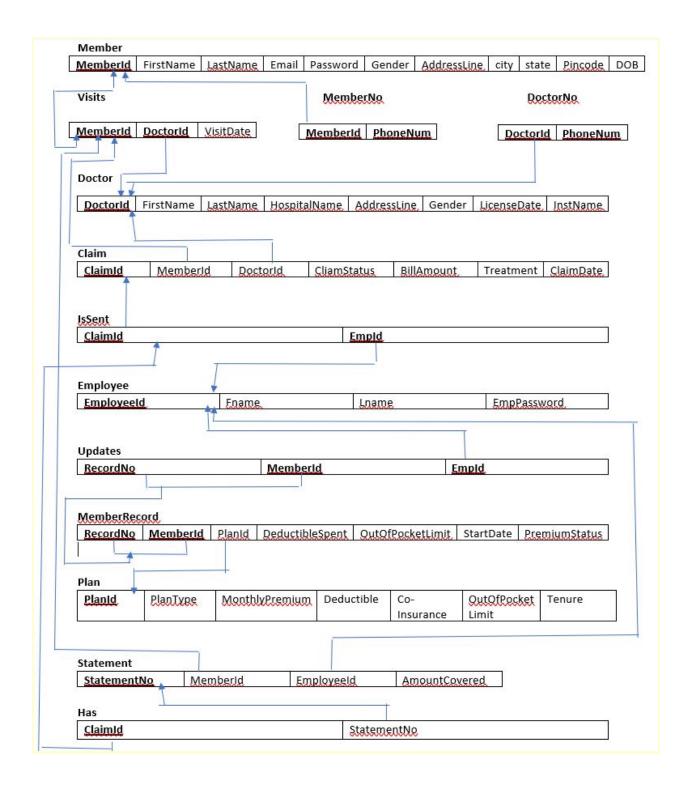
DoctorNo: This table defines the contact details for each member

Field	Data Type	Description	PK/FK
MemebrId	integer	Defines the unique Id for each member	PK,FK
PhoneNumber	integer	Contains the Contact Numbers of the doctor	

MemeberNo: This table defines the contact details of each doctor

Field	Data Type	Description	PK/FK
DoctorId	integer	This field defines the unique Id of each doctor	PK,FK
PhoneNumber	integer	Contains the Contact Numbers of the member	

Schema Diagram:



List of Tables and Views:

```
1 •
                                   DROP PROCEDURE IF EXISTS UpdateMemberRecord;
 hw2_HarshithaYerraguntla...
                             2
                                   DELIMITER $$
3
                             4 •
                                   CREATE PROCEDURE UpdateMemberRecord(IN var_claimID integer )
 ▼ Tables
                             5 

BEGIN
  ▶ ☐ claim
                             6
  ▶ ■ doctor
                             7
                                       DECLARE var_empid INT;
  ▶ ■ doctorNo
                             8
                                       DECLARE var_recordno INT;
  ▶ ■ employee
                                       DECLARE var_bill DEC(10,2) DEFAULT 0.0;
                             9
  ▶ ■ has
                            10
                                       DECLARE var_memberid INT;
  ▶ issent
                                       DECLARE var_oopSpent DEC(10,2) DEFAULT 0.0;
                            11
  ▶ ■ memberNo
                            12
                                       DECLARE var_deductibleSpent DEC(10,2) DEFAULT 0.0;
  ▶ ■ memberRecord
                            13
                                       DECLARE var_approvedAmount DEC(10,2) DEFAULT 0.0;
  ▶ ■ members
                                       DECLARE var_balanceOop DEC(10,2) DEFAULT 0.0;
                            14
  ▶ ■ plan
                            15
                                       DECLARE var_coInsurance DEC(10,2) DEFAULT 0.0;
  ▶ ■ statement
                            16
                                       DECLARE var_balanceDeductible DEC(10,2) DEFAULT 0.0;
  ▶ ■ updates
                            17
                                       DECLARE var_oopPlan DEC(10,2) DEFAULT 0.0;
  ▶  visits
                            18
                                       DECLARE var_deductiblePlan DEC(10,2) DEFAULT 0.0;
 ▼ 🖶 Views
                            19
                                       DECLARE var_coInsurancePlan INT DEFAULT 0;
  20
                                       DECLARE var_tobePaidByCust DEC(10,2) DEFAULT 0.0;
```

