INFO 6210 Data Management and Database Design

Group 6: COVID-19 hospitalization management system

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Content

Introduction - Background

- With the massive amount of COVID-19 patients occupying the hospital, the purpose of the design is to predict the disease prognosis, to modify the treatment strategy, and to adjust the admission standard in order to manage the COVID-19 patients more efficiently.

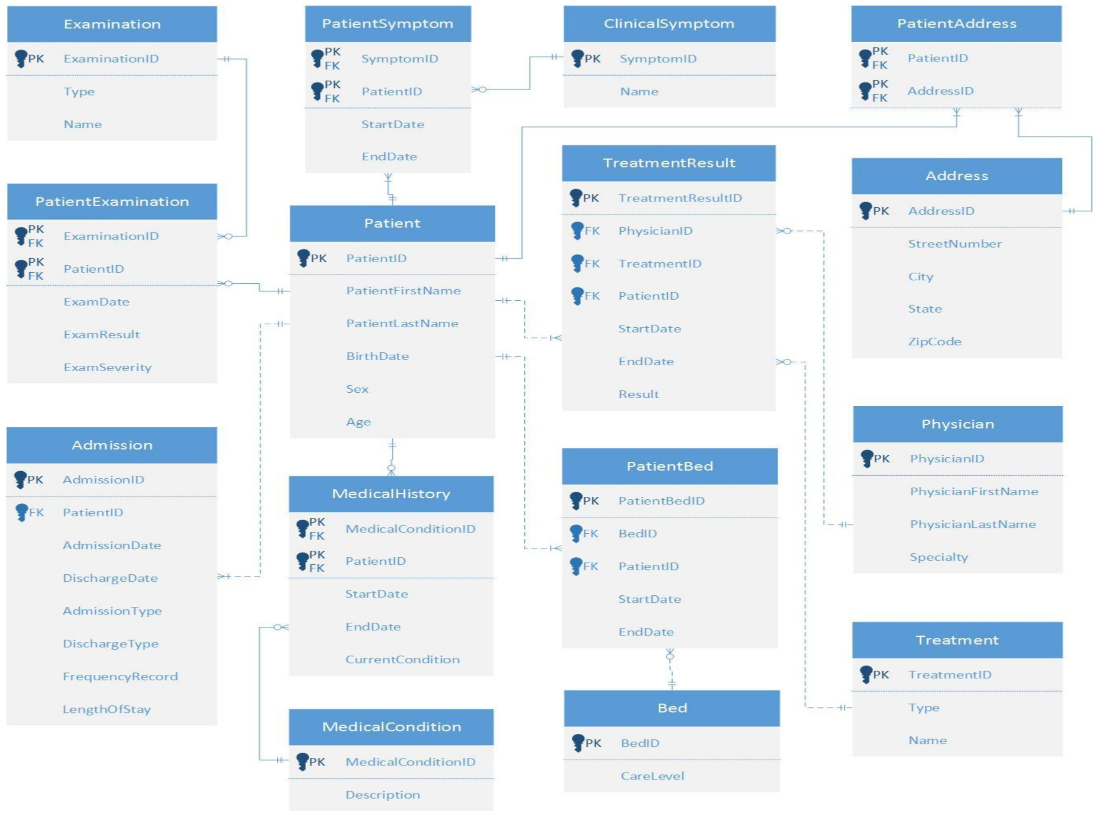
Introduction - Mission Objectives

- Track patients' addresses to send alerts and prevent community spread.
- Improve the scheduling of admission and discharge.
- Collect and analyze patients and treatment-related information that allows administrative staff to generate descriptive patients reports.
- Allow medical care providers to compare treatment results, which helps to further modify treatment strategies.
- Determine examinations and treatments that patients need based on clinical symptoms.

Database Implementation - ERD

- 9 Primary Entities: Patient, Address, ClinicalSymptom, MedicalCondition, Admission, Bed, Physician, Treatment, Examination

- 6 Associative Entities: PatientAddress, PatientSymptom, MedicalHistory, PatientBed, TreatmentResult, PaitentExamination



Database Implementation - Stored Procedure

- Create a Stored Procedure - AddPhysician.

