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ANNARBOR COMMUNITY CLINIC

A graduate project submitted to Dakota State University in partial fulfillment of the requirements for the degree of

Master of Science
In
Information systems

Fall-2007

By

Madhu S R Burujukindi

Project Committee:

Committee Chair: Dr. Shan Ronghua
Committee Member: Dr. Stephen Krebsbach
Committee Member: Dr. Amit Deokar

DAKOTA STATE dSU UNIVERSITY

PROJECT APPROVAL FORM

We certify that we have read this project and that, in our opinion, it is satisfactory in scope and quality as a project for the degree of Master of Science in Information Systems.

Student Name: **Madhu Sudhan Reddy Burujukindi**

Master's Project Title: **Ann Arbor Community Clinic**

Faculty supervisor: Ronghua Shang Date: 11/27/07

Committee member: Date: 11/27/07

Committee member: Date: 11/27/07

ACKNOWLEDGEMENT

- I express my sincere gratitude to my Project Supervisor Dr. Shan Ronghua for giving me this opportunity and leading me towards a better world of Database Management Systems with his efficient guidance.

- I am thankful to Dr. Stephen Krebsbach and Dr. Amit Deokar for supporting me in completing this project.

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- My hearty thanks to - Ann Arbor Community Clinic Management for their time and consideration. I am very thankful to them for providing all the information related to my project.

ABSTRACT

A Database is a collection of information organized in such a way that a computer program can select desired pieces of data; Database is simply called as a electronic filing system. As the collection of data is going high and high the importance of databases is increasing enormously with in no time. The time has come that each and every small organization need to develop a database. One of the important organizations where database plays a very important role is the health care industries. Health care is directly related to the health of the people, who are the most important resources in this world. The information about the patients is very important and has to be maintained with high security and without any errors. Like every year around 98000 Americans are dying because of medication errors. The CDB was conceptualized in 2004 by an internal medicine physician and informatics expert, along with a team of physicians and nurses who were living with the reality that patient care is an information-intensive service. This team recognized that a patient's medical record is often wanted in many places at the same time. The Ann Arbor Community Clinic is on of the organization which has around 5000 patient visits, and it is important for them to store the right information and save them for very long time and retrieve at the time it is required to provide the best service for the community. So ACC has come with an idea to develop the database to avoid the manual entry, medication errors, problem of storing bulk data and also save time in retrieving the information. This Report Contains the development of database and the importance it plays for the development of the organization by providing the best service in the community.

Declaration

I hereby certify that this project constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

I declare that the project describes original work that has not previously been presented for the award of any other degree of any institution.

Madhu S R Burujukindi

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INTRODUCTION

1.1 CURRENT PROBLEM:

Arbor Community Clinic provides services like Pediatric care, Family Practice, Internal Medicine, Obstetrics, Diabetics, and Dental etc .to the patients. When a patient requires some type of treatment, an *appointment is* scheduled. The appointment will be scheduled for a particular date at a particular time in a room and with a provider. The appointment will be for some number of services. ACC anticipates the clinic will have 5,000 patient visits by 2008. It is the goal of Ann Arbor Community Clinic to provide quality affordable health care for Ann Arbor community. But so far the community clinic is using the manual entry to maintain the records starting from scheduling to billing, discharging and finally to maintain records of patients. But as a part of this vision the founders hope to develop and utilize a Clinical Database System to improve the efficiency of tracking patient information, recording medical history, billing patient insurance companies, and collecting payments from patients. It is hoped that an efficient Database System will keep down costs, improve patient treatment, and allow the practice to meet its expansion goals.

1.2 Objective:

The main objective in the present project is to go for Designing, Developing, Implementing and Maintaining Clinical Database for Ann Arbor Community Clinic.

1.3 ABOUT ANNARBOR COMMUNITY CLINIC

Ann Arbor Community Clinic (ACC), a private, nonprofit, health care center established in Ann Arbor, Michigan in September, 2003. Doctors of major health organizations from in and around Ann Arbor, volunteer the Ann Arbor Community clinical activities.

They are in the process of getting established. They are on the look out for non-profitable organization that can put up a web site and design a Database system for their clinical activities. My company has shown interest to design, develop and implement Database System for Ann Arbor Community Clinic which would serve the community clinic.

Currently they are operating in hundreds, by the end of 2008, ACC anticipates the clinic will have 5,000 patient visits.

All medical staff at the clinic are highly qualified professionals who have chosen to work with those in need. The clinic functions like a regular medical practice, with patients returning to see their chosen primary care provider whenever possible. Convenient night and weekend hours are provided for both adult and pediatric patients.

The Ann Arbor Community Clinic provides comprehensive, high quality, primary health care to adults and children.

Population

- 85% of the patients are from working families.
- 22% of the patients are under five years old.
- 95% have incomes less than 200% of the federal poverty level.

ACC is governed by a volunteer Board of Directors comprised of members of the medical, professional and business community, including consumers.

Mission:

The Mission of Ann Arbor Community Clinic is to provide excellent healthcare for patients and the communities they serve.

Vision:

Ann Arbor Community Clinic will be a leader in providing comprehensive, convenient and excellent healthcare services to the people in the communities by continuously improving the quality, access, and value of services.

As employees, physicians, and volunteers they want continue to deliver exceptional healthcare and customer service to those choosing Ann Arbor Community Clinic and its affiliated physicians. They are committed to professional and organizational excellence; and serve others with compassion and respect for individual dignity.

It is the goal of Ann Arbor Community Clinic to provide quality affordable health care for Ann Arbor community. Keeping the philosophy of "Quality Medical Care for Everyone" the clinic currently offers Pediatric Care, Family Practice, Internal Medicine, Obstetrics, Diabetics, and Dental services. The practice has a vision of expanding the current services to include options targeted to improve patients self esteem and image. As a part of this vision the founders hope to develop and utilize a Clinical Database System to improve the efficiency of tracking patient information, recording medical history, billing patient insurance companies, and collecting payments from patients. It is hoped that an efficient Database System will keep down costs, improve patient treatment, and allow the practice to meet its expansion goals.

1.4 ENVIRONMENTAL ANALYSIS

Porter's Five Force Analysis related to healthcare Industry:

"Based on my research, I believe that healthcare providers and insurers need to respond to the active consumerism now sweeping healthcare and move forward proactively in a competitive, reorganizing marketplace. I evaluated healthcare using Porter's "five forces" model of industry competition. It analyzes the strengths of buyers, suppliers, potential entrants, and substitutes in relation to five forces--the bargaining power of buyers, the bargaining power of suppliers, the threat of new entrants, the threat of substitutes, and rivalry among current suppliers."

"I believe that the success of healthcare organizations in the new marketplace will rely on two factors.

First, healthcare organizations will have to learn how to leverage their Internet capabilities to lower costs to achieve a fundamentally more efficient production process.

Second, they will have to find ways to create distinct, even unique, products and services that set them apart from their competitors and that can, given the right market conditions, allow them to generate premium pricing structures or achieve some dominance in certain market niches."

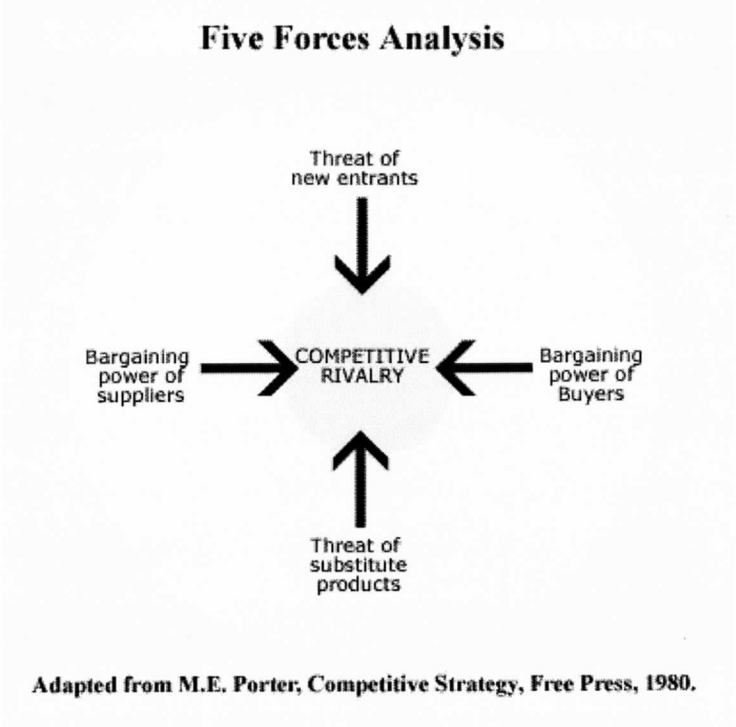


Figure1

The healthcare industry is ripe for collaboration with competitors, or "competition," under the right circumstances. Though not always easy to carry out, cooperative initiatives with competitors to develop acceptance of common information (clinical, administrative and financial standards) can benefit all those involved and improve the efficiency and quality of healthcare system wide.

Although the Internet has the potential for improving performance in many dimensions, healthcare leaders would do well to focus on a couple of key areas where the Internet provides the greatest value: linking physicians and consumers, and improving access to information and services.

Linking physicians and patients is critical. Physicians remain the most trusted source of medical information, advice and care, even in this Internet age. And whether the focus is on content, convenience, customization or connectivity, healthcare organizations must recognize the fundamental nature of the physician-patient relationship and continually reinforce it.

Plus, healthcare e-leaders need to meet the rising demands for greater convenience. Everything organizations can do to earn and retain the trust of consumers, patients and plan members--including ensuring the security and privacy of personal clinical information and documenting clinical outcomes improvement--can contribute to a competitive advantage. How you and your colleagues answer some basic but critical questions will help determine your success in leveraging the Internet for an advantage over your rivals

Healthcare organizations cannot stand still if they expect to compete effectively in the future. E-health, despite its setbacks to date, is here to stay. And, given the right strategies and a true understanding of the market, providers and plans can avoid the pitfalls and seize the opportunities inherent in this important sphere. While the excessive and misplaced optimism of a few years ago is not appropriate, neither is unfounded pessimism. Moving forward is possible. It just has to be done right.

1.5 SWOT ANALYSIS

Analysis of the strategic environment of the healthcare industry is referred to as a SWOT analysis. Environmental factors internal to the healthcare industry usually can be classified as ***Strength (S) or Weaknesses (W)***

- Patient Care & Services
- Compliance to health care standards

Environmental factors external to the firm can be classified as ***Opportunity (O) or Threats (T)***

- Growth in patient demand
- Advancing technology and
- Increased competition.

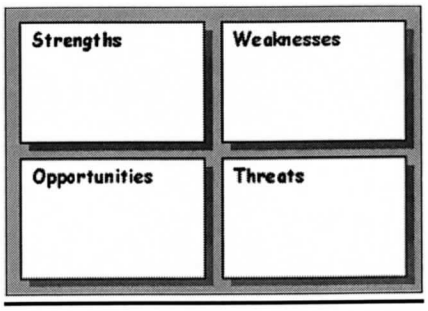


Figure2

1.6 HISTORY OF IT/IS AND DATABASE PROJECTS

The healthcare industry has historically invested the least in information technology. History has changed this however; and, all healthcare providers are now faced with many data-centric issues. Most notably, patient data is far from integrated in the typical hospital environment. In most scenarios, separate applications or packages individually handle treatment-related patient statistics. Lab testing and results, diagnoses, billing, and prescriptions are examples of hospital functions that are often supported with separate "best of breed" software. As a result, complete patient profiles that relate assigned physicians, prescribed tests and drugs, hospital stays, bills, and payments are often manually prepared based upon the hands-on evaluation of separate reports. Insurance claims add substantial complexity to this process.

Overall, healthcare inefficiencies including claim submission errors, billing and payment processing delays, and general inventory tracking can usually be tied to the inability to locate and access accurate information. Solid data management is a precursor to the future of healthcare, including Health Insurance Portability & Accountability Act (HIPPA) compliance.

Internally, hospitals often need to integrate new data into existing application frameworks. A common example is that of the hospital pharmacy and the statistics gathered upon completion of drug clinical trials. Clinical data management is required not only to track the variables and their values during the trial, but also to report the

results in a format that is usually distinct to each trial's sponsor. These clinical trial results then remain separate from the other hospital pharmacy databases as well as from those databases tracked by the overall healthcare institution. When the need for a consolidated expense report arises, the sponsor information typically has to be reported separately, without any connections to departmental accounting data.

As healthcare becomes a renewed focus of local, federal, and international governments, the need for solid data quality, data management, sharing, and transmission continues to expand. Evaluation of existing hospital data and its quality as a pre-requisite to HIPPA compliance.

1.7 NEED FOR DATABASE

Database technology has been a familiar tool in the operations of most healthcare departments, moves from the task of supporting paper systems to actually becoming the central digitized health information system. Healthcare professionals entering the work force need to have the necessary database skills to perform their jobs.

More than 98,000 Americans a year die from medication errors, the healthcare industry is also quickly adopting the use of databases to track everything from prescription medications and laboratory tests to patient outcomes. The reason for the shift is that until now, most medical information has been recorded on paper, a practice that has led to a great deal of waste, duplication, and inappropriate utilization of treatments.

Recently, the US Department of Health and Human Services (HHS) announced plans to create a national database containing electronic medical records that track a person's interaction with the healthcare system from birth to death. To stay current with the HHS proposal to digitize healthcare information, AHIMA has adopted a strategic plan called electronic health information management (e-HIM), which calls for the creation of practices that "ensure the availability of health information to facilitate real-time healthcare delivery and critical health related decision-making for multiple purposes across diverse organizations, settings, and disciplines." These goals, although ambitious,

will not come to fruition unless healthcare information is stored accurately, reliably, and securely in well-designed computerized databases.

1.8 CLINICAL DATABASE IMPLEMENTATION

The CDB was conceptualized in 2004 by an internal medicine physician and informatics expert, along with a team of physicians and nurses who were living with the reality that patient care is an information-intensive service. This team recognized that a patient's medical record is often wanted in many places at the same time.

The CDB allows physicians, nurses and other authorized caregivers to access clinical information from most ACC departments, including admitting, core labs, medical records, clinic scheduling, insurance, billing and payments.

Physicians will be able to access the system through one of more terminals located on inpatient and outpatient units throughout ACC. By the end of the year, the data should be available through dial-in connections to authorized users at remote sites, including physician offices.

Currently ACC is using disparate IT applications, which are proprietary and home grown at various operation platforms. It is required to build up a clinical database platform so as to exchange & share the information.

ACC is planning to use clinical database in four main areas:

1. Audit, to assess the quality of care provided in terms of its effectiveness, equity and efficiency.
2. Individual patient care, by providing accurate data on the possibilities of different outcomes, which are needed to inform patients.
3. Planning services.
4. Evaluative research, to establish the clinical effectiveness and cost-effectiveness of interventions and services.

Key issues for consideration in Clinical Database Management

Data security: is increasingly important in order to protect the privacy of individuals' data. A workshop of database custodians held on 20 February 2003 identified the following six principal areas of concern that should be considered by all those responsible for a database.

Data confidentiality: useful web links to sites containing practical information and advice regarding confidentiality and privacy of data.

Database quality: practical tips on measuring and improving the validity and reliability of data.

Disclosure of performance: examples of methods of disclosure and useful publications.

Database outputs: examples of audit reports and other outputs.

Data integration: is usually a constant issue regardless of the state of a healthcare provider's internal data stores. New data problems arise on a regular basis and can be internal or external to the institution but are usually a combination of both.

1.9 RELATIONAL DATABASES

The most common form of database used in healthcare is the relational database. Relational databases can be used to track patient care in the form of treatments, outcomes of those treatments, and critical indicators of a patient's current state such as blood pressure, heart rate, and blood glucose levels. Relational databases can also be used to interconnect with multiple informational systems throughout a healthcare facility. For example, a relational database in a cardiac care unit can be directly linked to a hospital's registration system. Upon registration, a newly admitted patient's demographic information is sent automatically to the cardiac database using Health Level 7 protocols.

This eliminates the need for cardiac care clinicians to input patient information into the database, freeing them to concentrate on providing the patient with the best care possible.

Relational databases have the potential to eliminate paper storage and transfer of information and to answer important questions about healthcare efficacy rather than merely serving as an accounting mechanism. For example, diabetic patients sharing similar health risk factors (for example, slightly overweight, high HbA1c and fasting blood glucose readings) can be closely monitored to determine how different drugs (for example, Glucovance) help to control those factors. From an administrative and prevention standpoint, relational databases can be used to identify at-risk patients, for example, those who have a family history of aneurysms. Once identified, patients can be screened to prevent them from succumbing to a particular disease.

WHY DID ACC CHOOSE ORACLE 9i?

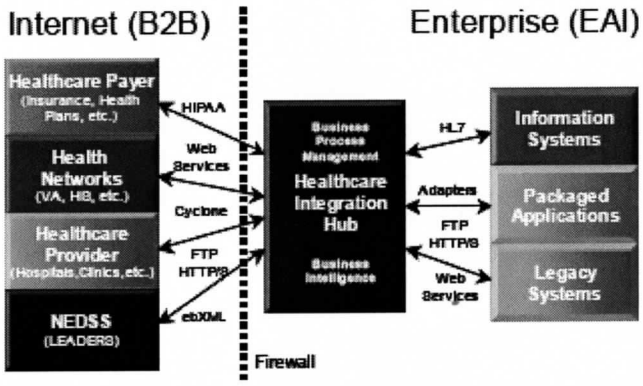


Figure 1: Oracle 9i Healthcare Integration Hub

Source: http://www.oracle.com/industries/government/iHub4PubHCpdf.pdf

Figure 3

ACC has concrete and well designed plans to expand in future. Oracle's built in features were well analyzed by ACC panel of experts. Since the integration component is readily

available, ACC decided to go with Oracle 9i. This integration hub provides healthcare industry to integrate from legacy systems to B2B – applications for going online, which is the next step in ACC's task of things.

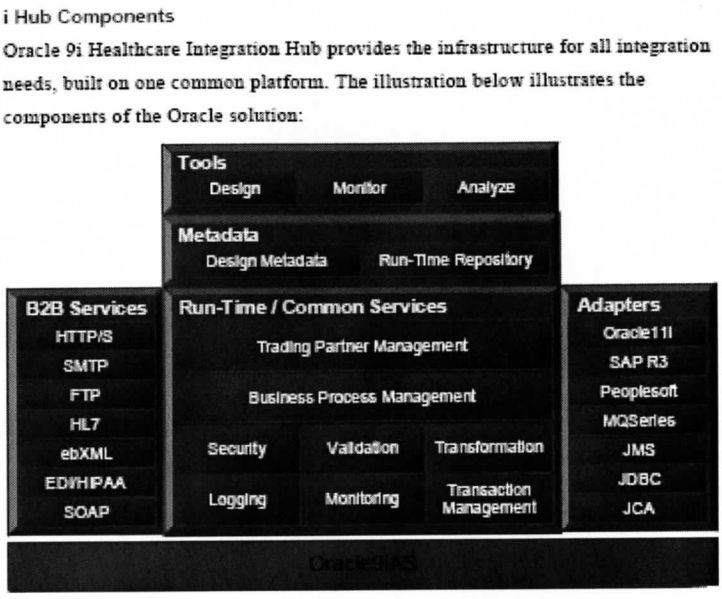


Figure 2: Oracle 9i Healthcare Integration Hub Components

Source : http://www.oracle.com/industries/government/iHub4PubHCpdf.pdf

Figure4

CHAPTER 2

SYSTEM REQUIREMENTS

2.1 DATABASE DEVELOPMENT PROCESS (SDLC)

PLANNING:

Scope:

- Gathering user requirements
- Designing, Developing, Implementing and Maintaining Clinical Database for Ann Arbor Community Clinic.