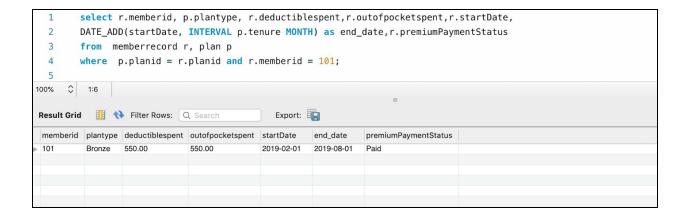
SQL QUERIES:

Member Queries:

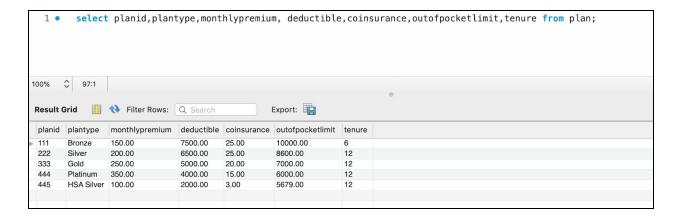
1. Member Profile Query: It fetches profile information such as email, address of a member.



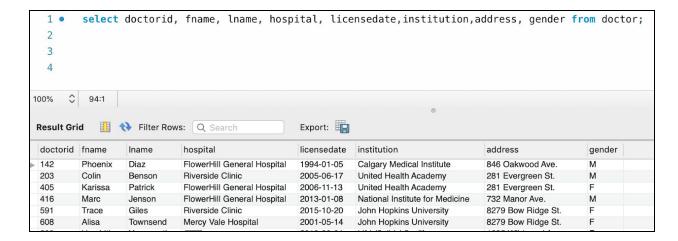
2. Current plan Query: It fetches current plan details such as plan start date, end date, OOP Spent, Deductible spent, premium payment status.



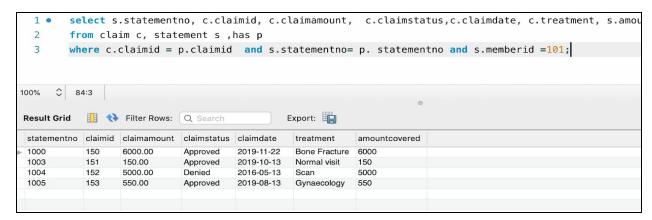
3. Plans query: It fetches all the plans that are available for members.



4. Available Doctors query: It fetches list of doctors available along with their details.

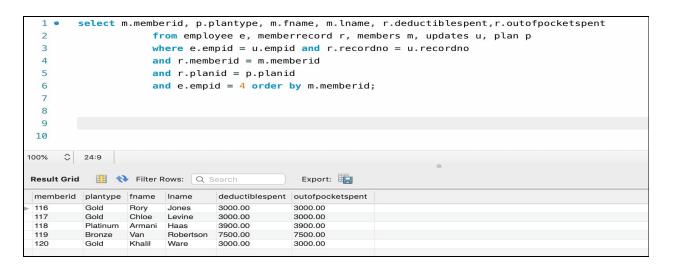


5.Statements Query: It fetches both approved and denied statements related to member

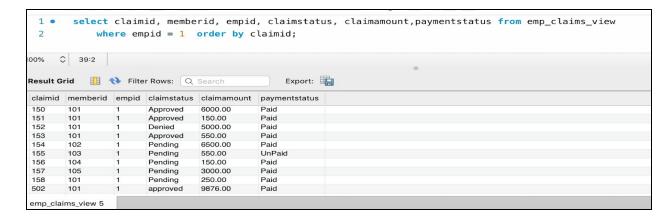


Employee Queries:

6.Members Fetch Query: Lists down members along with their details that are assigned to an employee.