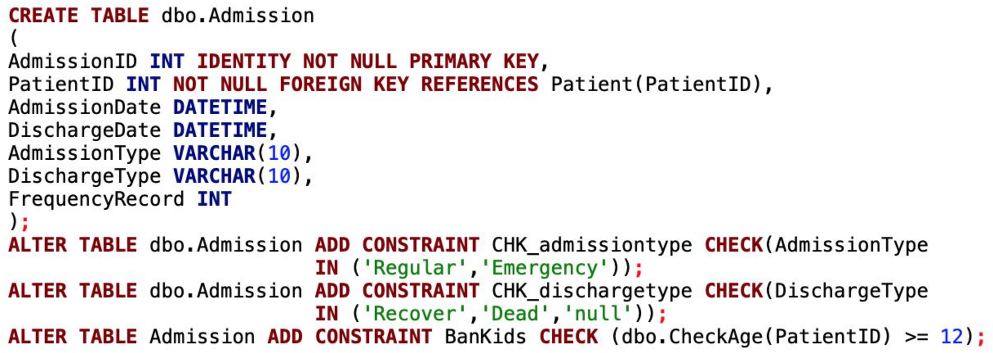
```sql
CREATE PROCEDURE dbo.AddPhysician
    @PhysicianFirstName VARCHAR(50),
    @PhysicianLastName VARCHAR(50),
    @Specialty VARCHAR(50)
AS
BEGIN
    INSERT INTO dbo.Physician(PhysicianFirstName, PhysicianLastName,Specialty)
    VALUES (@PhysicianFirstName, @PhysicianLastName, @Specialty)
END
```

- Physician data are inserted into database by “Stored Procedure.”

```sql
DECLARE @PhysicianFirstName VARCHAR(50) SET @PhysicianFirstName = 'Robert'
DECLARE @PhysicianLastName VARCHAR(50) SET @PhysicianLastName ='Smith'
DECLARE @Specialty VARCHAR(50) SET @Specialty = 'Pulmonology'
EXEC dbo.AddPhysician @PhysicianFirstName, @PhysicianLastName, @Specialty
```

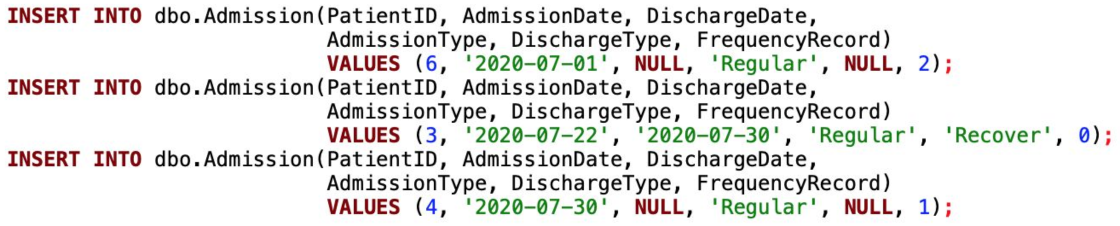
Database Implementation - Creating tables & Inserting data

- Create table and set data type, PK and FK.
  Add check constraint as well.



```
CREATE TABLE dbo.Admission
(
AdmissionID INT IDENTITY NOT NULL PRIMARY KEY,
PatientID INT NOT NULL FOREIGN KEY REFERENCES Patient(PatientID),
AdmissionDate DATETIME,
DischargeDate DATETIME,
AdmissionType VARCHAR(10),
DischargeType VARCHAR(10),
FrequencyRecord INT
);
ALTER TABLE dbo.Admission ADD CONSTRAINT CHK_admissiontype CHECK(AdmissionType
                          IN ('Regular','Emergency'));
ALTER TABLE dbo.Admission ADD CONSTRAINT CHK_dischargetype CHECK(DischargeType
                          IN ('Recover','Dead','null'));
ALTER TABLE Admission ADD CONSTRAINT BanKids CHECK (dbo.CheckAge(PatientID) >= 12);
```