ANALYSIS:

Modeling Entity Relationship Diagram

LOGICAL DESIGN:

Developing Relational Schema

PHYSICAL DESIGN:

- Designing Tables; Forms

IMPLEMENTATION:

- Loading Data
- Creating Stored Procedures; Triggers
- Designing Reports

MAINTENANCE:

- Testing; Debugging
- Support

2.2 METHODOLOGY & Tool Selection

1. Database Design: NEW

2. DBMS: Oracle 9i; Forms Builder 6i, Reports Builder 6i

3. Query: SQL , PL/SQL

4. For Creating Entity Relationship Diagram - **Smart Draw**

CHAPTER 3

SYSTEM ANALYSIS

The analysis of the system starts when the requirements of the system are collected from the client. The requirements are analyzed by the business analyst using different methodologies and converts in to readable way by the pictorial representation(UML diagrams) using the tools like rational software. When the business analyst is done with the UML diagrams to goes to the developer to understand that and transform them into ER diagrams.

3.1 ENTITY RELATIONSHIP DIAGRAM

Entity relationship diagrams are the major data modeling tools that will help in organizing the data by entities and relation between the entities. This process enables the analyst to produce the good database structures so that data can be stored and retrieved in most efficient manner.

ENTITY:

A data entity is anything real or abstract about which we want to store data, Entity types fall into five classes: roles, events, locations, tangible things or concepts. E.g. employee, payment, campus, book. Specific examples of an entity are called **instances**

RELATIONSHIP:

A data relationship is a natural association that exists between one or more entities. E.g. Employees process payments.

ATTRIBUTE:

A data attribute is a characteristic common to all or most instances of a particular entity. An attribute or combination of attributes that uniquely identifies one and only one instance of an entity is called a **primary key** or **identifier**. E.g. Employee Number is a primary key for Employee.

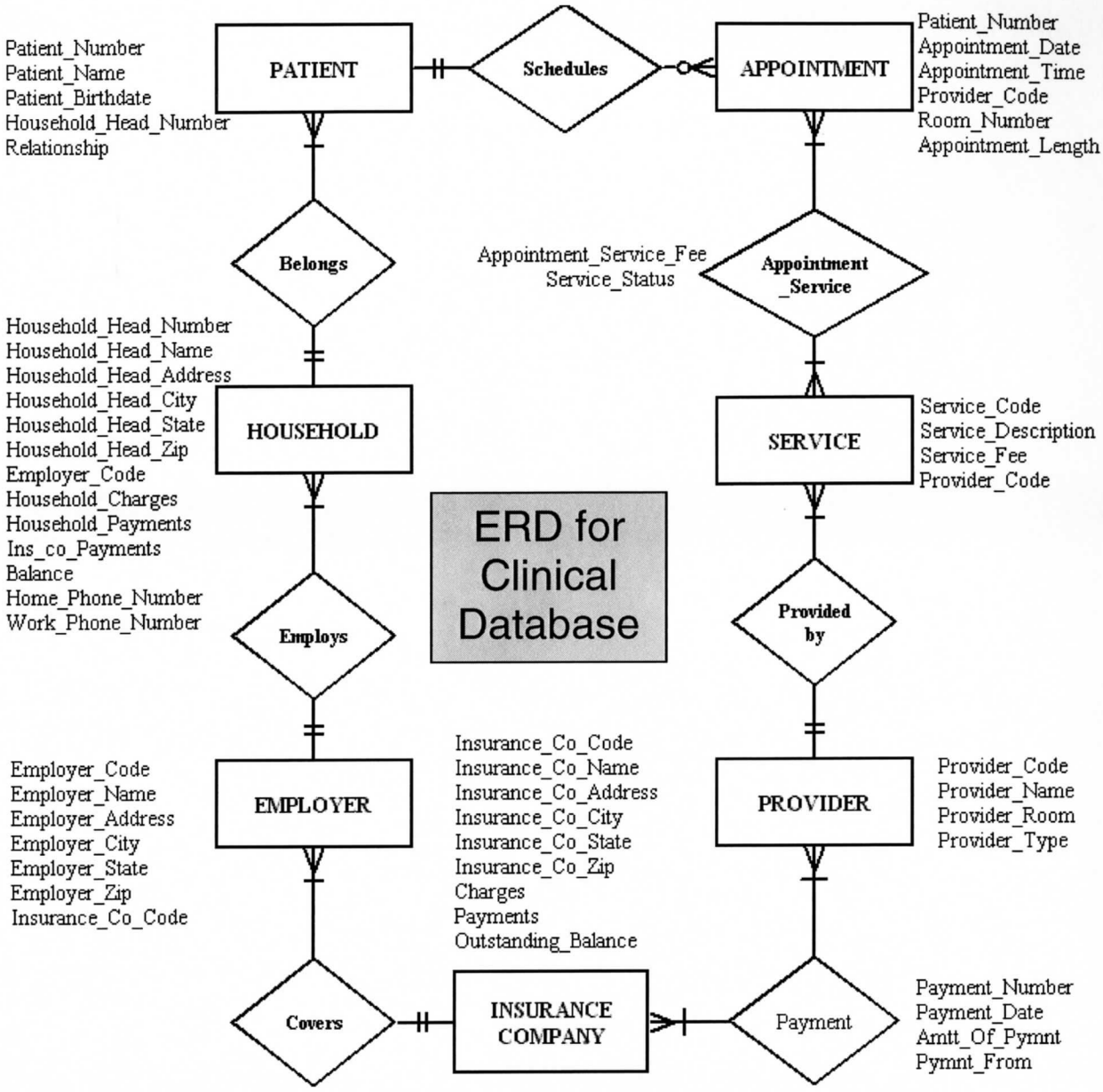

Patient_Number
Patient_Name
Patient_Birthdate
Household_Head_Number
Relationship
PATIENT
Schedules
APPOINTMENT
Patient_Number
Appointment_Date
Appointment_Time
Provider_Code
Room_Number
Appointment_Length
Belongs
Appointment_Service_Fee
Service_Status
Appointment_Service
Household_Head_Number
Household_Head_Name
Household_Head_Address
Household_Head_City
Household_Head_State
Household_Head_Zip
Employer_Code
Household_Charges
Household_Payments
Ins_co_Payments
Balance
Home_Phone_Number
Work_Phone_Number
HOUSEHOLD
SERVICE
Service_Code
Service_Description
Service_Fee
Provider_Code
ERD for Clinical Database
Employs
Provided by
Employer_Code
Employer_Name
Employer_Address
Employer_City
Employer_State
Employer_Zip
Insurance_Co_Code
EMPLOYER
Insurance_Co_Code
Insurance_Co_Name
Insurance_Co_Address
Insurance_Co_City
Insurance_Co_State
Insurance_Co_Zip
Charges
Payments
Outstanding_Balance
PROVIDER
Provider_Code
Provider_Name
Provider_Room
Provider_Type
Covers
INSURANCE COMPANY
Payment
Payment_Number
Payment_Date
Amtt_Of_Pymnt
Pymnt_From

Figure 5

3.2 BUSINESS RULES

1. Patient schedules many appointments; appointment is scheduled by one and only one patient.

2. Appointment is related to one or many services; service is related to one or many appointments.

3. Patient belongs to one and only one household; household can have one or many patients.

4. Household is employed by one and only one employer; employer employs one or many households.

5. Employer is covered by one and only one insurance company; insurance company covers one or many employers.

6. Service is provided by one and only one provider; provider provides one or many services.

7. Provider is paid by one or more insurance companies; insurance company pays to one or more provider.

8. Services are provided to the patients by providers.

9. Patients are grouped into households.

10. Household is employed by an employer with insurance policy through insurance company.

CHAPTER 4

DATABASE DESIGN

4.1 RELATIONAL SCHEMA

STRUCTURE:

PROVIDER (Provider_Code, Provider_Name, Provider_Room, Provider_Type)

SERVICE (Service_Code, Service_Description, Service_Fee, Provider_Code)

FK Provider_Code -> Provider

INSURANCE_CO (Insurance Co Code, Insurance_Co_Name, Insurance_Co_Address, Insurance_Co_City, Insurance_Co_State, Insurance_Co_Zip, Charges, Payments, Outstanding_Balance)

EMPLOYER (Employer Code, Employer_Name, Employer_Address, Employer_City, Employer_State, Employer Zip, Insurance_Co_Code, Group_Number)

FK Insurance_Co_Code -> Insurance_Co

HOUSEHOLD (Household Head Number, Household_Head_Name, Household_Head_Address, Household_Head_City,Household_Head_State,Household_Head_Zip, Employer_Code,Household_Charges, Household_Payments, Ins_Co_Payments, Balance, Home_Phone_Number, Work_Phone_Number)

FK Employer_Code -> Employer

PATIENT (Patient Number, Patient_Name, Patient_Birthdate, Household_Head_Number, Relationship)

FK Household_Head_Number -> Household

APPOINTMENT (Patient Number, Date, Time, Provider_Code, Room Number,Appointment Length)

FK Patient_Number -> Patient
FK Provider_Code -> Provider

APPOINTMENT_SERVICE (Patient Number, Date, Time, Service_Code, Service_Status, Appointment_Service_Fee,)

FK Patient_Number-> Appointment
FK Date -> Appointment
FK Time -> Appointment
FK Service_Code -> Service

PAYMENT (Payment_Number, Payment_Date, Amt_Of_Payment, Pymnt_From, Povider_Code Insurance_Co_Code,)

FK Insurance_Co_Code -> Insurance_Co
FK Provider_Code -> Provider

4.2 DOMAIN:

Attribute	Logical Name	Physical Name
Appointment_Length	Appointment Length	Integer
Appointment_Service_Fee	Appointment Service Fee	Integer
Balance	Balance	Integer
Charges	Insurance Charges	Integer
Date	Appointment Date	Date(mm/dd/yyyy)
Employer_Code	Employer Code	Character(2)
Employer Name	Employer Name	Character(30)
Employer Address	Employer Address	Character(25)
Employer_City	Employer City	Character(20)
Employer_State	Employer State	Character(2)
Employer_Zip	Employer Zip Code	Integer
Home_Phone_Number	Household HomePhoneNumber	Integer
Group_Number	Employer Group Number	Character(10)
Household_Head_Number	Household Head Number	Character(5)
Household_Head_Name	Household Head Name	Character(30)
Household_Head_Address	Household Head Address	Character(25)
Household_Head_City	Household Head City	Character(20)

Household_Head_State	Household Head State	Character(2)
Household_Head_Zip	Household Head Zip code	Integer
Household_Charges	Household Charges	Integer
Household_Payments	Household Payments	Integer
Insurance_Co_Code	Insurance Company Code	Character(2)
Insurance_Co_Name	Insurance Company Name	Character(30)
Insurance_Co_Address	Insurance Company Address	Character(25)
Insurance_Co_City	Insurance Company City	Character(20)
Insurance_Co_State	Insurance Company State	Character(2)
Insurance_Co_Zip	Insurance Company Zip Code	Integer
Ins_Co_Payments	Insurance Company	Integer
Outstanding_Balance	Insurance Outstanding Balance	Integer
Patient_Number	Patient Number	Integer
Patient_Name	Patient Name	Character(25)
Patient_Birth_Date	Patient Birth Date	Date(mm/dd/yyyy)
Payments	Insurance Payments	Integer
Payment_Date	Payment Date	Date(mm/dd/yyyy)
Provider_Code	Provider Code	Character(2)
Provider_Name	Provider Name	Character(20)
Provider_Room	Provider Room	Integer
Provider_Type	Provider Type	Character(15)
Relationship	Household Relationship	Character(15)
Room_Number	Room Number	Integer
Service_Code	Service Code	Character(5)
Service_Description	Service Description	Character(20)
Service_Fee	Service Fee	Integer
Service_Status	Service Status	Character(20)
Time	Appointment Time	Time
Work_Phone_Number	HouseHold Work PhoneNumber	Integer

4.3 STRUCTURAL CONSTRAINTS:

Primary Key:

1. Provider_Code in PROVIDER may not be null.
2. Service_Code in SERVICE may not be null.
3. Insurance_Co_Code in INSURANCE_CO may not be null.
4. Employer_Code in EMPLOYER may not be null.
5. Household_Head_Number in HOUSEHOLD may not be null.
6. Patient_Number in PATIENT may not be null.
7. Patient_Number in APPOINTMENT may not be null.
8. Date in APPOINTMENT may not be null.
9. Time in APPOINTMENT may not be null.
10. Patient_Number in APPOINTMENT_SERVICE may not be null.
11. Date in APPOINTMENT_SERVICE may not be null.
12. Time in APPOINTMENT_SERVICE may not be null.
13. Service_code in APPOINTMENT_SERVICE may not be null.
14. Payment_Number in PAYMENT may not be null.

4.4 CARDINALITIES:

Minimum cardinality:

1. Service_Code in SERVICE must exist in Service_Code in APPOINTMENT_SERVICE
2. Patient_Number in PATIENT must exist in Patient_Number in APPOINTMENT.
3. Provider_Code in PROVIDER must exist in Provider_Code in APPOINTMENT.
4. Household_Head_Number in HOUSEHOLD must exist in Household_Head_Number in PATIENT.
5. Employer_Code in EMPLOYER must exist in Employer_Code in HOUSEHOLD.
6. Insurance_Co_Code in INSURANCE_CO must exist in Insurance_Co_Code in EMPLOYER.
7. Provider_Code in PROVIDER must exist in Provider_Code in SERVICE.

8. Patient_Number in APPOINTMENT must exist in Patient_Number in APPOINTMENT_SERVICE.
9. Date in APPOINTMENT must exist in Date in APPOINTMENT_SERVICE.
10. Time in APPOINTMENT must exist in Time in APPOINTMENT_SERVICE.
11. Provider_Code in PROVIDER must exist in Provider_Code in PAYMENT.
12. Insurance_Co_Code in INSURANCE_CO must exist in Insurance_Co_Code in PAYMENT.

4.5 REFERENTIAL INTEGRITY:

1. Service_Code in APPOINTMENT_SERVICE must exist in Service_Code in SERVICE.
2. Patient_Number in APPOINTMENT must exist in Patient_Number in PATIENT.
3. Provider_Code in APPOINTMENT must exist in Provider_Code in PROVIDER.
4. Household_Head_Number in PATIENT must exist in Household_Head_Number in HOUSEHOLD.
5. Employer_Code in HOUSEHOLD must exist in Employer_Code in EMPLOYER.
6. Insurance_Co_Code in EMPLOYER must exist in Insurance_Co_Code in INSURANCE_CO.
7. Provider_Code in SERVICE must exist in Provider_Code in PROVIDER.
8. Patient_Number in APPOINTMENT_SERVICE must exist in Patient_Number in APPOINTMENT.
9. Date in APPOINTMENT_SERVICE must exist in Date in APPOINTMENT.
10. Time in APPOINTMENT_SERVICE must exist in Time in APPOINTMENT.
11. Provider_Code in PAYMENT must exist in Provider_Code in PROVIDER
12. Insurance_Co_Code in PAYMENT must exist in Insurance_Co_Code in INSURANCE_CO.

4.6 OPERATIONAL CONSTRAINTS:

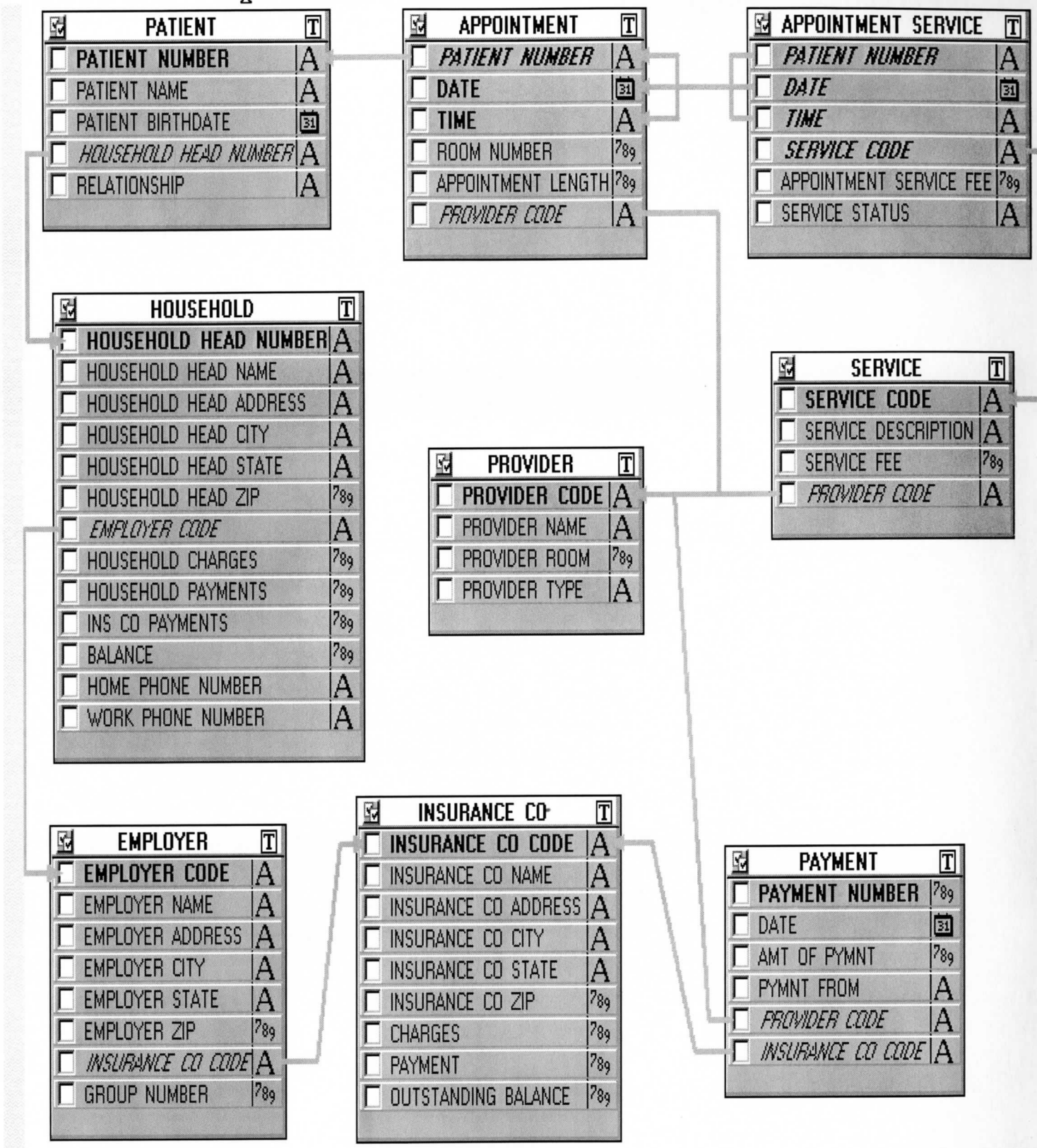
1. Household Head is the only person responsible for paying the bills.
2. All the patients in the household are covered by only one insurance policy.
3. No household is covered by a policy except through the employer of the head of the household.