7.Claims List Query: It fetches the claim details of the members assigned to the employee.



8. Member record update for approved claim: It is a stored procedure which runs whenever a claim is approved. It generates a statement with claim details and approved amount. It also updates member record with new values for deductible spent and out of pocket spent.

Transaction has been implemented as part of the stored procedure to maintain ACID properties. If one of the update/insert statements fail in the transaction then database roll back to previous state. Fig.1 illustrates the transaction performed during the member record update.

Fig.1 Transaction during member record update.

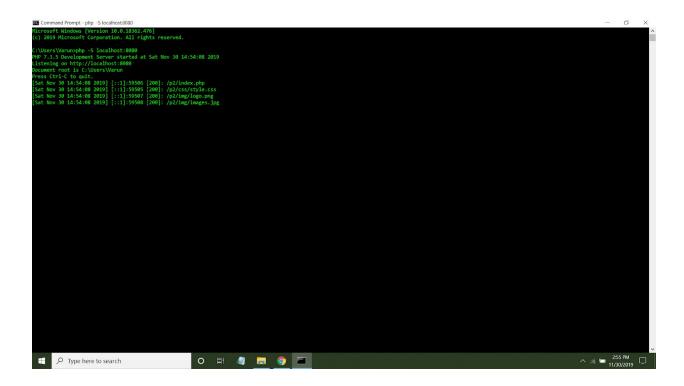
9. Denial Claim: Stored procedure performed when claim gets denied. It generates a statement with claim details and claim status. Transaction has been implemented as part of stored procedure such that if any of the query fails, database roll backs to the earlier state. Fig. 2. Displays stored procedure for denial of the

```
CREATE PROCEDURE claimDenial(IN var_claimID integer )
   DECLARE var_rollback BOOL DEFAULT 0;
   DECLARE var_approvedAmount DEC(10,2) DEFAULT 0.0;
   DECLARE var_bill DEC(10,2) DEFAULT 0.0;
   DECLARE out_param INT;
   DECLARE var_memberid INT;
  DECLARE var_empid INT;
 DECLARE CONTINUE HANDLER FOR SQLEXCEPTION SET var_rollback = 1;
   SELECT claimamount, memberid INTO var_bill, var_memberid FROM claim where claimid=var_claimID;
   SELECT u.empid INTO var_empid FROM memberrecord mr, updates u
 where u.recordno = mr.recordno and u.memberid = mr.memberid and mr.memberID=var_memberid;
 START TRANSACTION;
 UPDATE claim SET claimStatus = 'denied' WHERE claimid = var_claimID;
 SET var_approvedAmount = 0.0;
 INSERT INTO statement(memberid,empid,amountCovered) values (var_memberid, var_empid, var_approvedAmount);
 SET out_param = LAST_INSERT_ID();
 INSERT INTO has(claimid,statementNo) values (var_claimID,out_param);
 IF var_rollback THEN
  COMMIT;
 END IF;
 SELECT var_claimID, var_bill, var_memberid, out_param, var_rollback;
```

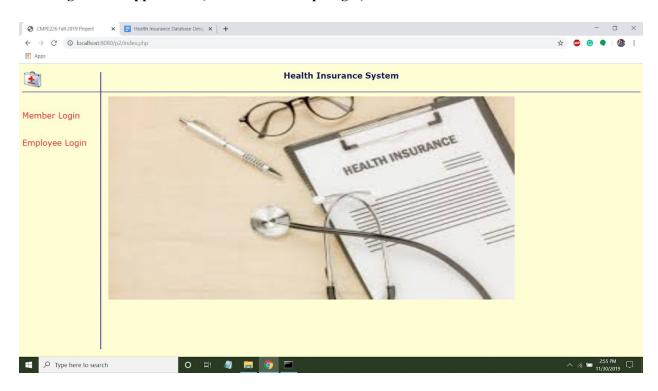
10.