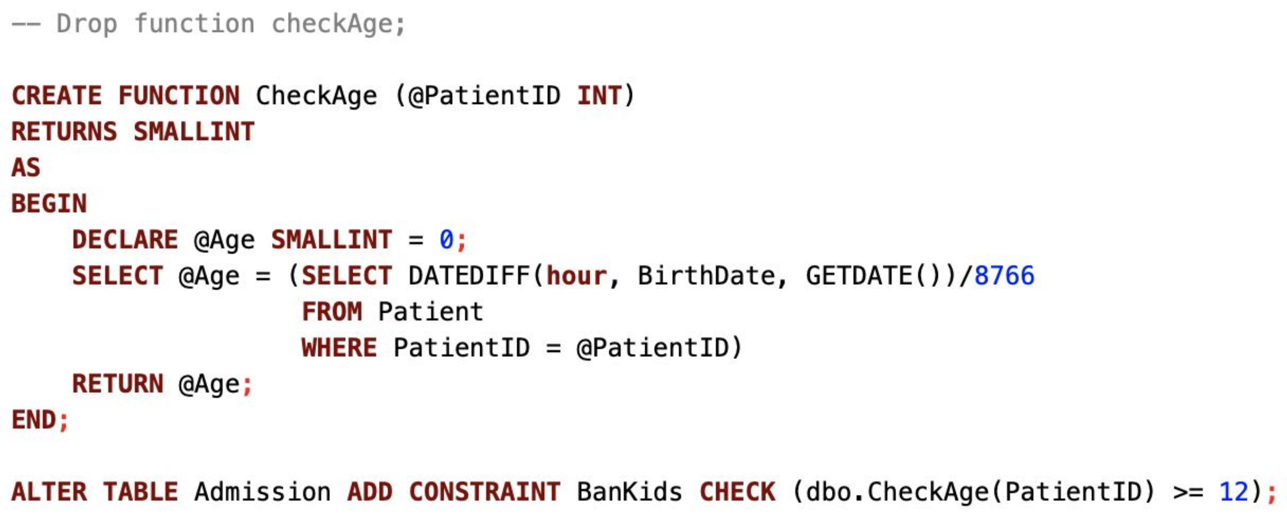
- Most data are inserted into tables by “Inserting”.



```
INSERT INTO dbo.Admission(PatientID, AdmissionDate, DischargeDate,
                          AdmissionType, DischargeType, FrequencyRecord)
                          VALUES (6, '2020-07-01', NULL, 'Regular', NULL, 2);
INSERT INTO dbo.Admission(PatientID, AdmissionDate, DischargeDate,
                          AdmissionType, DischargeType, FrequencyRecord)
                          VALUES (3, '2020-07-22', '2020-07-30', 'Regular', 'Recover', 0);
INSERT INTO dbo.Admission(PatientID, AdmissionDate, DischargeDate,
                          AdmissionType, DischargeType, FrequencyRecord)
                          VALUES (4, '2020-07-30', NULL, 'Regular', NULL, 1);
```

Database Implementation - Table Level Constraint

- We check patients' age to make sure patients < 12 years old will not be admitted.
- The insertion of patient < 12 years old into admission table will be terminated.



```
-- Drop function checkAge;

CREATE FUNCTION CheckAge (@PatientID INT)
RETURNS SMALLINT
AS
BEGIN
    DECLARE @Age SMALLINT = 0;
    SELECT @Age = (SELECT DATEDIFF(hour, BirthDate, GETDATE())/8766
                   FROM Patient
                   WHERE PatientID = @PatientID)
    RETURN @Age;
END;

ALTER TABLE Admission ADD CONSTRAINT BanKids CHECK (dbo.CheckAge(PatientID) >= 12);
```

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Database Implementation - Computed column

- The length of hospital stay is calculated to provide convenience for observation.

```sql
DROP FUNCTION fn_CountLengthOfStay

CREATE FUNCTION fn_CountLengthOfStay (@AdmissionID INT)
RETURNS INT
AS BEGIN
    DECLARE @CountDays INT =
    (SELECT DATEDIFF (DAY, AdmissionDate , COALESCE (DischargeDate, getdate()) )
     FROM dbo.Admission
     WHERE AdmissionID = @AdmissionID)
    SET @CountDays = isnull(@CountDays , 0)
    RETURN @CountDays
END

ALTER TABLE dbo.Admission
ADD LengthOfStay AS (dbo.fn_CountLengthOfStay (AdmissionID))
```

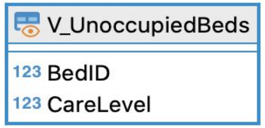
- The age is calculated to provide convenience to analyze patients' age distribution.

```sql
CREATE FUNCTION fn_CountAge (@PatientID INT)
RETURNS INT
AS BEGIN
    DECLARE @CountAge INT =
    (SELECT DATEDIFF (HOUR, BirthDate , GETDATE())/8766
     FROM dbo.Patient
     WHERE PatientID = @PatientID)
    RETURN @CountAge
END

ALTER TABLE dbo.Patient
ADD Age AS (dbo.fn_CountAge (PatientID))
```