4.7 CLINICAL DATABASE TABLES

From the Entity Relationship Diagram, I identified 9 entities in the Clinical Database System, hence 9 tables in the database design.

1. **PROVIDER**
2. **SERVICE**
3. **INSURANCE_CO**
4. **EMPLOYER**
5. **HOUSEHOLD**
6. **PATIENT**
7. **APPOINTMENT**
8. **APPOINTMENT_SERVICE**
9. **PAYMENT**

Visual Representation of the Clinical Database Tables



CHAPTER 5

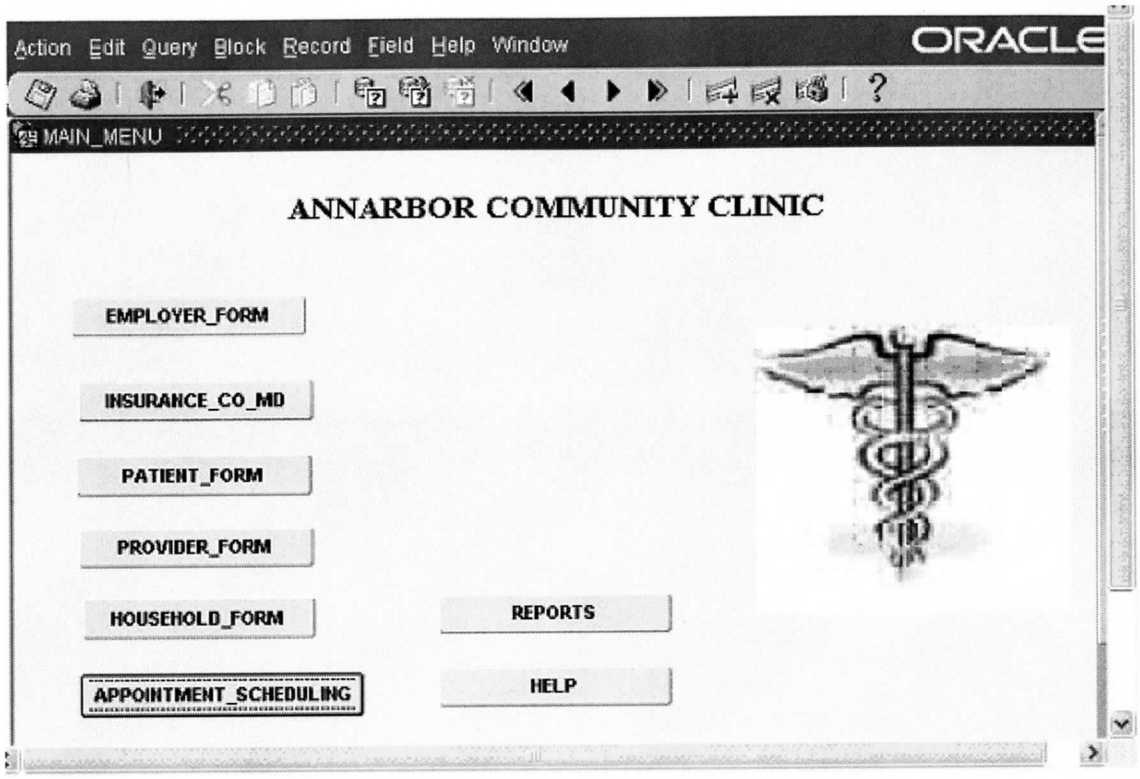
IMPLEMENTATION

5.1 FORMS:

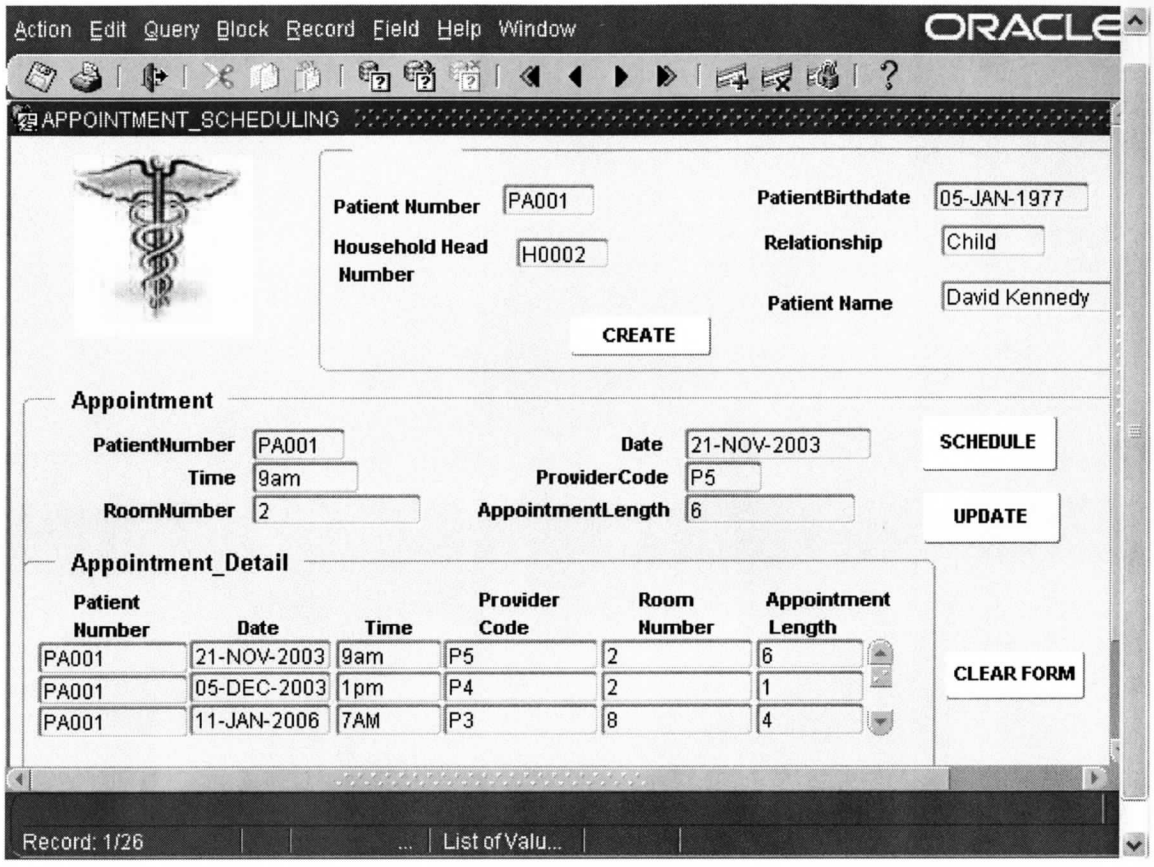
A. Main User Interface Form
B. Provider Form
C. Service Form
D. Insurance company Form
E. Employer Form
F. Household Form
G. Patient Form
H. Payment Form
I. Appointment Form
J. Appointment Service Form
K. Insurance Company Master Detail
L. Appointment Scheduling

FORMS

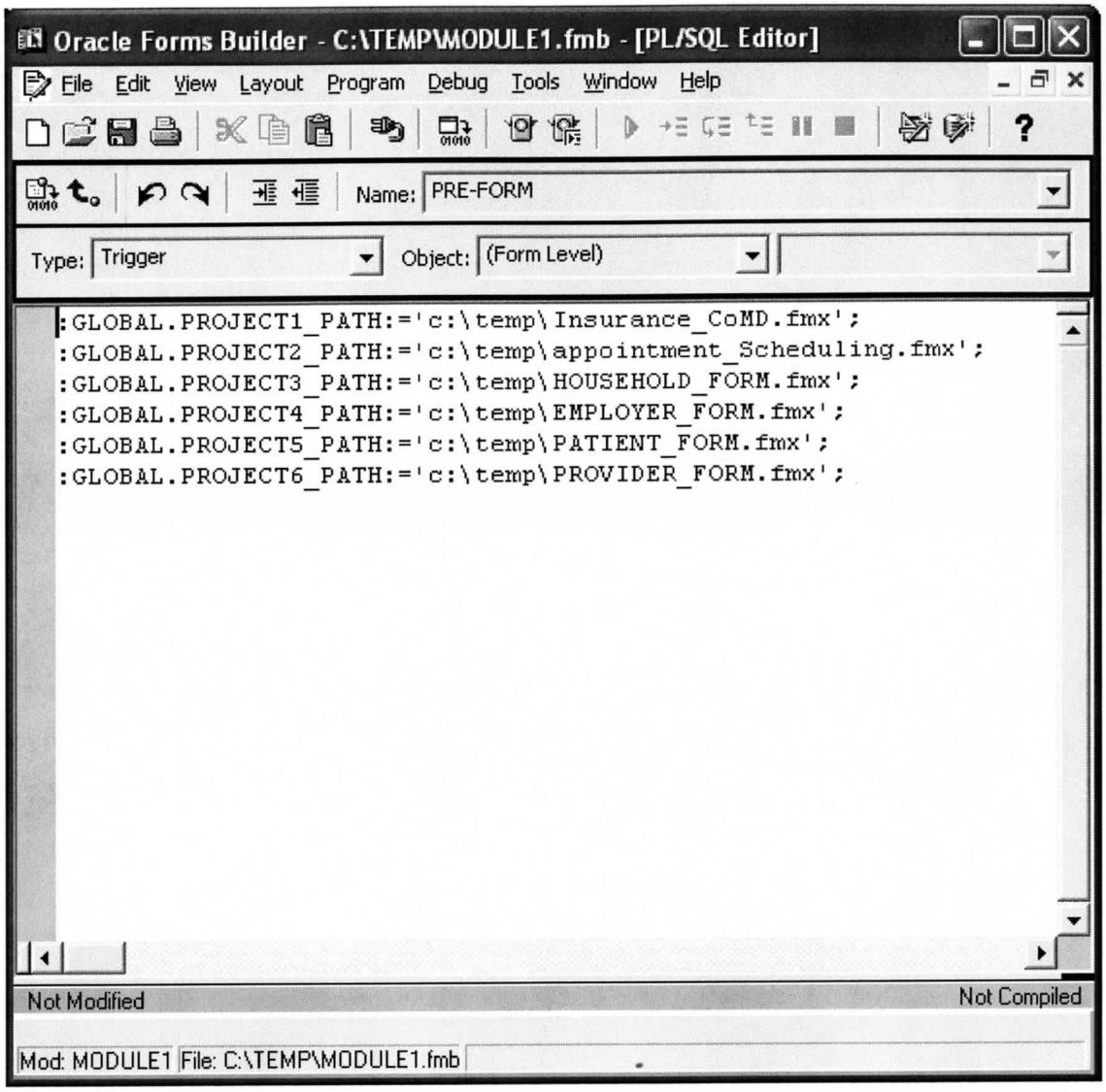
MAIN USER INTERFACE FORM



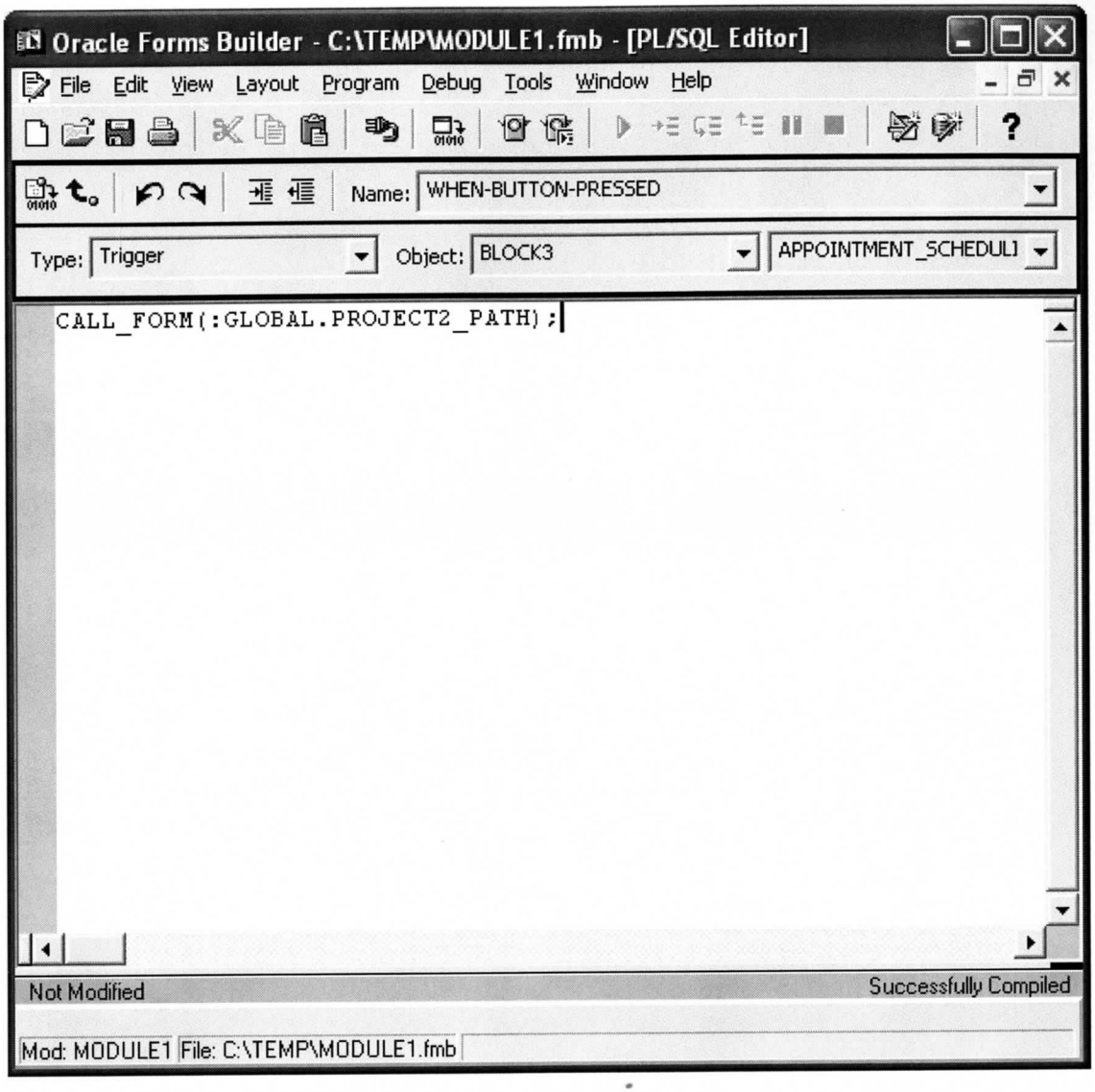
APPOINTMENT_SCHEDULING FORM is displayed when the user clicks on APPOINTMENT_SCHEDULING Button on the User Interface Form



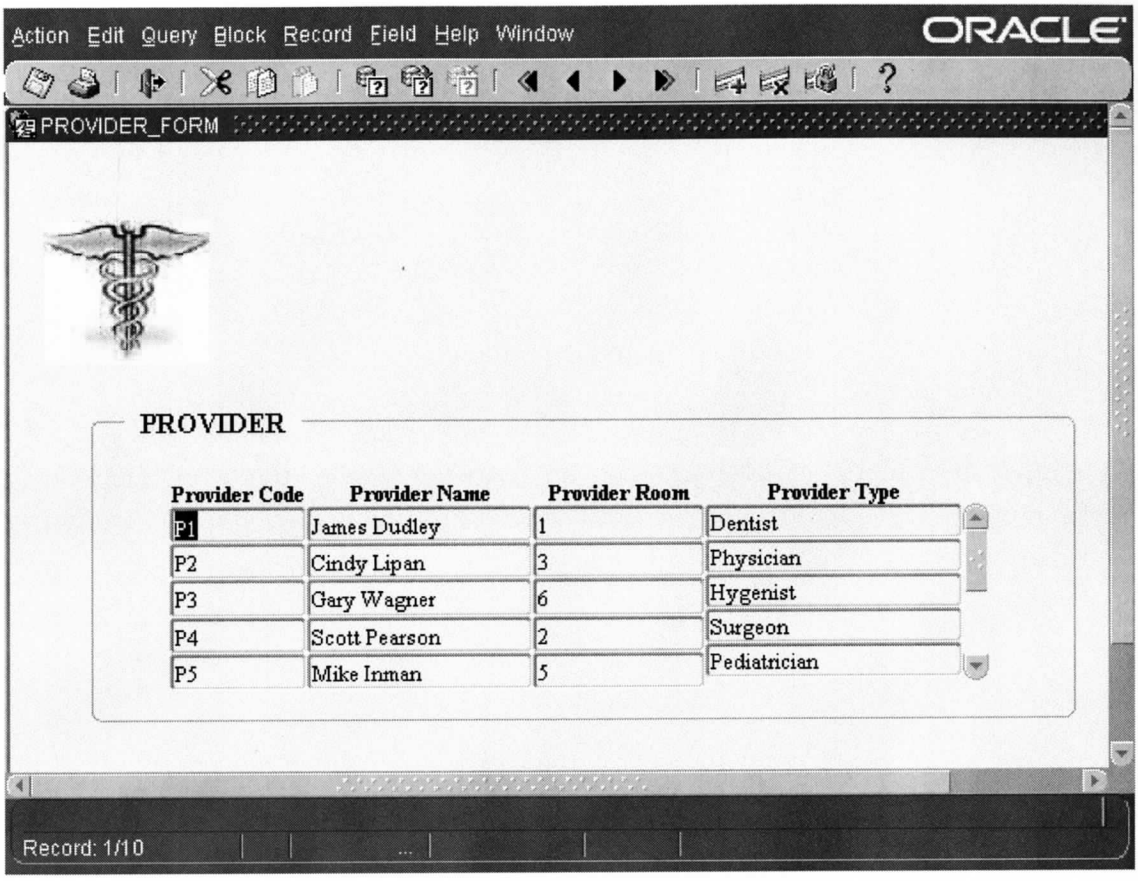
PRE-FORM trigger gives details about the path of the various forms on the UserInterface Menu



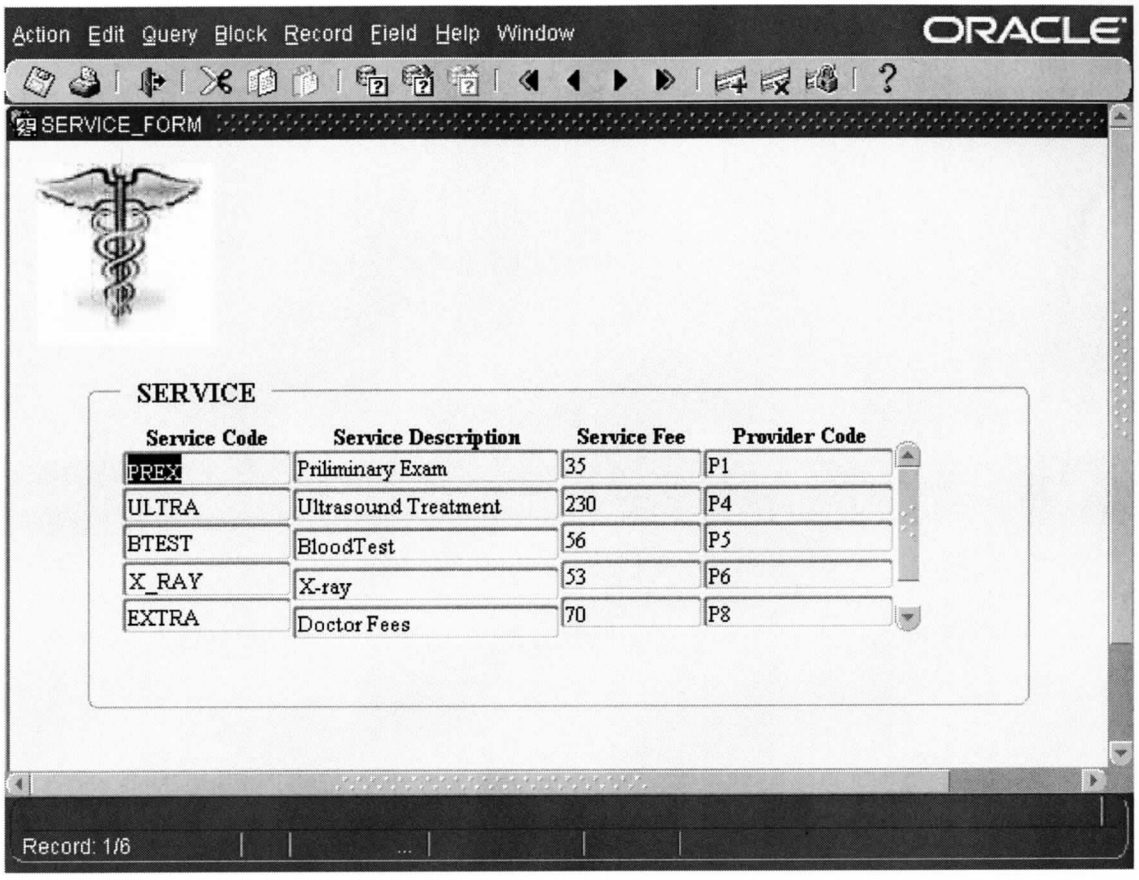
WHEN-BUTTON-PRESSED trigger gives details about the PL/SQL commands associated with APPOINTMENT_SCHEDULING Button.