Application Execution

Starting the localhost server using Wamp Server

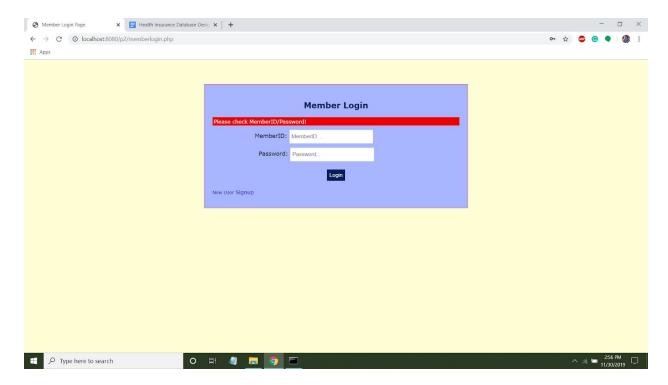


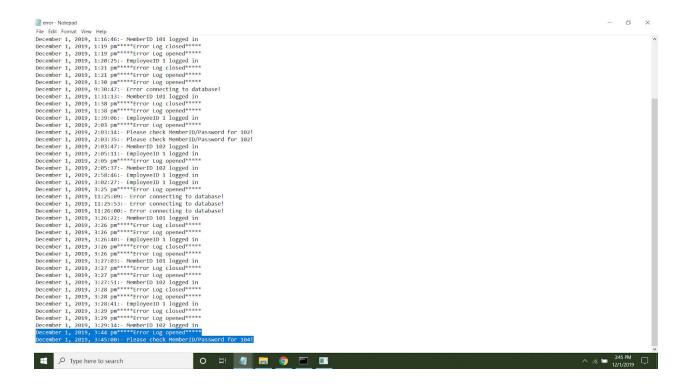
First Page of the Application (Member and Emp Login)



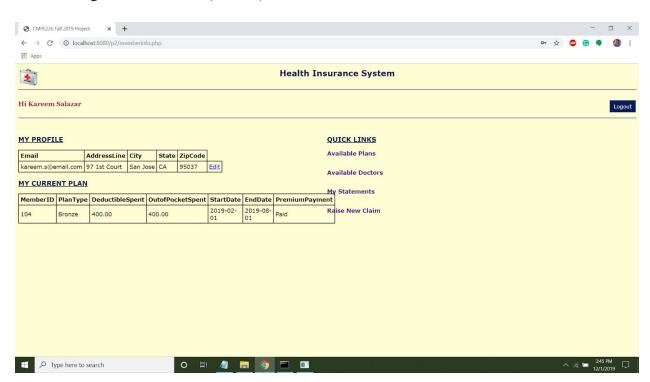
Login in as Member 104

Logging the Login Error in a text file

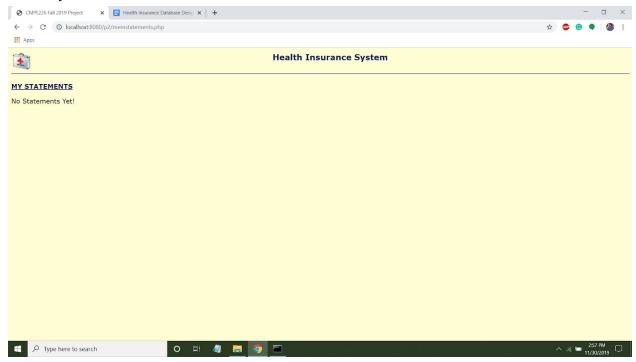




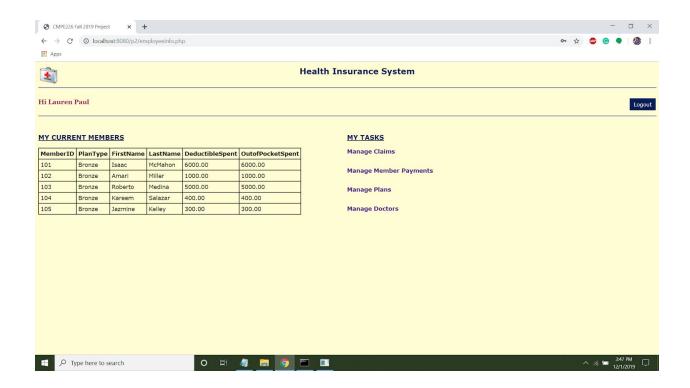
Successful login of Member 104 (Kareem)



