After completing a course in database management, you have

been hired as a summer intern by Mountain View Community

Hospital. Your first assignment is to work as part of a team of

three people to develop a high-level E-R diagram for the hospital.

You conduct interviews with a number of hospital administrators

and staff to identify the key entity types for the hospital.

You have also seen the preliminary enterprise-level diagram

shown in MVCH Figure 1-3 and subsequent revisions. As a

result, your team has identified the following entity types:

• Care Center—a treatment center within the hospital.

Examples of care centers are maternity, emergency care,

or multiple sclerosis center. Each care center has a care

center ID (identifier) and a care center name.

• Patient—a person who is either admitted to the hospital

or is registered as an outpatient. Each patient has an identifier,

the medical record number (MRN), and a name.

• Physician—a member of the hospital medical staff who

may admit patients to the hospital and who may administer

medical treatments. Each physician has a physician ID

(identifier) and name.

• Bed—a hospital bed that may be assigned to a patient

who is admitted to the hospital. Each bed has a bed number

(identifier), a room number, and a care center ID.

• Item—any medical or surgical item that may be used in

treating a patient. Each item has an item number (identifier),

description, and unit cost.

• Employee—any person employed as part of the hospital

staff. Each employee has an employee number (identifier)

and name.

• Diagnosis—a patient’s medical condition diagnosed by a

physician. Each diagnosis has a diagnosis ID/code and

diagnosis name. Mountain View Community Hospital is

using the HIPAA-mandated ICD-9-CM Volume 1 diagnosis

codes1 for patient conditions (e.g., 00.50, STAPH

FOOD POISONING, 173.3, BASAL CELL CARCINOMA,

200.2, MALIGNANT MELANOMA, BURKITT’S TYPE,

or 776.5. CONGENITAL ANEMIA).

• Treatment—any test or procedure ordered by and/or performed

by a physician for a patient. Each treatment has a

treatment ID/treatment code and treatment name using

standard codes. HIPAA-mandated ICD-9-CM Volume 3

Procedure Codes are used for diagnostic and therapeutic

procedures (e.g., 03.31, SPINAL TAP, 14.3, REPAIR OF

RETINAL TEAR, 87.44, ROUTINE CHEST X-RAY, or 90.5,

MICROSCOPIC EXAMINATION OF BLOOD).

• Order—any order issued by a physician for treatment

and/or services such as diagnostic tests (radiology, laboratory)

and therapeutic procedures (physical therapy, diet

orders), or drugs and devices (prescriptions). Each order

has an order ID, order date, and order time.

The team next recorded the following information concerning

relationships:

• Each hospital employee is assigned to work in one or

more care centers. Each care center has at least one

employee and may have any number of employees. The

hospital records the number of hours per week that a

given employee works in a particular care center.

• Each care center has exactly one employee who is designated

nurse-in-charge for that care center.

• A given patient may or may not be assigned to a bed

(since some patients are outpatients). Occupancy rates are

seldom at 100 percent, so a bed may or may not be

assigned to a patient.

• A patient may be referred to the hospital by exactly one

physician. A physician may refer any number of patients

or may not refer any patients.

• A patient must be admitted to the hospital by exactly one

physician. Aphysician may admit any number of patients

or may not admit any patients.

• Prior to a patient being seen by a physician, a nurse typically

obtains and records relevant information about the

patient. This includes the patient’s weight, blood pressure,

pulse, and temperature. The nurse who assesses the

vital signs also records the date and time. Finally, the reasons

for the visit and any symptoms the patient describes

are recorded.

• Physicians diagnose any number of conditions affecting a

patient, and a diagnosis may apply to many patients. The

hospital records the following information: date and time

of diagnosis, diagnosis code, and description.

• Physicians may order and perform any number of services/

treatments for a patient or may not perform any

treatment. A treatment or service may be performed on

any number of patients, and a patient may have treatments

performed or ordered by any number of physicians.

For each treatment or service rendered, the hospital

records the following information: physician ordering the

treatment, treatment date, treatment time, and results.

• A patient may also consume any number of items. A

given item may be consumed by one or more patients, or

may not be consumed. For each item consumed by a

patient, the hospital records the following: date, time,

quantity, and total cost (which can be computed by multiplying

quantity times unit cost).

The study team identified a preliminary set of 11 entity types

that describe the data required by the hospital in support of the

various business functions: FACILITY, PHYSICIAN, PATIENT,

DIAGNOSTIC UNIT, WARD, STAFF, ORDER, SERVICE/DRUG,

MEDICAL/SURGICAL ITEM, SUPPLY ITEM, and VENDOR.

From discussions with hospital staff, reviewing hospital documents,

and studying existing information systems, the study

team developed a list of business rules describing the policies of

the hospital and nature of the hospital’s operation that govern

the relationships between these entities. Some of these rules are:

1. AFACILITY maintains one or more DIAGNOSTIC UNITS

(radiology, clinical laboratory, cardiac diagnostic unit, etc.).

2. AFACILITY contains a number of WARDs (obstetrics, oncology,

geriatrics, etc.).

3. Each WARD is assigned a certain number of STAFF members

(nurses, secretaries, etc.); a STAFF member may be

assigned to multiple WARDs.

4. A FACILITY staffs its medical team with a number of

PHYSICIANs. APHYSICIAN may be on the staff of more

than one FACILITY.

5. A PHYSICIAN treats PATIENTs, and a PATIENT is treated

by any number of PHYSICIANs.

6. A PHYSICIAN diagnoses PATIENTs, and a PATIENT is

diagnosed by any number of PHYSICIANs.

7. A PATIENT may be assigned to a WARD (outpatients are

not assigned to a WARD). The hospital cares only about the

current WARD a patient is assigned to (if assigned at all).

8. A PATIENT uses MEDICAL/SURGICAL ITEMS, which

are supplied by VENDORs. A VENDOR also provides

SUPPLY ITEMs that are used for housekeeping and maintenance

purposes.

9. A PHYSICIAN writes one or more ORDERS for a PATIENT.

Each ORDER is for a given PATIENT, and a PATIENT

may have many ORDERs.

10. An ORDER can be for a diagnostic test (lab tests such as

lipid profile, CBC, liver function tests; diagnostic imaging

such as MRIs and X-rays) or a drug.

They recognized that certain business functions, such as

risk management and volunteering, were not adequately represented

in the set of data entities and business rules, but they decided

to deal with these and other areas later. The study team

stored descriptions of these data entities and the business rules

in the CASE repository for later analysis. Using the identified

entities and business rules, the study team developed a preliminary

enterprise data model (see MVCH Figure 1-3). Again, this

conceptual model is preliminary and does not follow all the

conventions used in the information systems department for

drawing data models, but the purpose of this enterprise model

is to give only a general overview of organizational data.