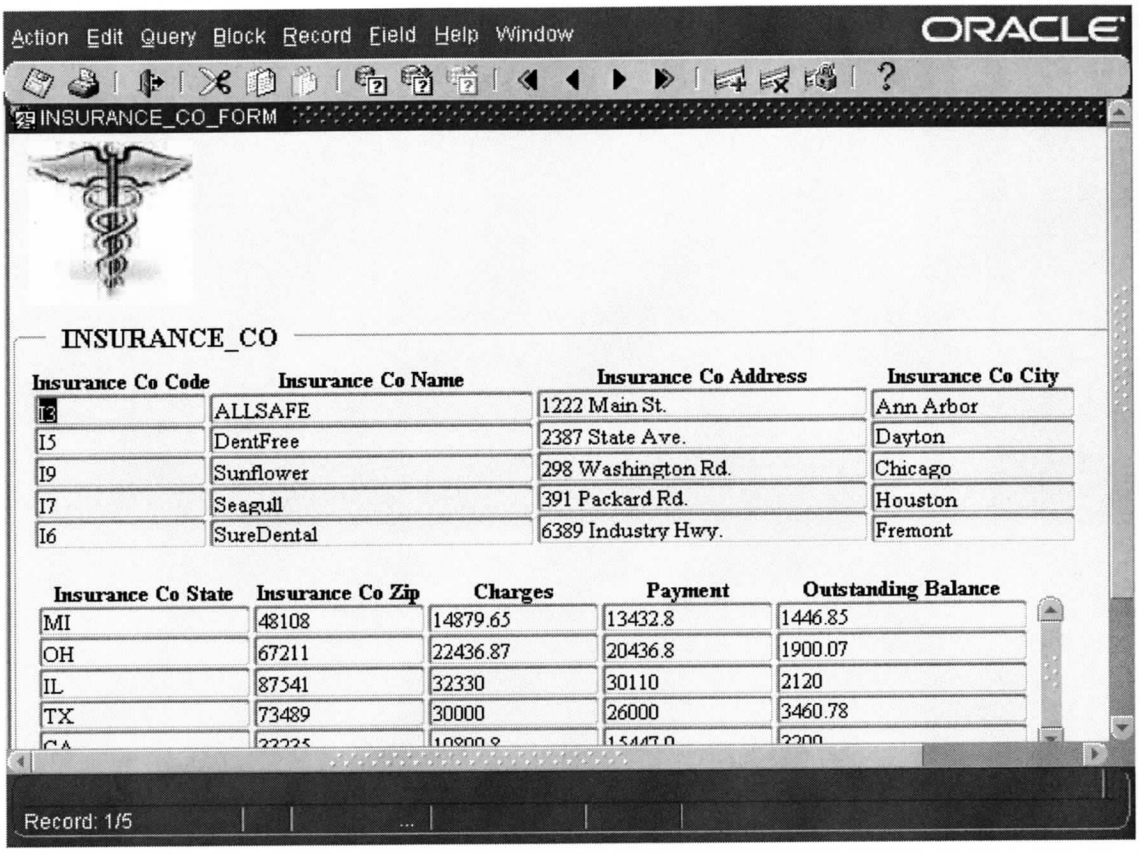
PROVIDER_FORM gives details about the PROVIDERS in ACC



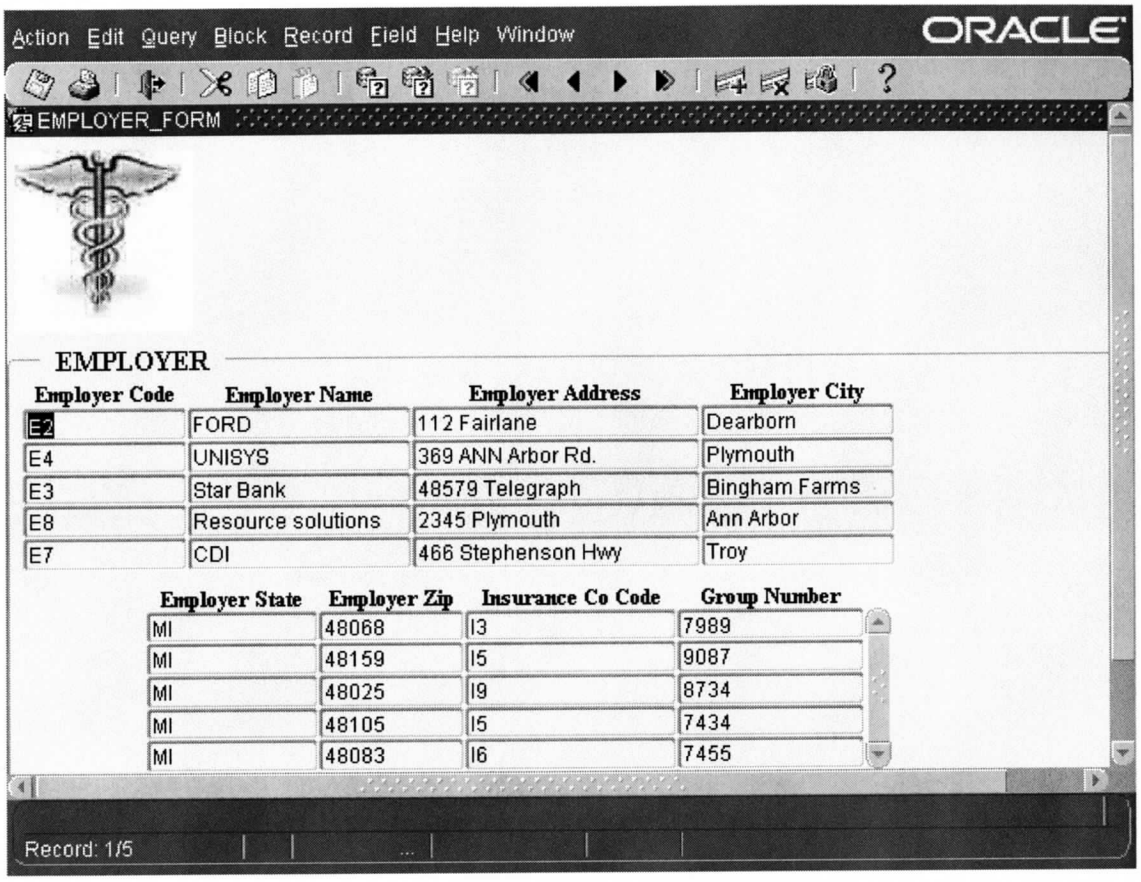
SERVICE_FORM gives details about the SERVICES offered at ACC.



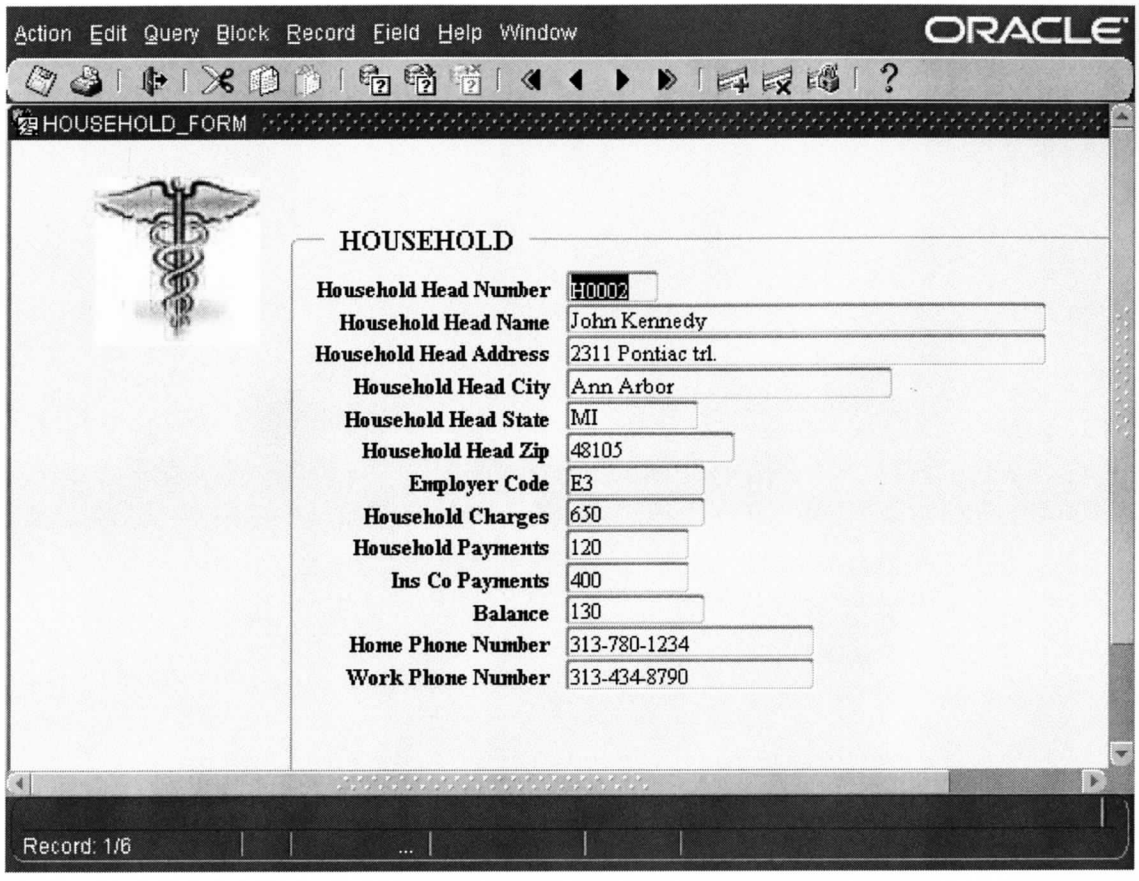
INSURANCE_CO_FORM is maintained by the provider to get a list of INSURANCE COMPANIES they are associated with.



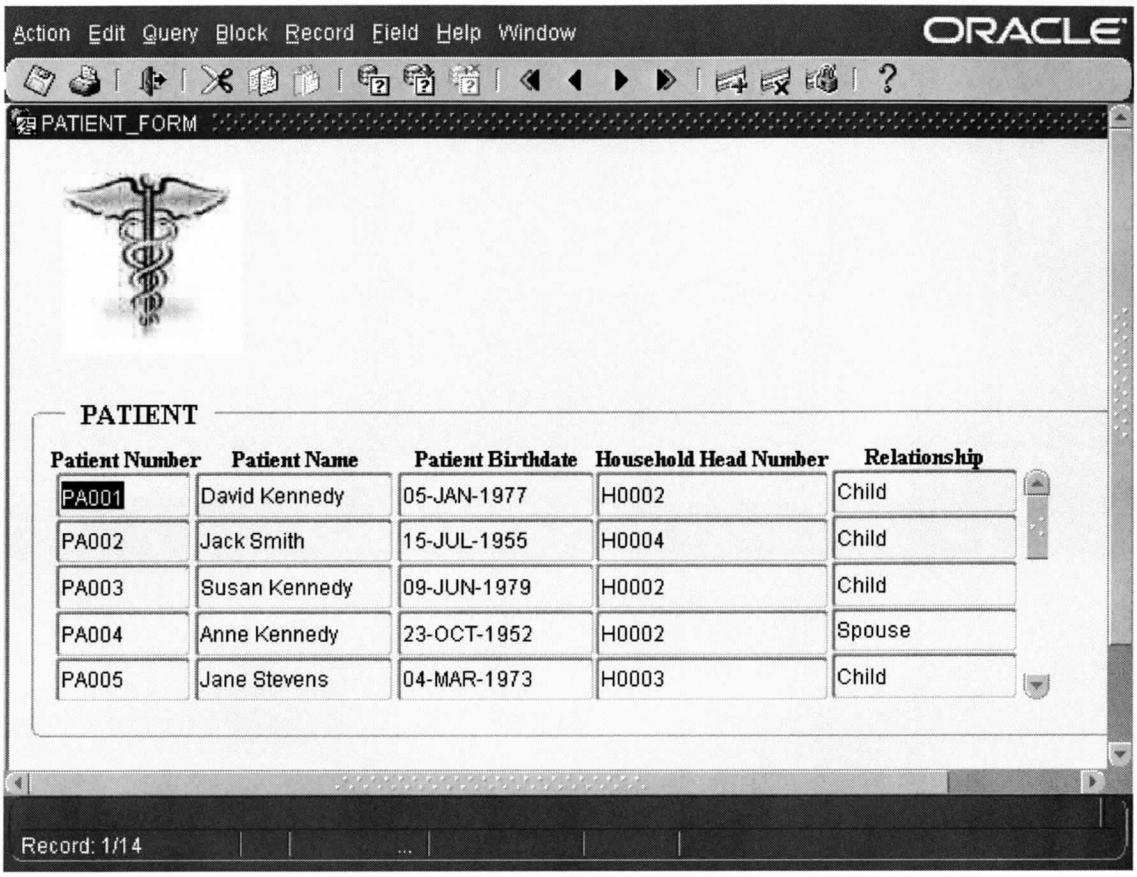
EMPLOYER_FORM lists the EMPLOYEES details.



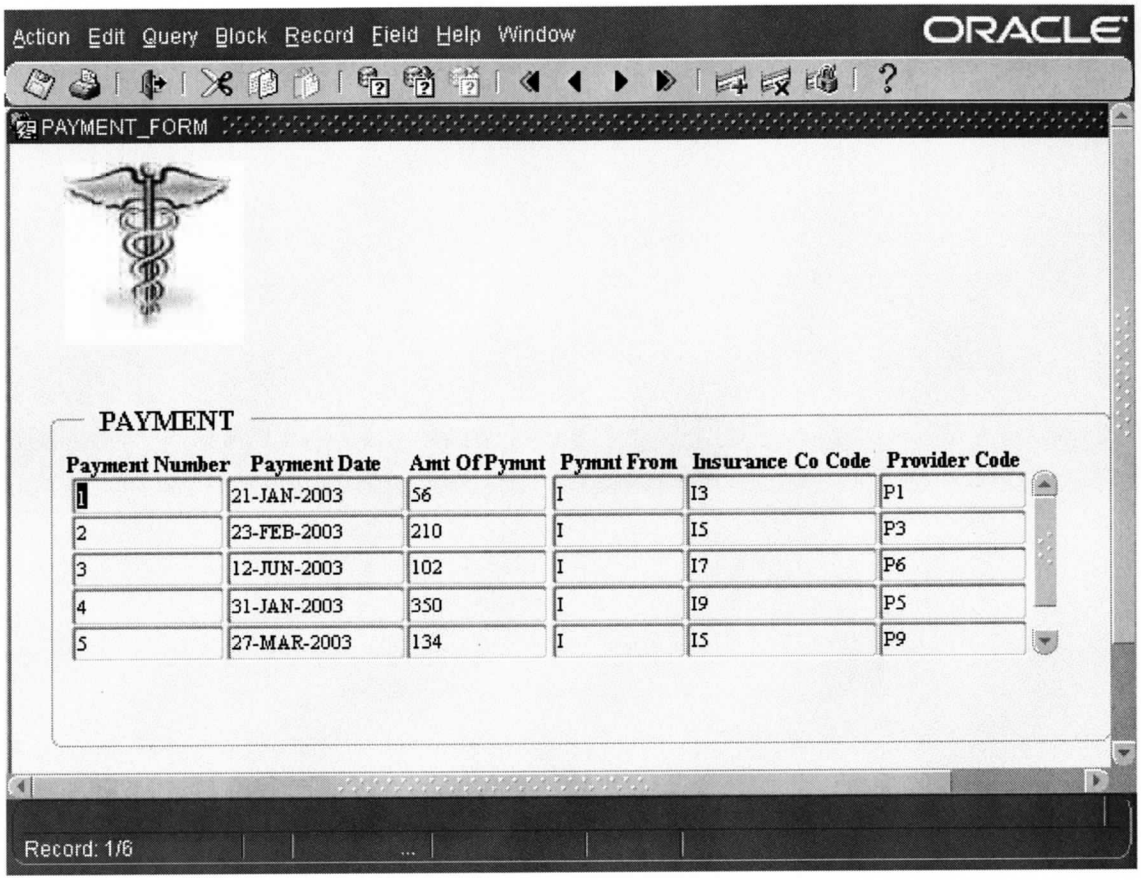
HOUSEHOLD_FORM gives the details about each HOUSEHOLD member.