Database Implementation - Views

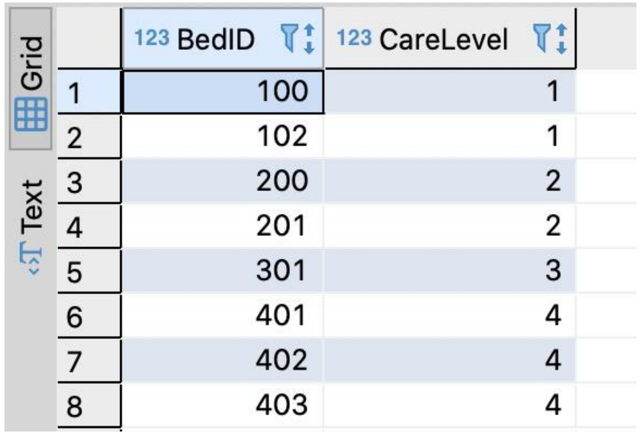
- View 1: Observed the relationships between the patient's' medical conditions and the prognosis.
- View 2: Tracked the physicians' treatments and the effectiveness
- View 3: Tracked the geographical distribution of COVID-19 patients.
- View 4: Looked up for unoccupied beds.

```sql
CREATE VIEW V_UnoccupiedBeds
AS
SELECT t.BedID, CareLevel
FROM
(
(SELECT DISTINCT BedID FROM BED
EXCEPT
SELECT DISTINCT BedID FROM PatientBed )
union
(SELECT DISTINCT BedID FROM PatientBed
EXCEPT
SELECT DISTINCT BedID FROM PatientBed
WHERE EndDate is null)
) t
JOIN Bed b
ON t.BedID = b.BedID

SELECT * FROM V_UnoccupiedBeds
```



V_UnoccupiedBeds

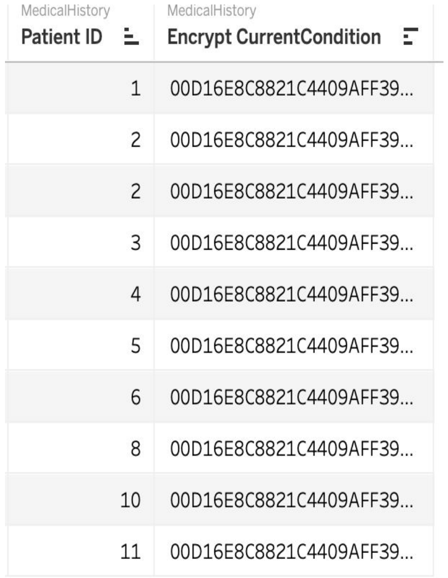
123 BedID
123 CareLevel



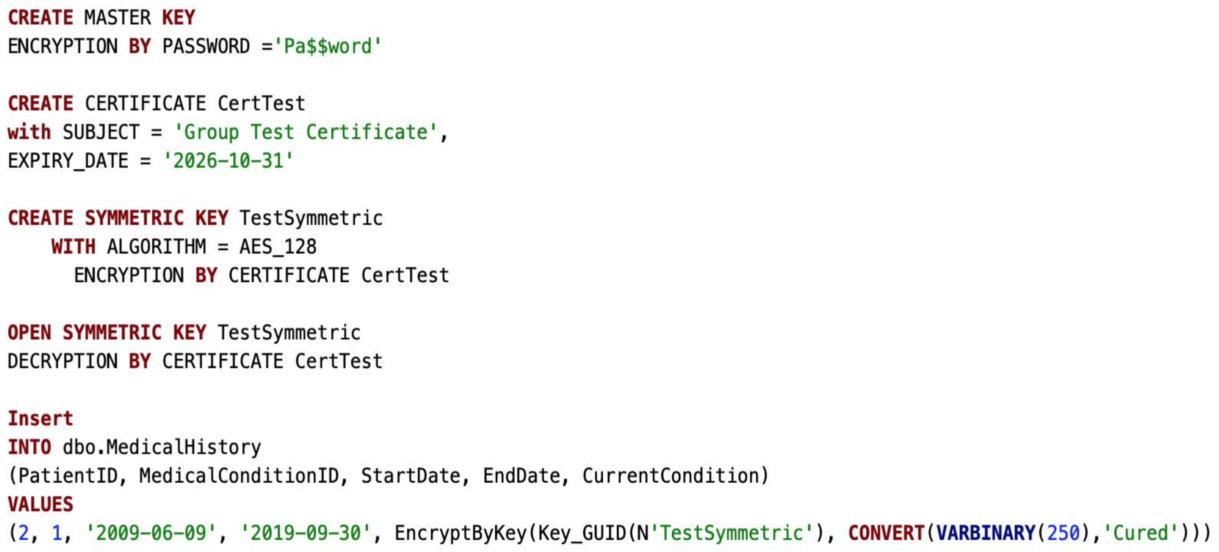
	123 BedID	123 CareLevel
1	100	1
2	102	1
3	200	2
4	201	2
5	301	3
6	401	4
7	402	4
8	403	4

Database Implementation - Column Data Encryption

- Encrypted the current condition of patients' medical history with passwords.