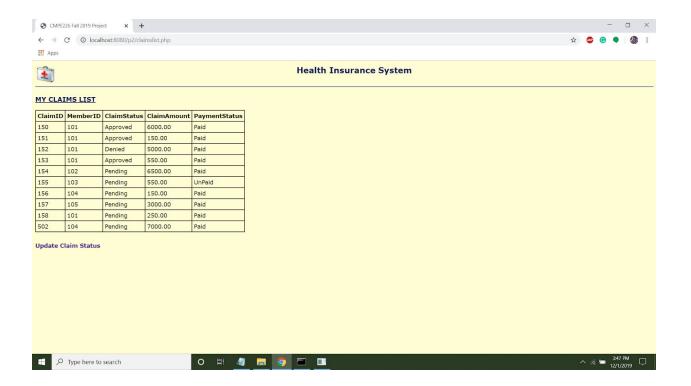
Currently no statements

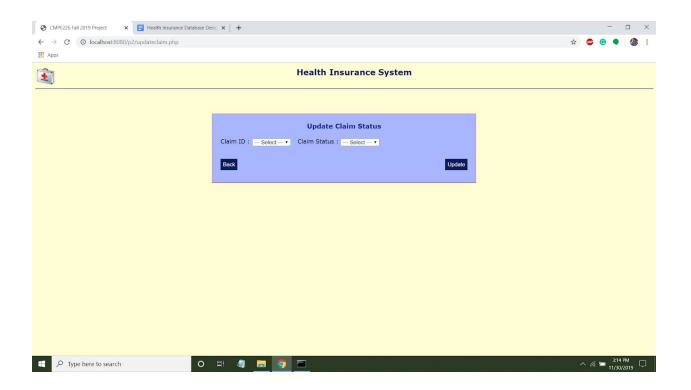


Logging in as Employee 1 (Lauren) who manages members

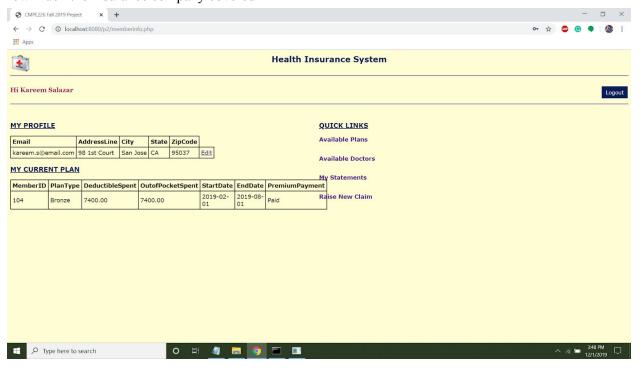


Approving member 101 claim from pending to approved

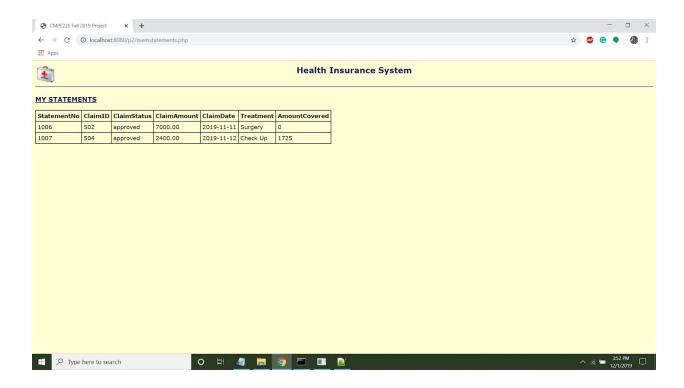




As you can see, once member 104 logs in again, he is able to view his updated record and a statement of how much the insurance company covered



When he raises a new claim for amount (2400), the record is updated again and he can view his statements which show that the insurance company covered \$1725.



For member 200, there is a reminder that he has not paid his monthly premium upon login!