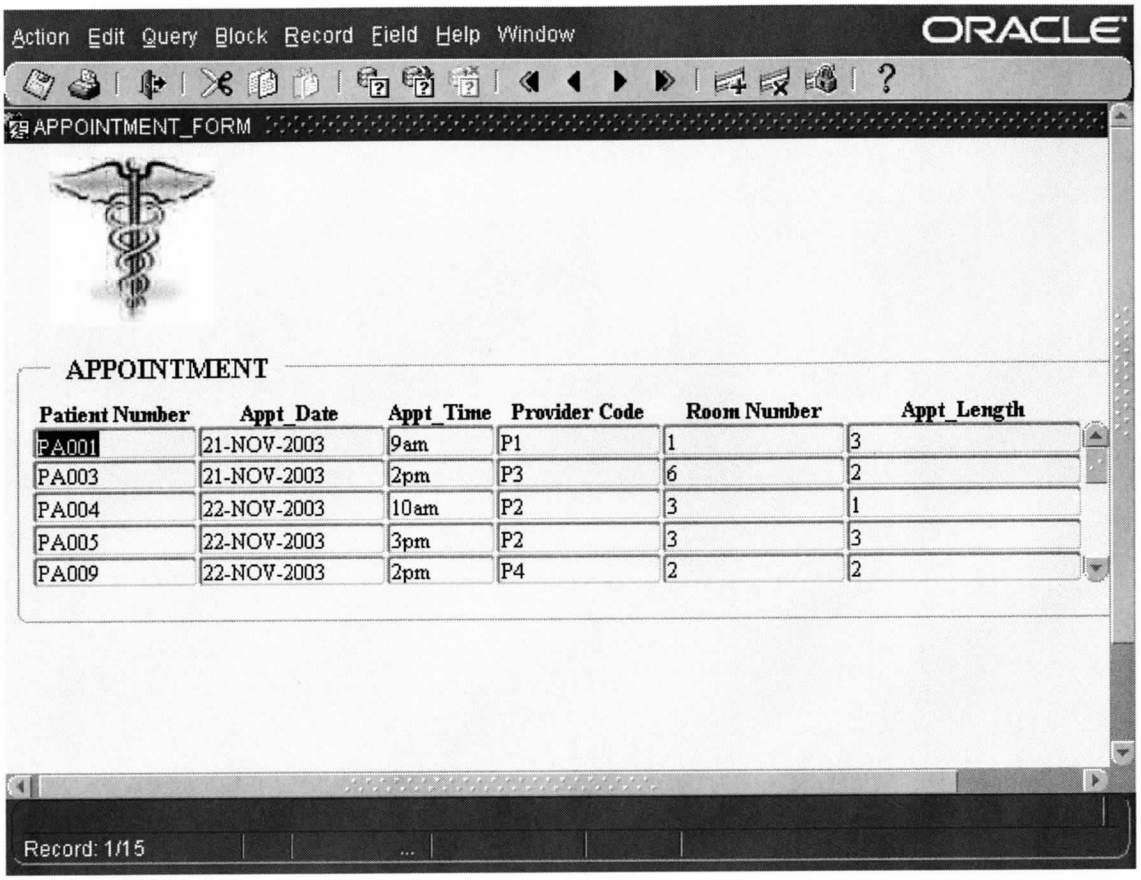
PATIENT_FORM gives details about PATIENT and their HOUSEHOLD RELATIONSHIP.



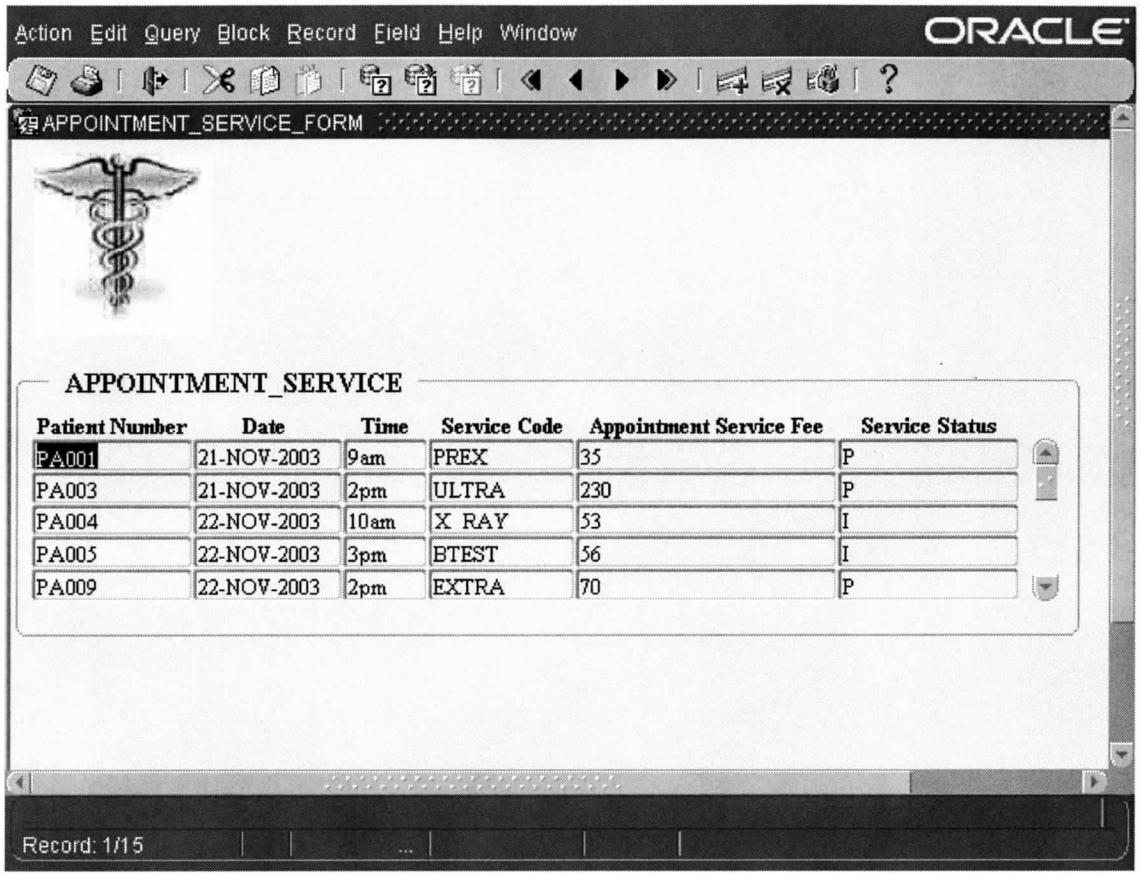
PAYMENT_FORM gives details about the PAYMENT from INSURANCE COMPANY.



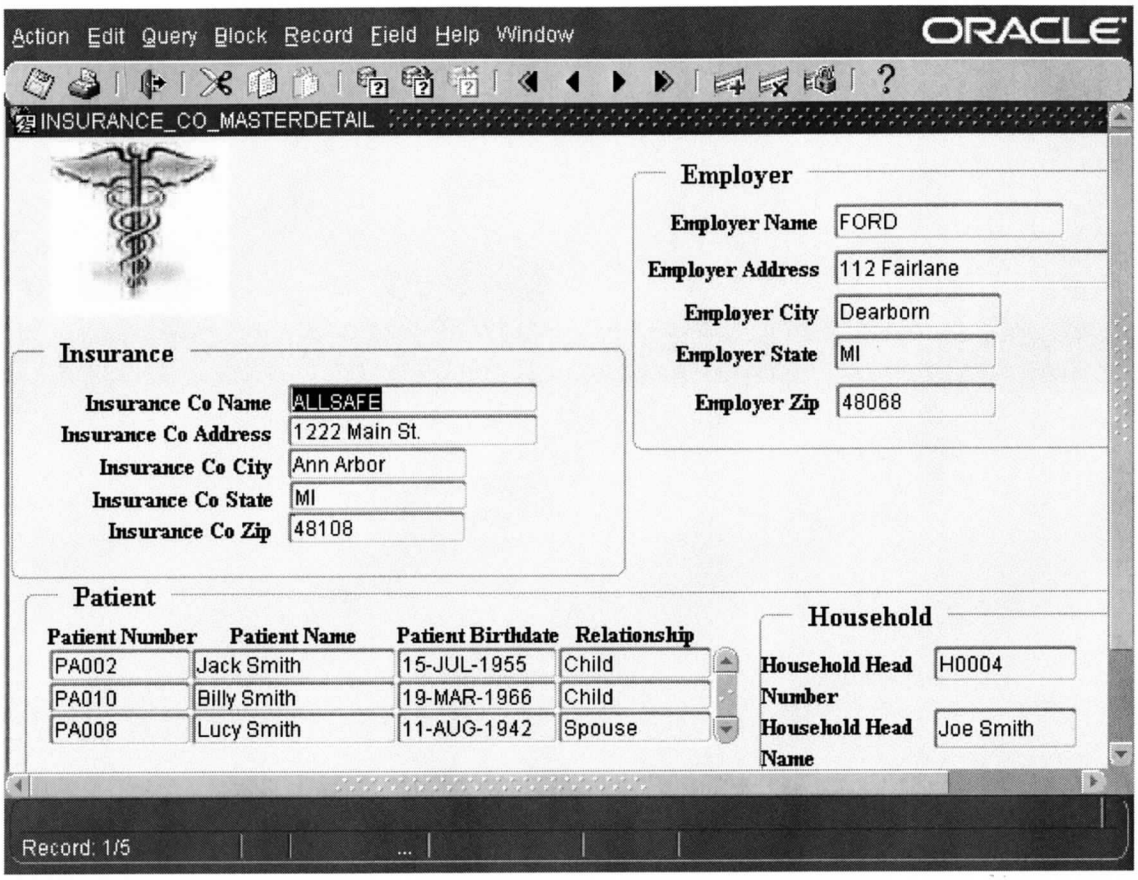
APPOINTMENT_FORM gives details of the APPOINTMENT Scheduled for PATIENTS.



APPOINTMENT_SERVICE_FORM gives details of the SERVICES given for the APPOINTMENT Scheduled by PATIENTS.

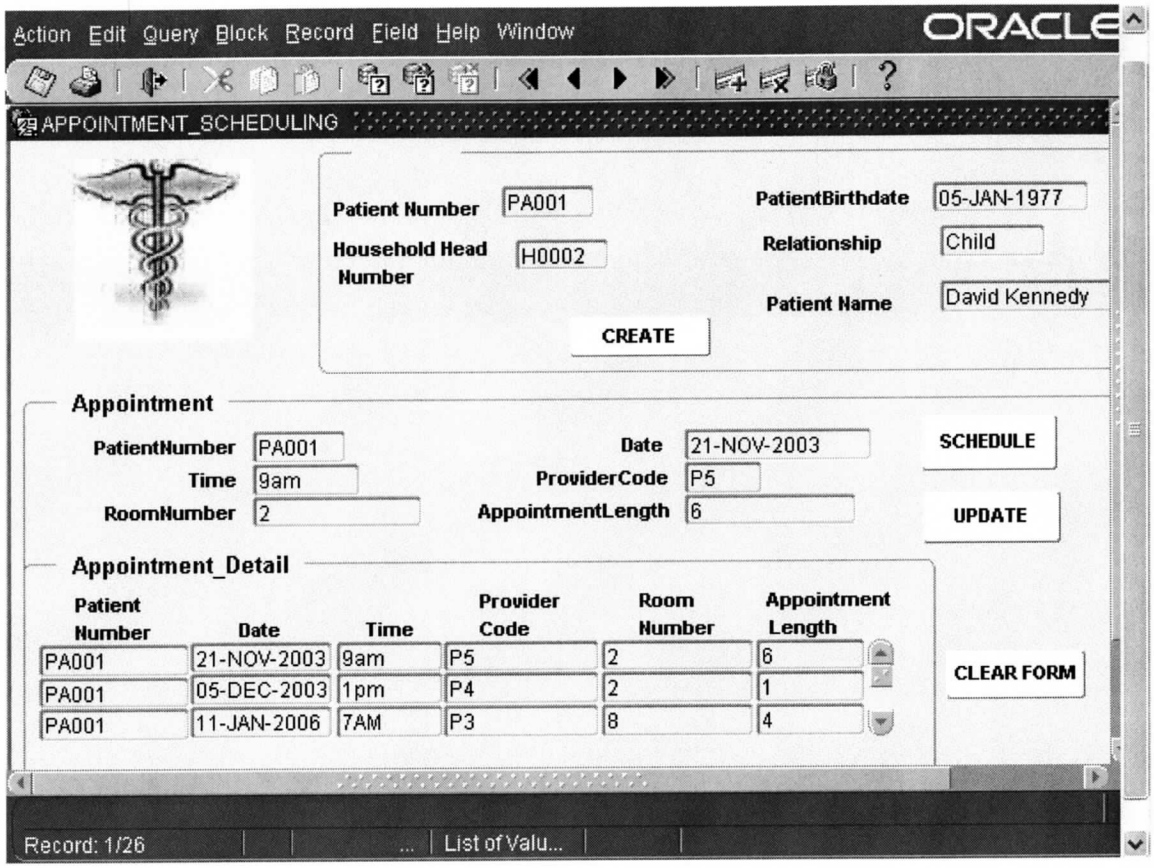


INSURANCE_CO_MASTERDETAIL gives the relationship between PATIENT, HOUSEHOLD, EMPLOYER and INSURANCE COMPANY

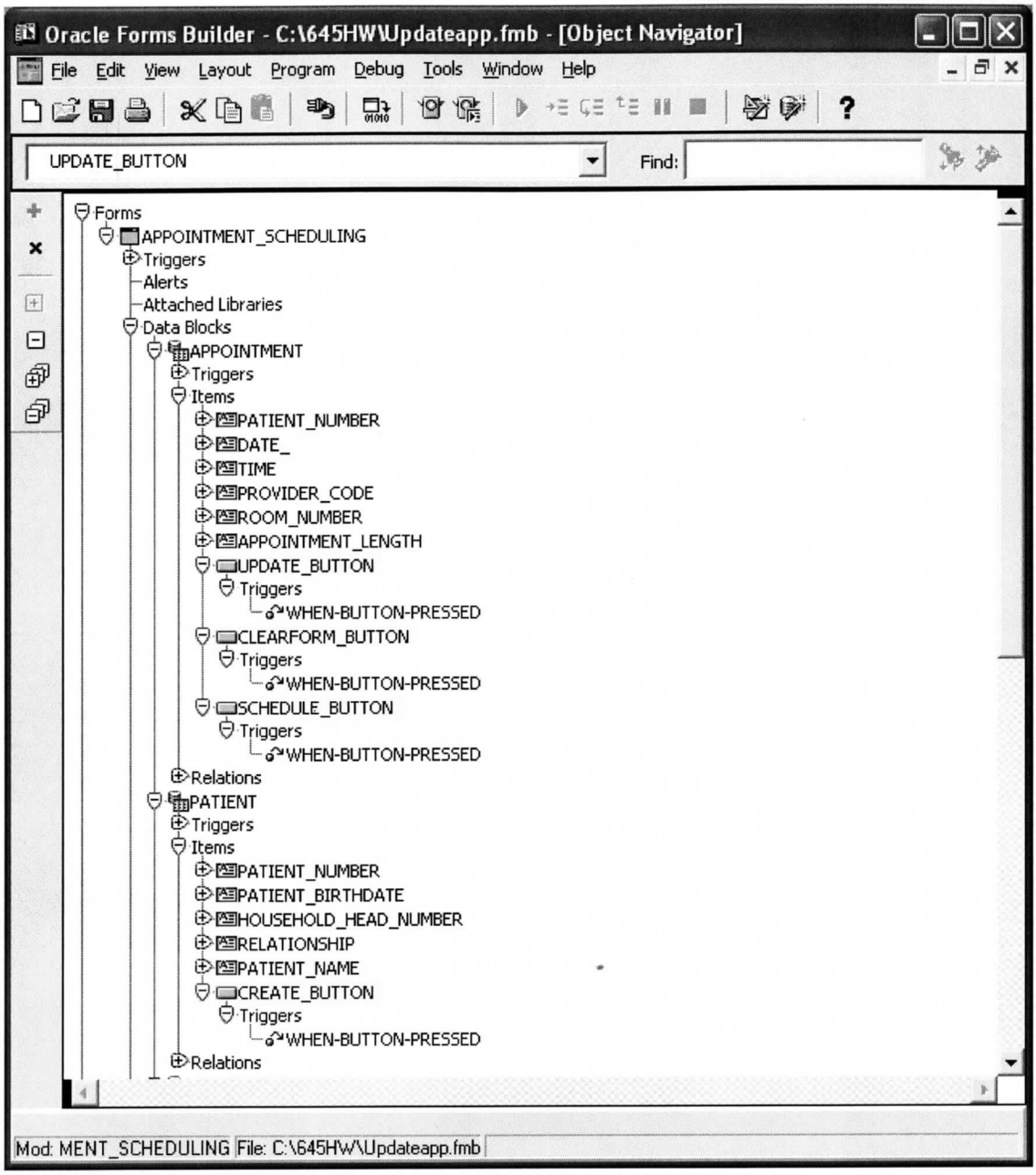


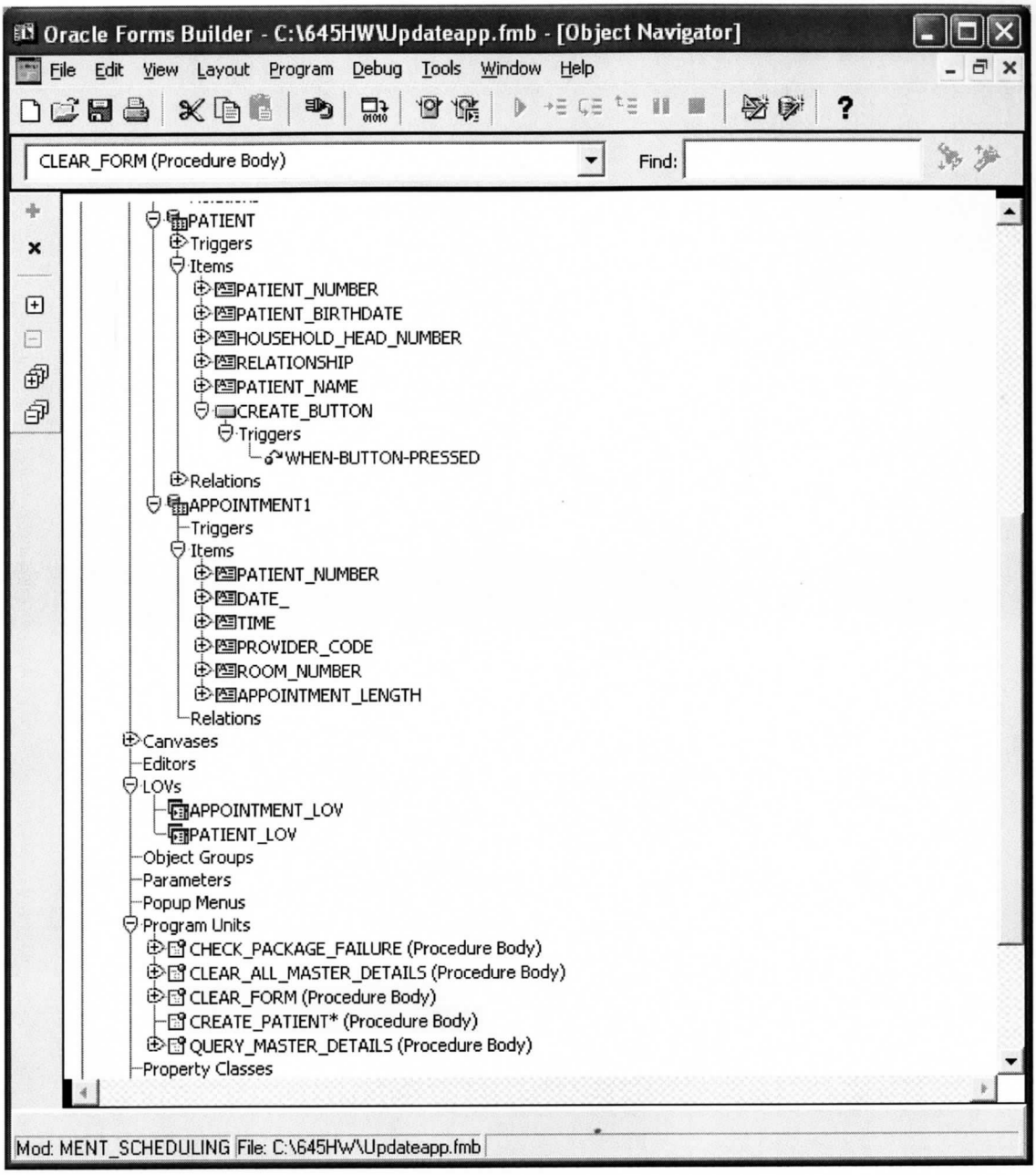
APPOINTMENT_SCHEDULING

This form is used to CREATE a new PATIENT Record,
SCHEDULE APPOINTMENT for the new PATIENT
SCHEDULE APPOINTMENT for the existing PATIENT
UPDATE APPOINTMENT for the existing PATIENT