MedicalHistory Patient ID	MedicalHistory Encrypt CurrentCondition
1	00D16E8C8821C4409AFF39...
2	00D16E8C8821C4409AFF39...
2	00D16E8C8821C4409AFF39...
3	00D16E8C8821C4409AFF39...
4	00D16E8C8821C4409AFF39...
5	00D16E8C8821C4409AFF39...
6	00D16E8C8821C4409AFF39...
8	00D16E8C8821C4409AFF39...
10	00D16E8C8821C4409AFF39...
11	00D16E8C8821C4409AFF39...

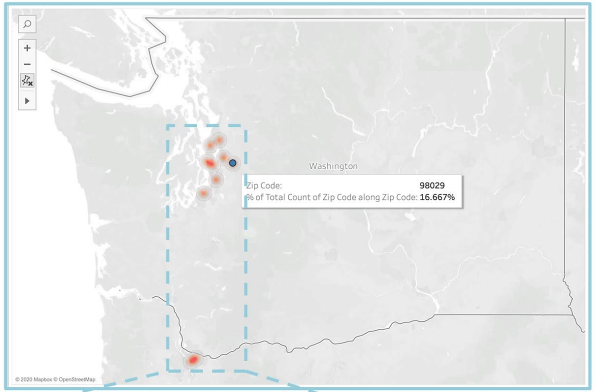


```
CREATE MASTER KEY
ENCRYPTION BY PASSWORD ='Pa$$word'

CREATE CERTIFICATE CertTest
with SUBJECT = 'Group Test Certificate',
EXPIRY_DATE = '2026-10-31'

CREATE SYMMETRIC KEY TestSymmetric
    WITH ALGORITHM = AES_128
      ENCRYPTION BY CERTIFICATE CertTest

OPEN SYMMETRIC KEY TestSymmetric
DECRYPTION BY CERTIFICATE CertTest

Insert
INTO dbo.MedicalHistory
(PatientID, MedicalConditionID, StartDate, EndDate, CurrentCondition)
VALUES
(2, 1, '2009-06-09', '2019-09-30', EncryptByKey(Key_GUID(N'TestSymmetric'), CONVERT(VARBINARY(250),'Cured')))
```

Report & Visualization

- The top 3 most-affected cities are Seattle, Bothell and Issaquah.

- The 3 most commonly reported symptoms are cough, fever, and headache.


Washington
Zip Code: 98029
% of Total Count of Zip Code along Zip Code: 16.667%
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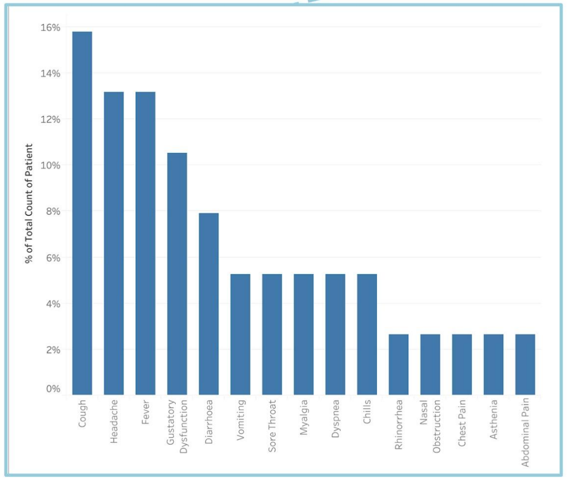

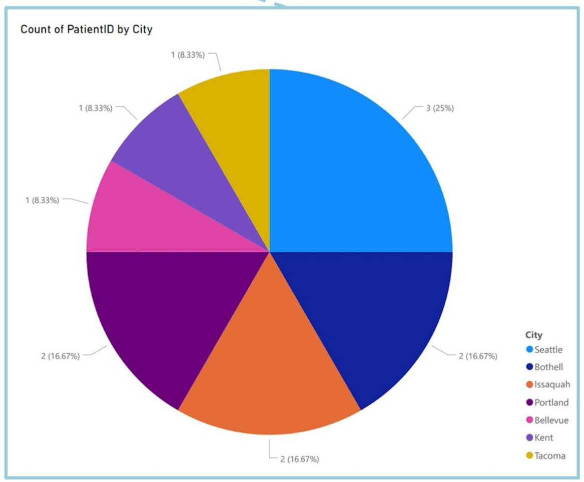

Thank you !
Q&A