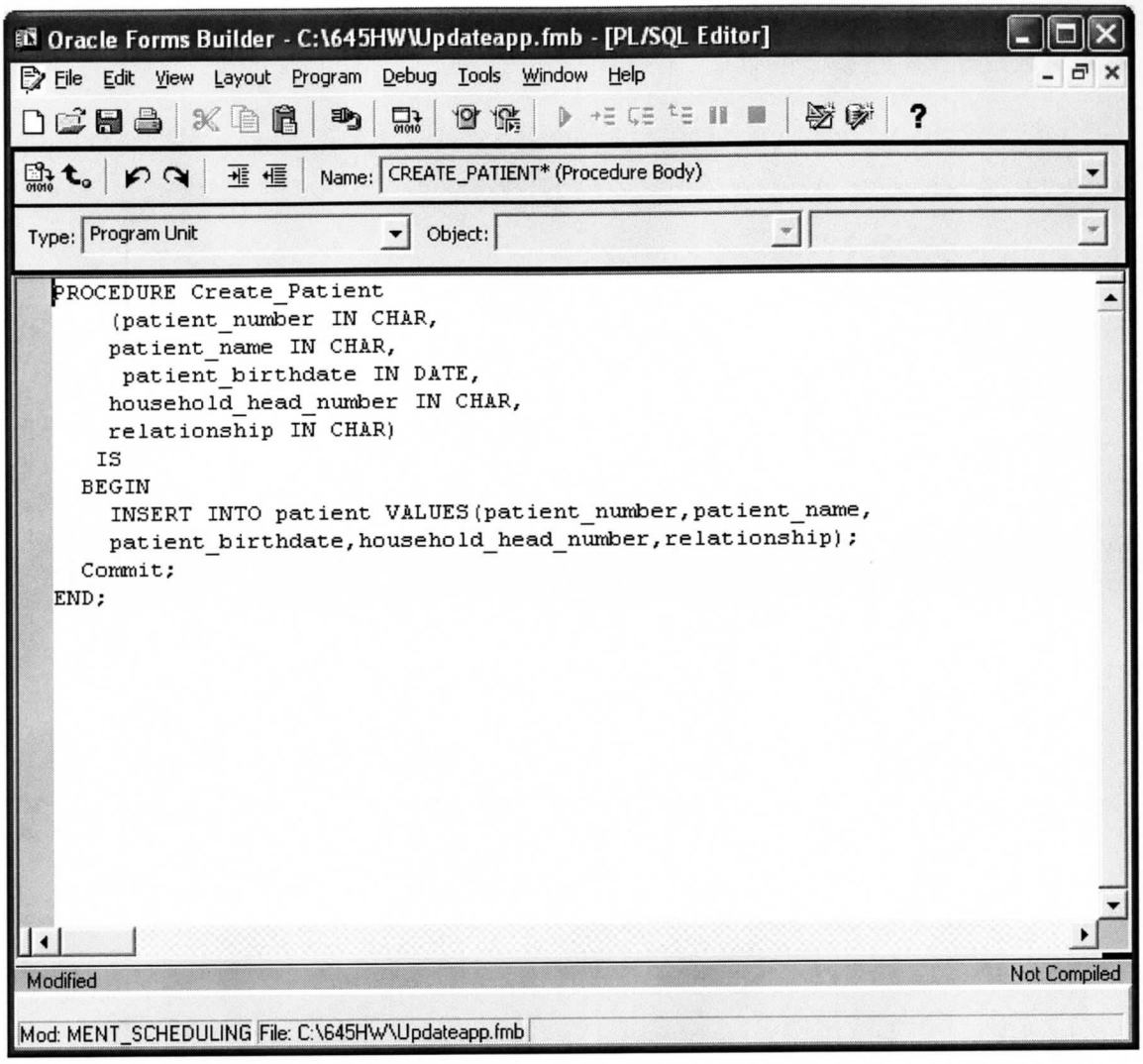


Navigation Bar gives details about the various TRIGGERS and PROCEDURES associated with APPOINTMENT_SCHEDULING form

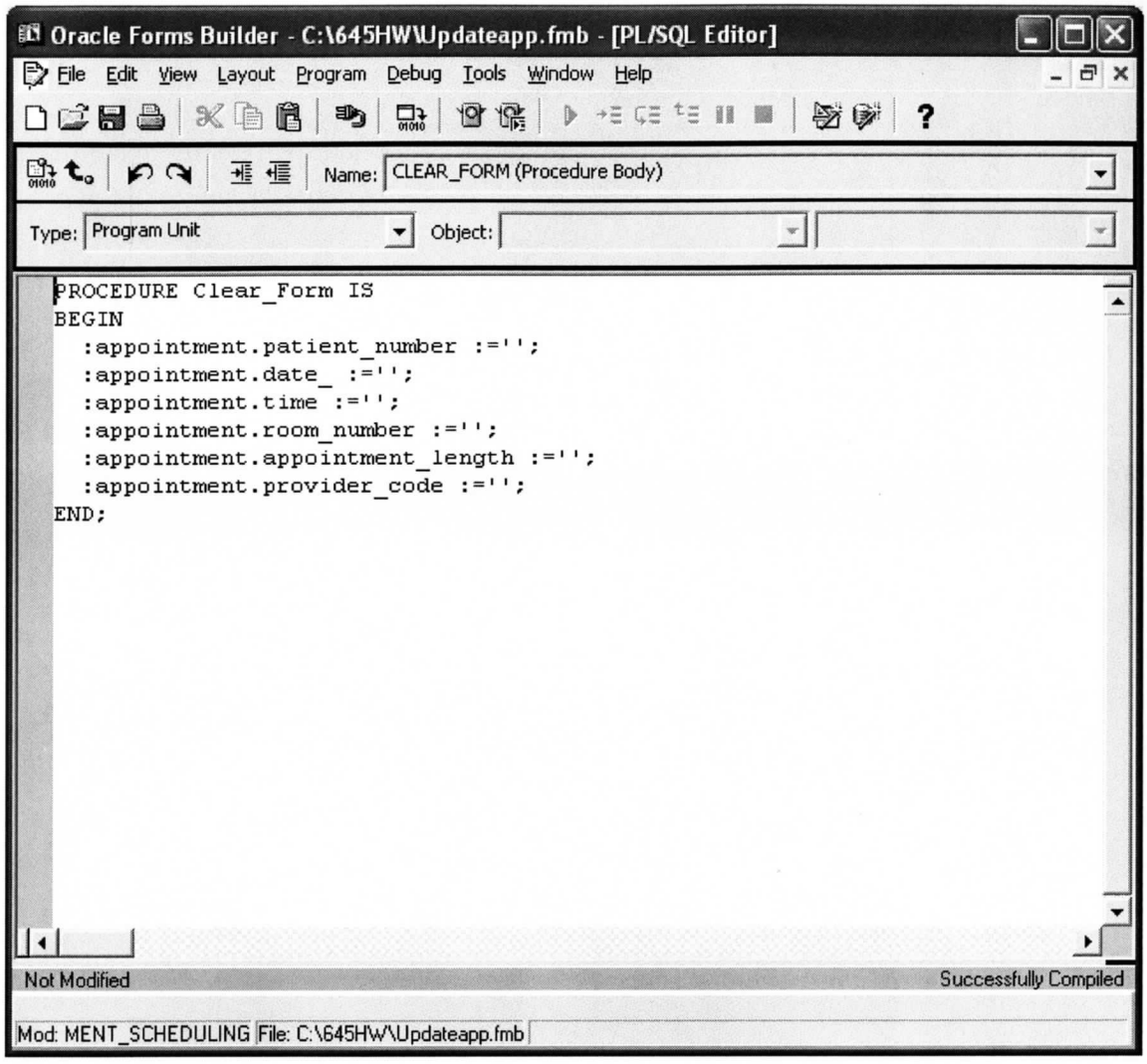



Oracle Forms Builder - C:\645HW\Updateapp.fmb - [Object Navigator]
File Edit View Layout Program Debug Tools Window Help
CLEAR_FORM (Procedure Body)
Find:
PATIENT
Triggers
Items
PATIENT_NUMBER
PATIENT_BIRTHDATE
HOUSEHOLD_HEAD_NUMBER
RELATIONSHIP
PATIENT_NAME
CREATE_BUTTON
Triggers
WHEN-BUTTON-PRESSED
Relations
APPOINTMENT1
Triggers
Items
PATIENT_NUMBER
DATE_
TIME
PROVIDER_CODE
ROOM_NUMBER
APPOINTMENT_LENGTH
Relations
Canvases
Editors
LOVs
APPOINTMENT_LOV
PATIENT_LOV
Object Groups
Parameters
Popup Menus
Program Units
CHECK_PACKAGE_FAILURE (Procedure Body)
CLEAR_ALL_MASTER_DETAILS (Procedure Body)
CLEAR_FORM (Procedure Body)
CREATE_PATIENT* (Procedure Body)
QUERY_MASTER_DETAILS (Procedure Body)
Property Classes
Mod: MENT_SCHEDULING File: C:\645HW\Updateapp.fmb

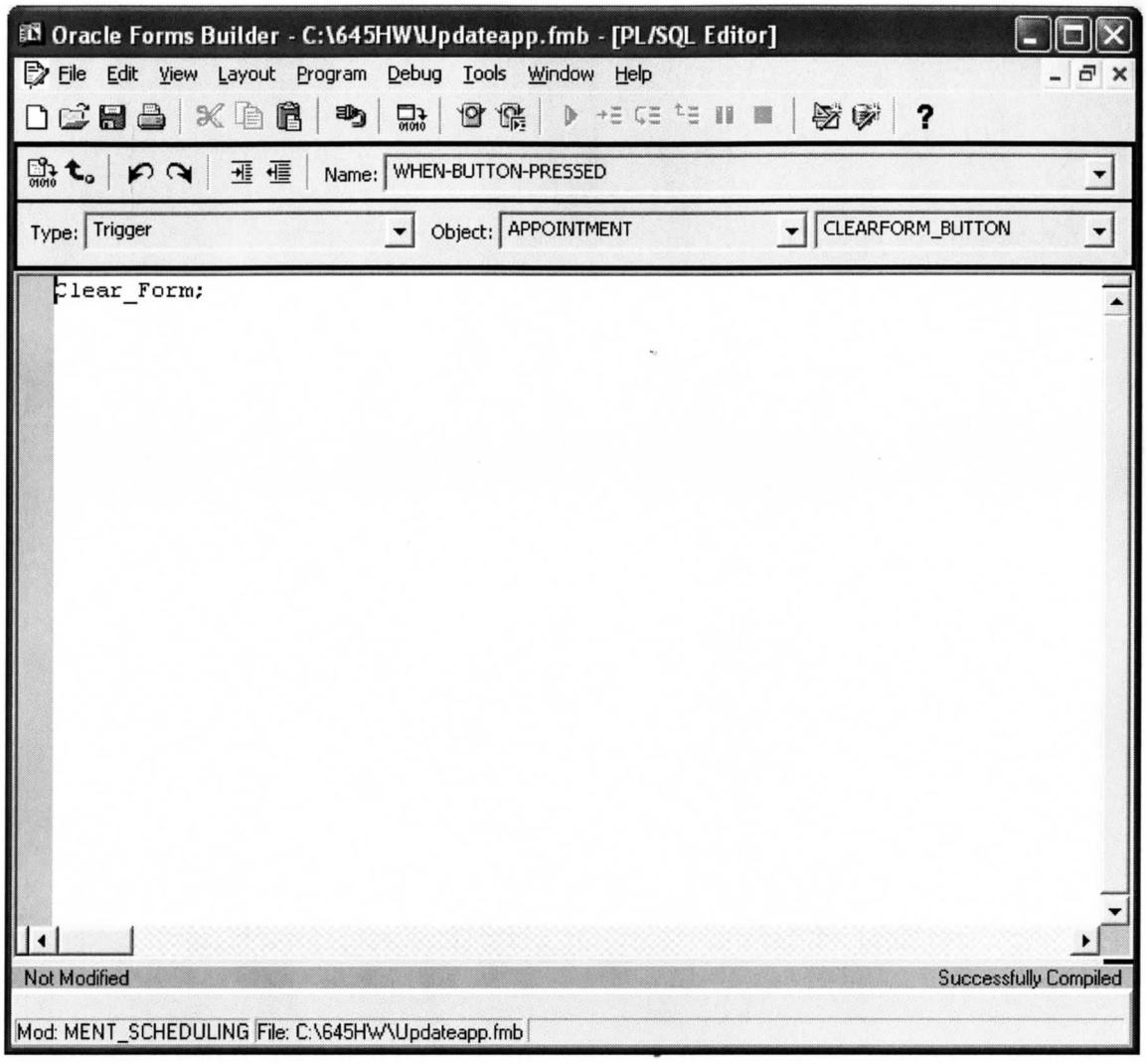
PROCEDURE to create a PATIENT record



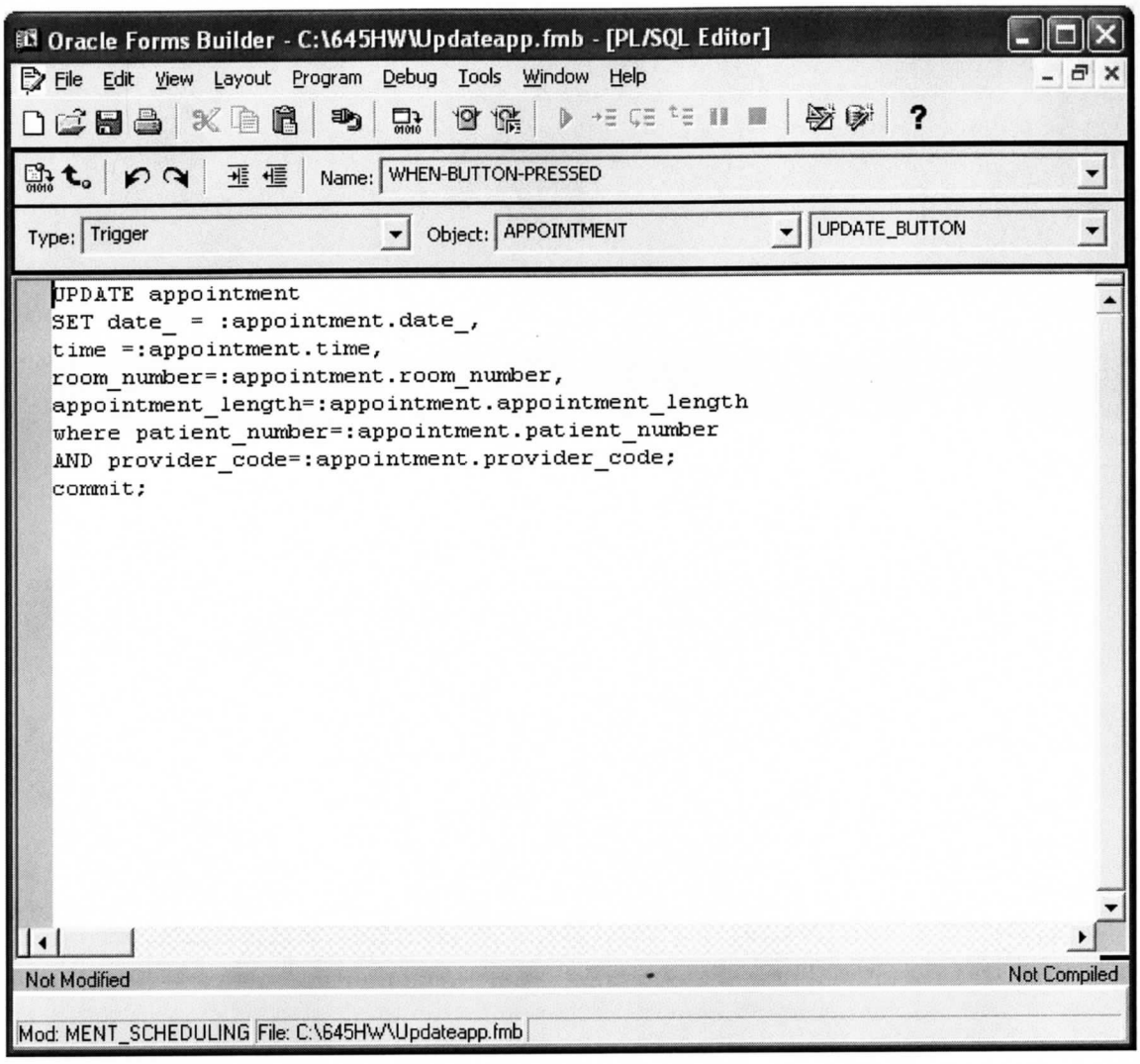
PROCEDURE to CLEAR the form



TRIGGER to call the PROCEDURE CLEAR_FORM



TRIGGER for UPDATE_BUTTON to UPDATE an APPOINTMENT



5.2 REPORTS

M. Provider list

N. Services list

O. Insurance company list

P. Employer list - Insurance

Q. Household list

R. Patient list - Services

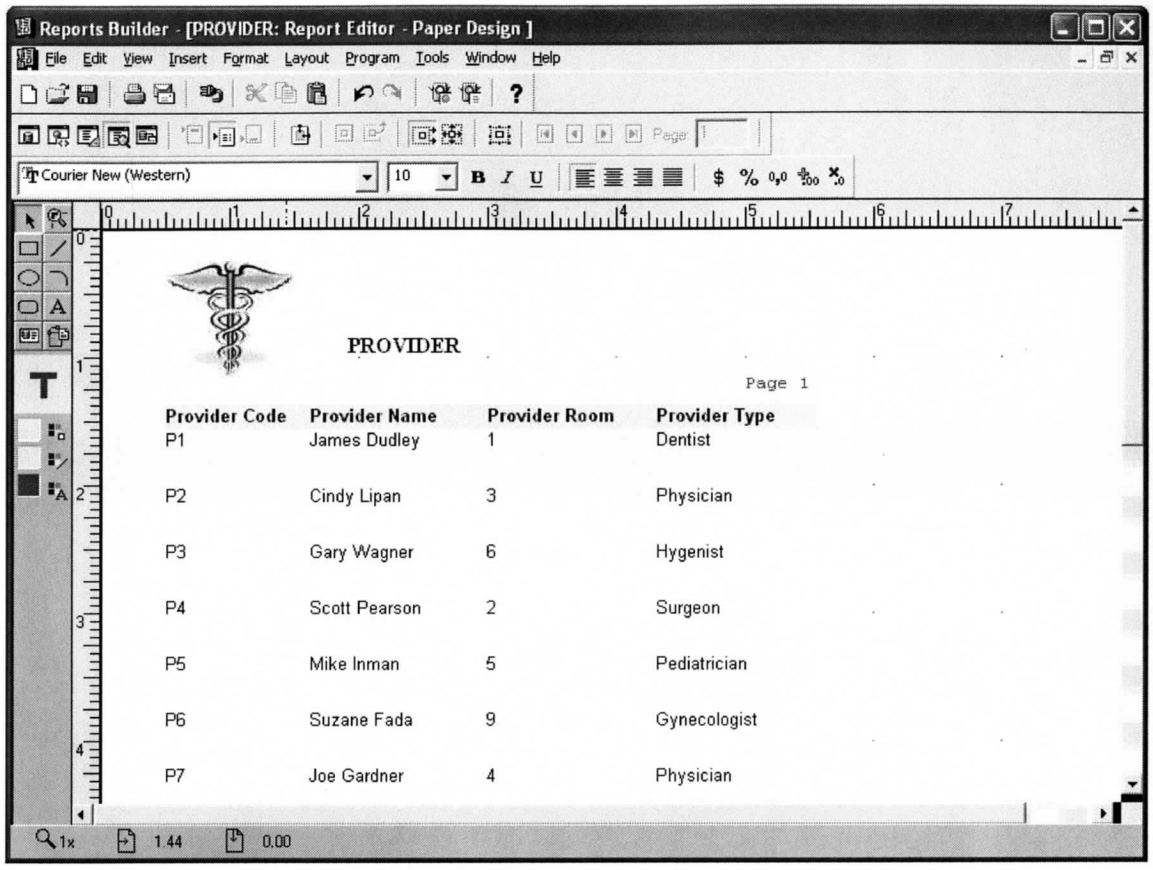
S. Appointment book -Services - for next working day

T. Appointment book - Services - for End of month processing

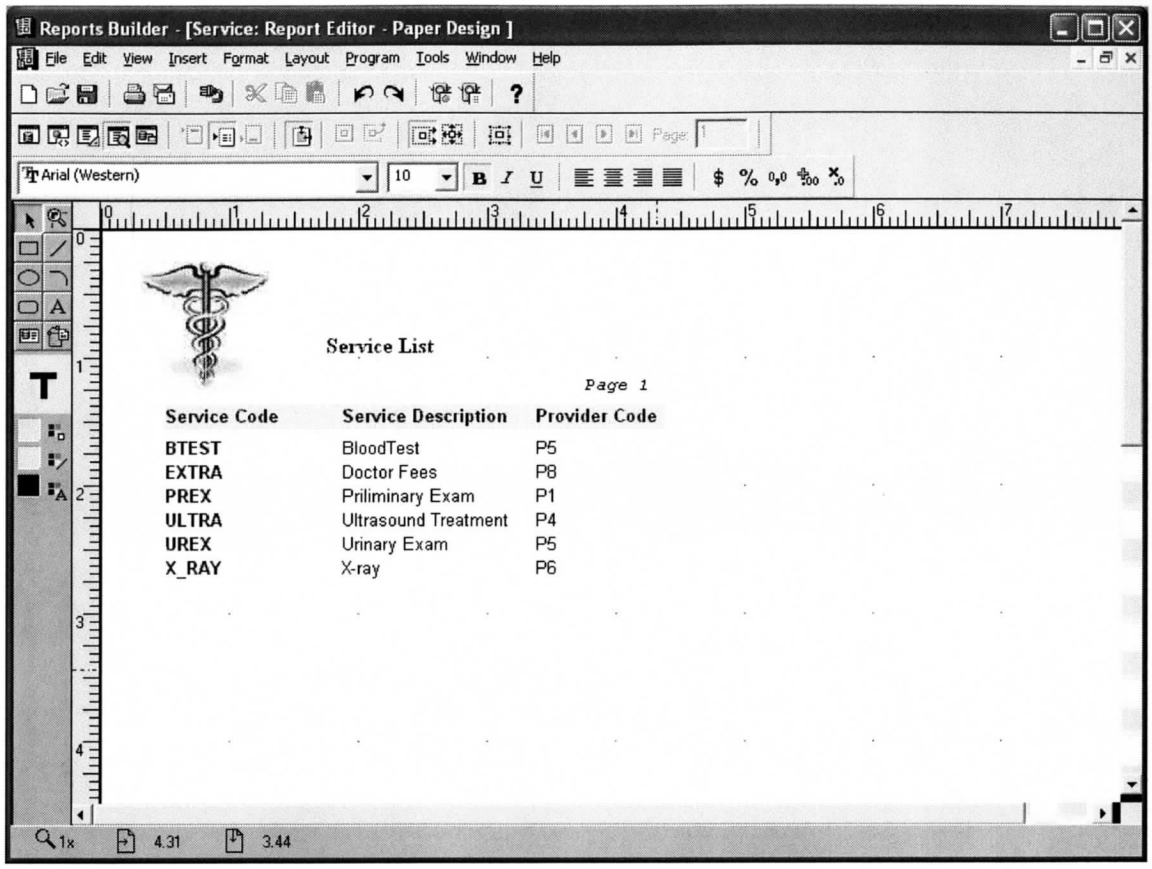
U. Insurance – Employer-Household-Patient –Relationship

V. Statements – Household – Service – Insurance company – Insurance Payments

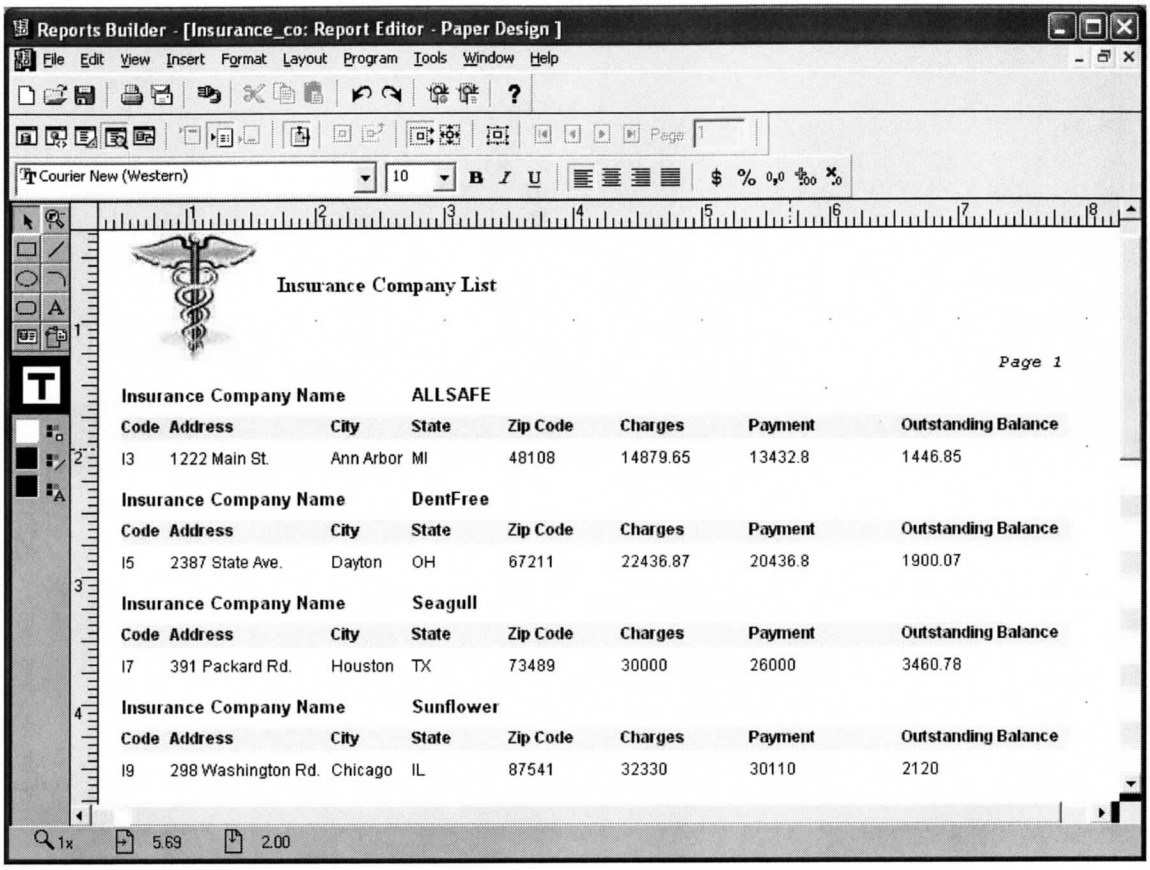
PROVIDER_REPORT gives details about the PROVIDERS in ACC



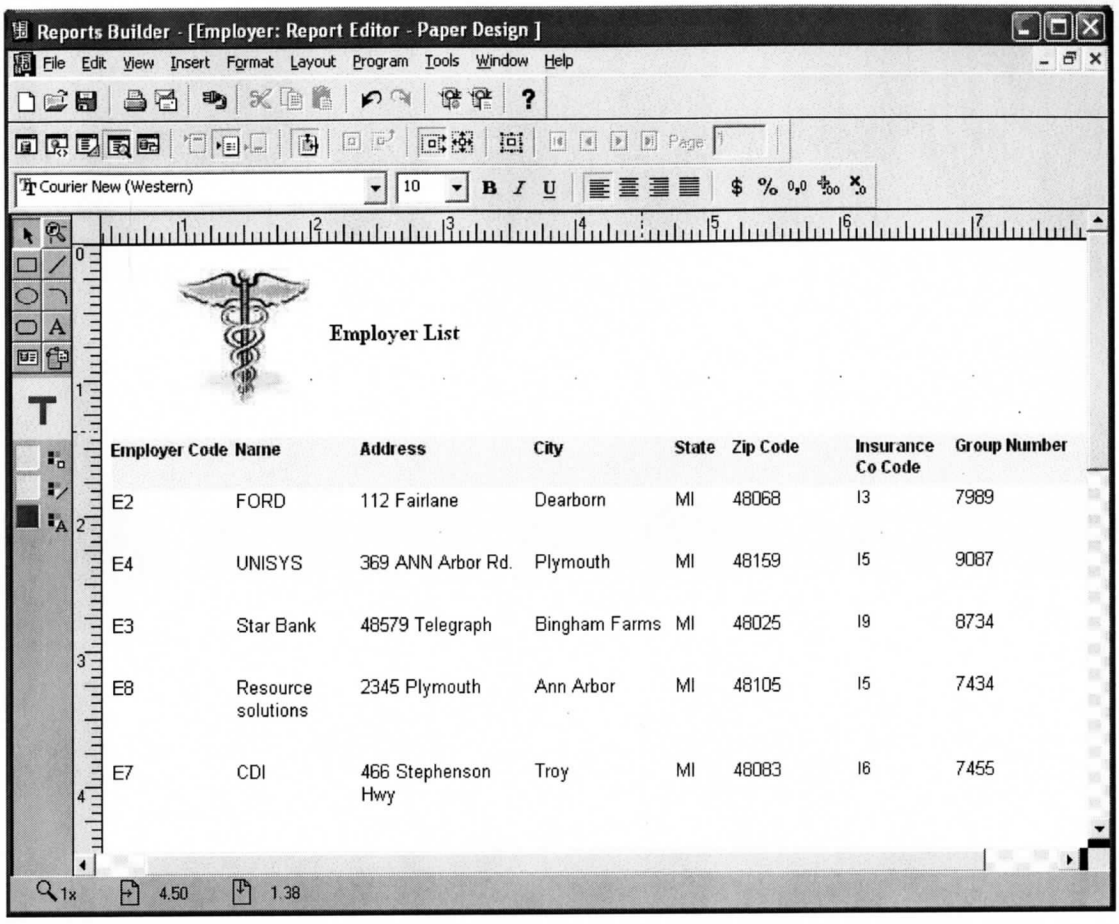
SERVICE_REPORT gives details about the SERVICES offered at ACC.



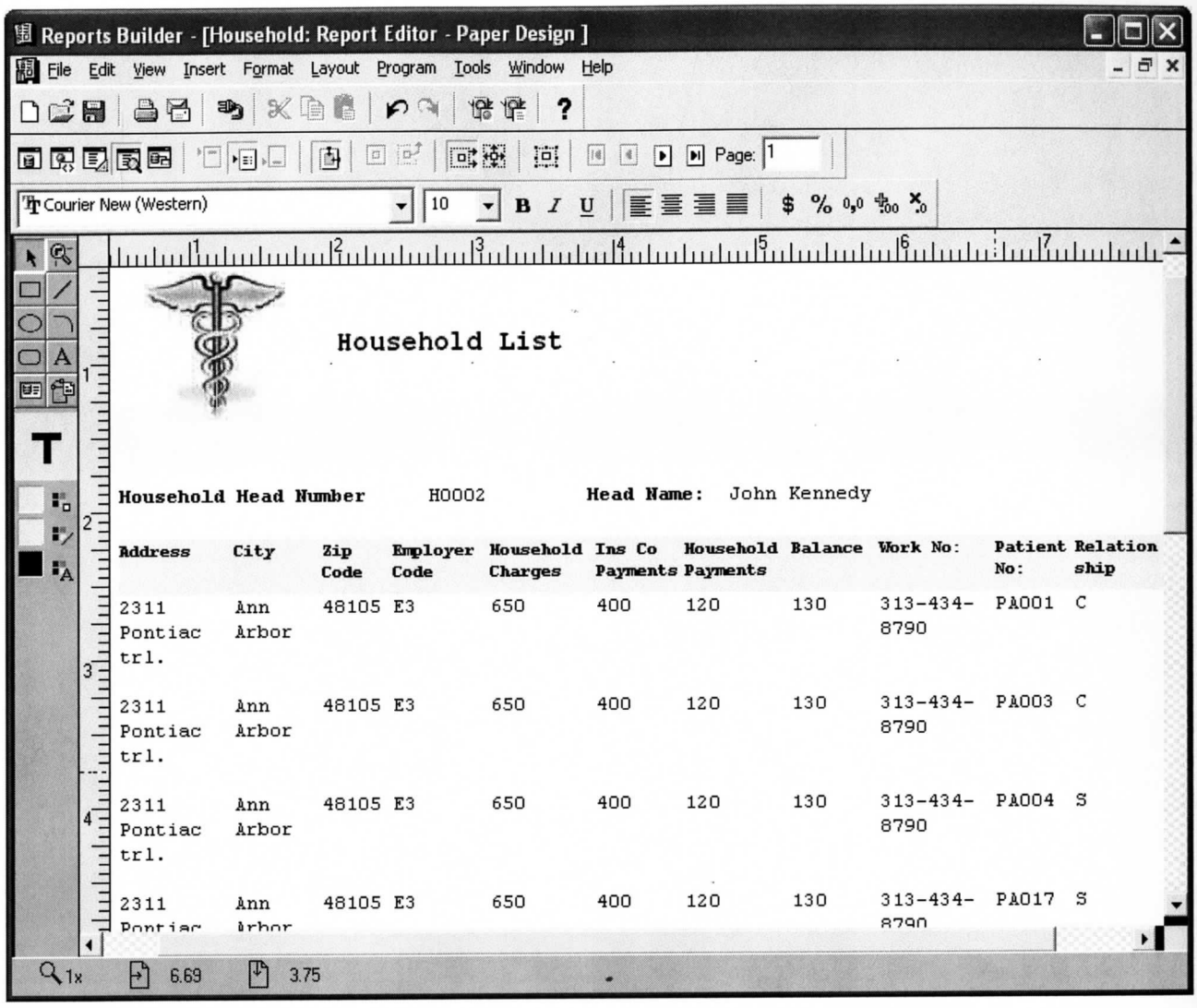
INSURANCE_CO_REPORT is maintained by the provider to get a list of INSURANCE COMPANIES they are associated with.



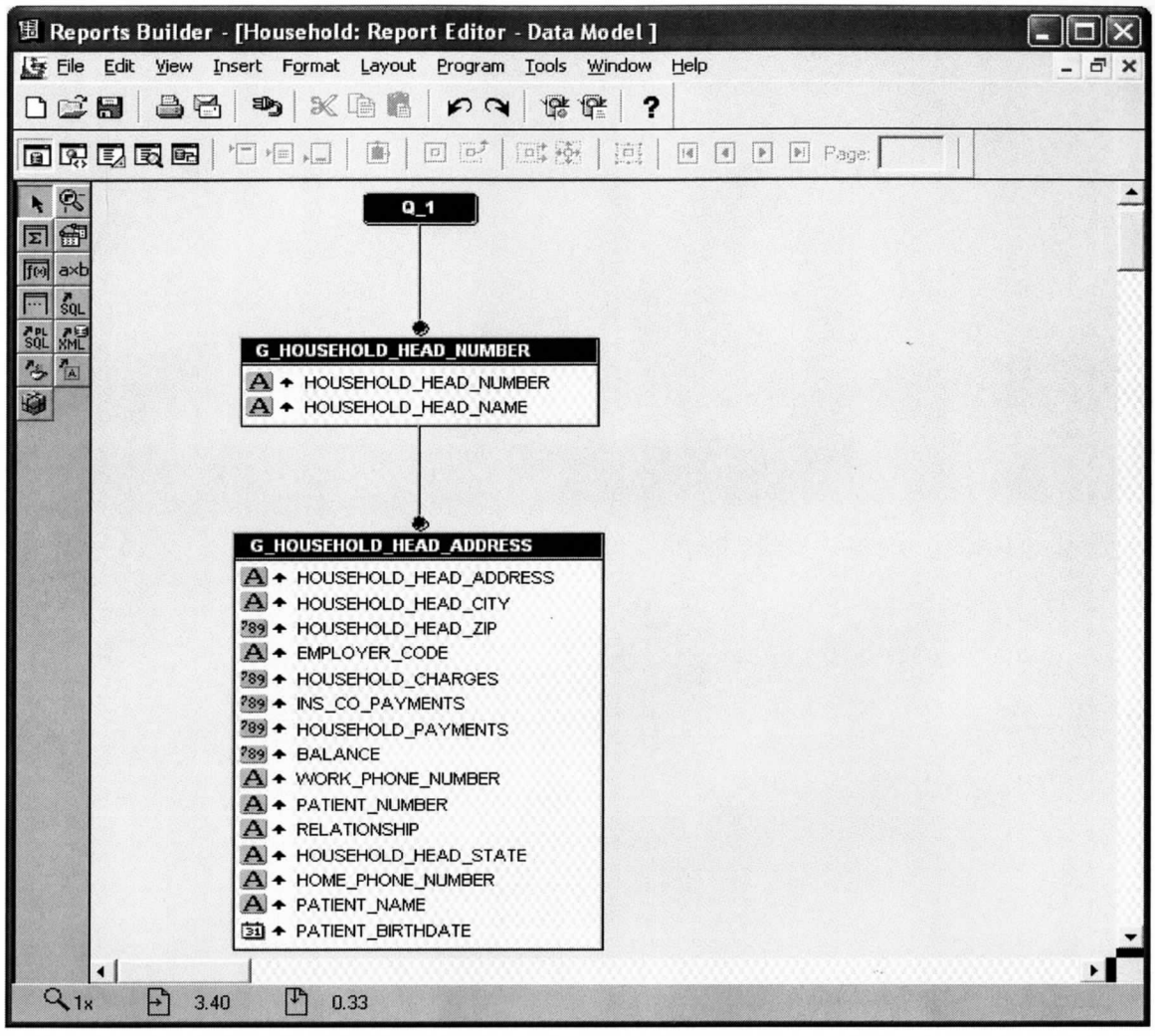
EMPLOYER_REPORT lists the EMPLOYEES details.



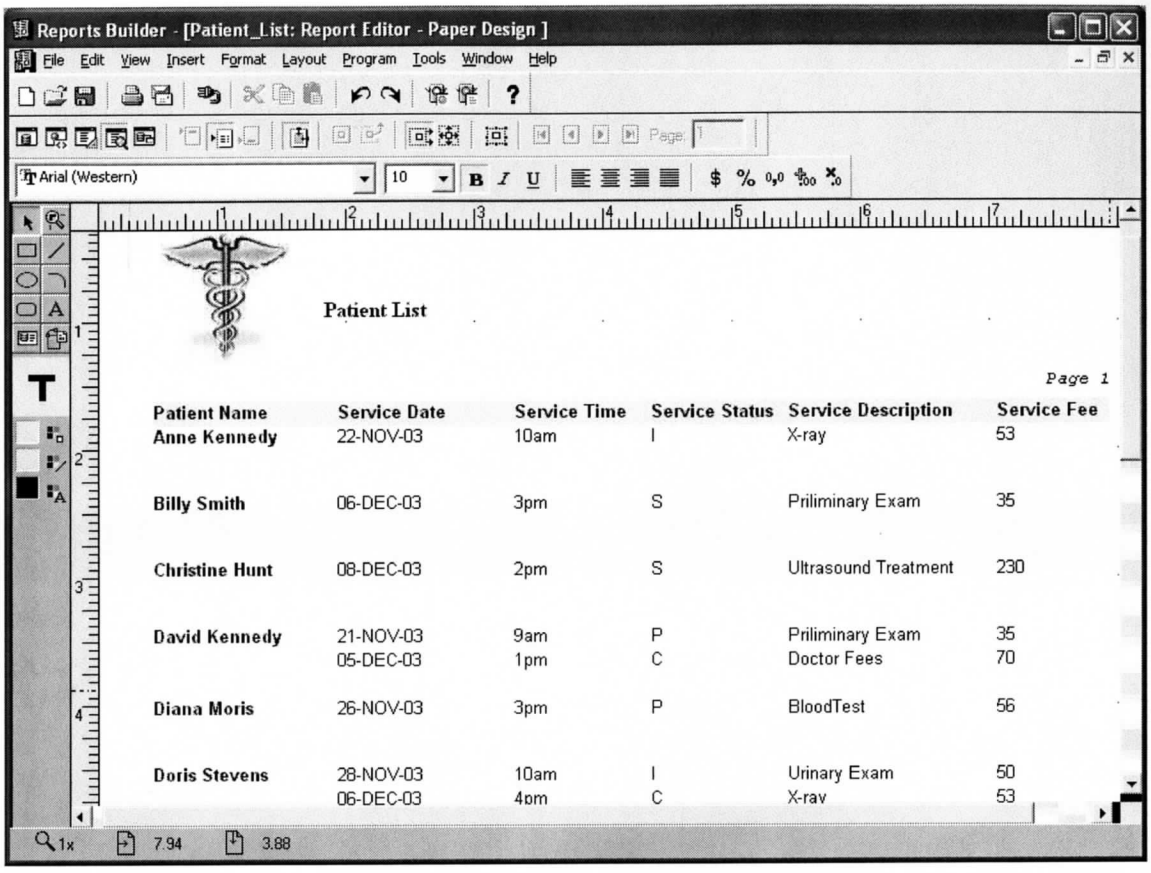
HOUSEHOLD_REPORT gives the details about each HOUSEHOLD member.



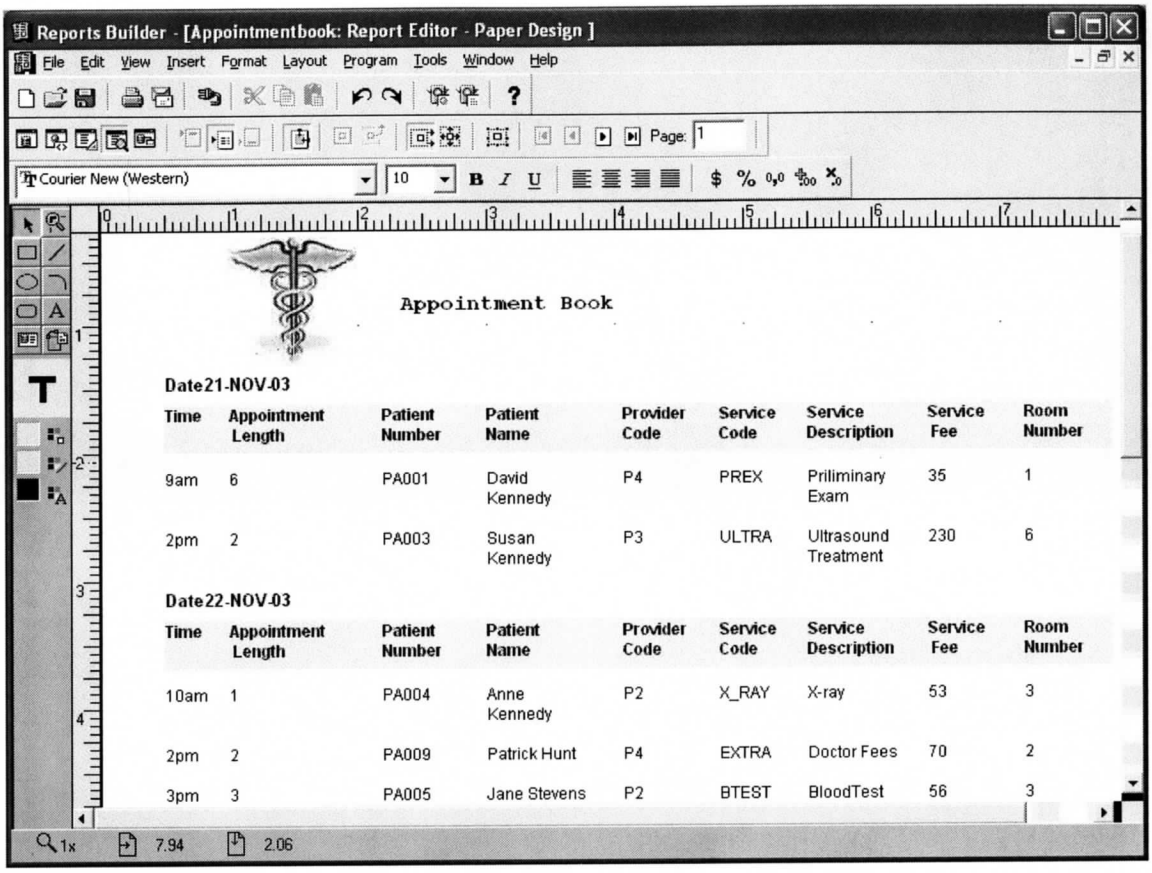
DATAMODEL for HOUSEHOLD report.



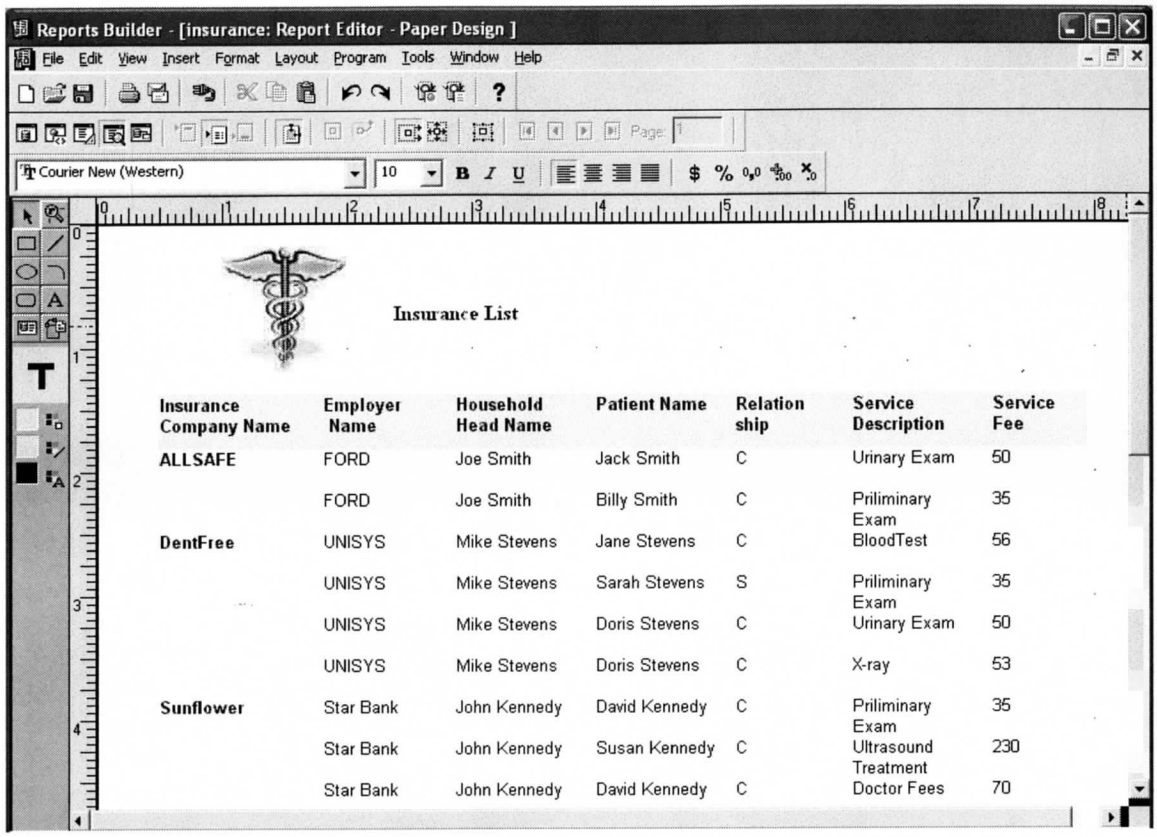
PATIENT_REPORT gives details about PATIENT and the SERVICES they took.



APPOINTMENT BOOK gives details of the APPOINTMENT Scheduled for PATIENTS as on particular date.

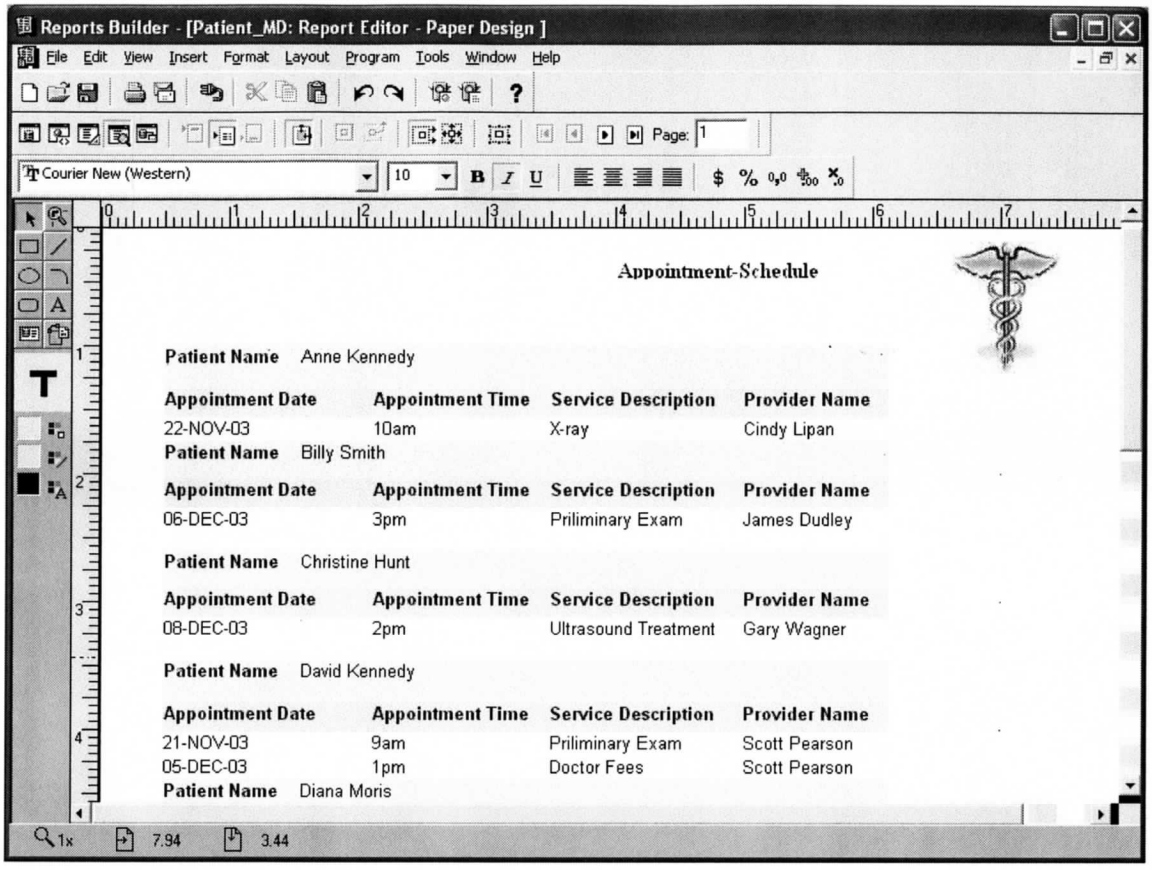


INSURANCE LIST gives details of the Total fees due by the INSURANCE COMPANY as on particular date .

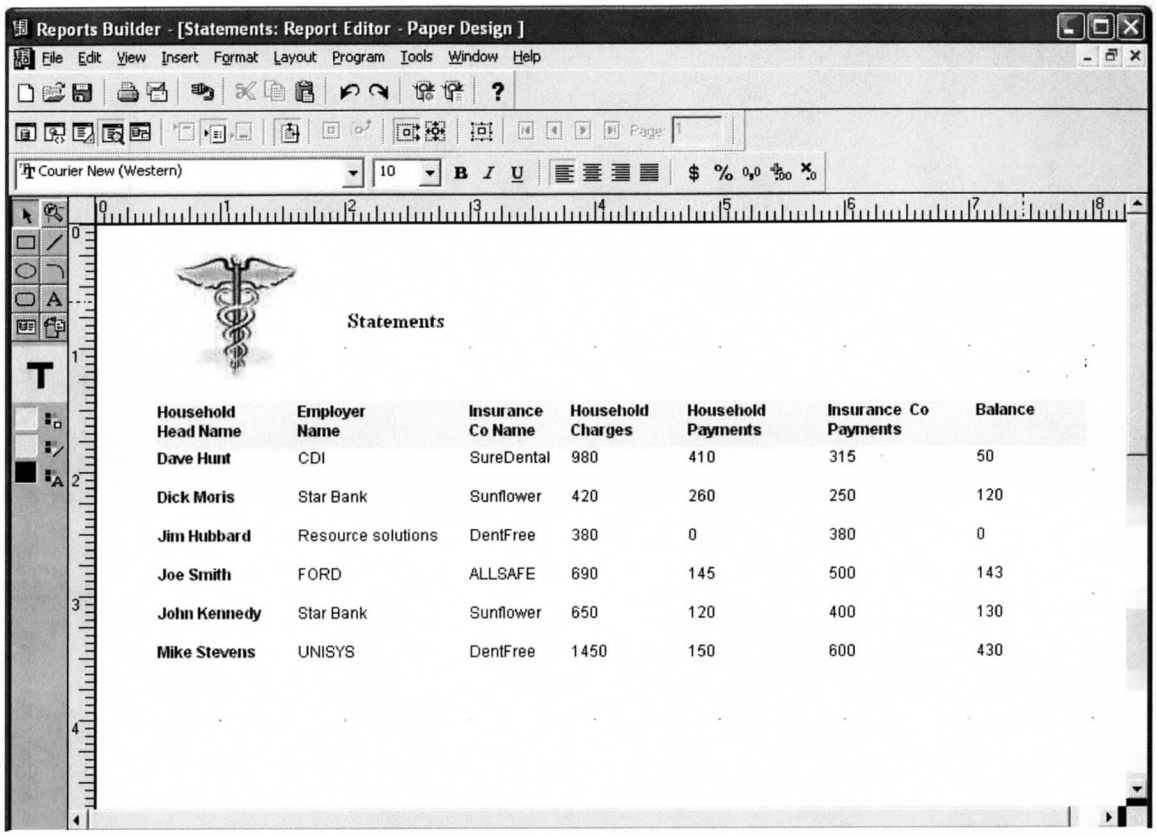


Insurance Company Name	Employer Name	Household Head Name	Patient Name	Relation ship	Service Description	Service Fee
ALLSAFE	FORD	Joe Smith	Jack Smith	C	Urinary Exam	50
	FORD	Joe Smith	Billy Smith	C	Priliminary Exam	35
DentFree	UNISYS	Mike Stevens	Jane Stevens	C	BloodTest	56
	UNISYS	Mike Stevens	Sarah Stevens	S	Priliminary Exam	35
	UNISYS	Mike Stevens	Doris Stevens	C	Urinary Exam	50
	UNISYS	Mike Stevens	Doris Stevens	C	X-ray	53
Sunflower	Star Bank	John Kennedy	David Kennedy	C	Priliminary Exam	35
	Star Bank	John Kennedy	Susan Kennedy	C	Ultrasound Treatment	230
	Star Bank	John Kennedy	David Kennedy	C	Doctor Fees	70

APPOINTMENT_SCHEDULE gives details of the APPOINTMENT Scheduled for PATIENTS.



STATEMENTS gives the details of the HOUSEHOLD BALANCE as of particular month.



Household Head Name	Employer Name	Insurance Co Name	Household Charges	Household Payments	Insurance Co Payments	Balance
Dave Hunt	CDI	SureDental	980	410	315	50
Dick Moris	Star Bank	Sunflower	420	260	250	120
Jim Hubbard	Resource solutions	DentFree	380	0	380	0
Joe Smith	FORD	ALLSAFE	690	145	500	143
John Kennedy	Star Bank	Sunflower	650	120	400	130
Mike Stevens	UNISYS	DentFree	1450	150	600	430

CHAPTER 6

CONCLUSION AND DISCUSSIONS

In brief this project developed the clinical database for Ann Arbor Community Clinic. The development process is explained step by step in this report. The development starts with the analyzing the UML diagrams, developing the ER diagrams, defining the business rules, creating the tables, defining the integrity constraints, structural constraints, operational constraints. The each and every stage of development process plays a very important role, as each and every task are inter dependent. Development of every step is complete team effort, discussing number of times making changes and finalizing the development after reaching the expected level. My experience in the involvement as team member in development was really great. I was really enjoying learning the development of the project in different areas gaining the practical exposure before graduating

Coming to the development of User Interfaces, it is most important section because it is really directly linked to the users. The forms help in storing the data in the database and reports help in retrieving the data from the database. Our team had designed with special care so that they are understood by the users and each and every bit of information is saved in the database.

Thus the conclusion is the design, development and implementation of the Ann Arbor Community Clinic is achieved successfully.

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2. **Guide to ORACLE 10G by Morrision&Morrision.**

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2 http://www.sonicwall.com/us/products/Solutions_Markets.html

3. http://www.oracle.com/industries/government/iHub4PubHCpdf.pdf

4 http://library.ahima.org/xpedio/groups/public/documents/ahima/bok1_024307.html

5. http://www.infocom.cqu.edu.au/Courses/spr2000/95169/Extra_Examples/ERD.htm