

Data & Knowledge Management

Presented by

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Objectives



Differentiate between structured versus unstructured EMR data



Summarize high level concepts for EMR data transactions and data warehousing



Describe key elements of a relational database.



Formulate simple SQL queries using a basic understanding of language syntax

Databases & Healthcare – My story

- PGY1 at the Fort Harrison VA Medical Center in Helena, MT.
- Identified missed opportunities for improved care
- Learned about patient dashboards during anticoag rotation
- Pursued PGY2 in Pharmacy Outcomes and Health Care Analytics
- Using data to improve patient care through population health management

Why specialize in informatics as a pharmacist?



Multiply your impact on a patient population



Improve health care quality and patient safety



Support clinical research projects



Lead the data revolution in health care



Medical Data Pipeline - Overview

VA Computerized Patient Record System (CPRS)

File Edit View Tools Help

ZZAMERICA, CAPTAIN [OUTPATIENT] Visit Not Selected No PACT assigned at any VA location /
000-00-1776 Jun 01, 1948 (71) Current Provider Not Selected

Flag JLIV Remote Data Postings CWAD

Active Problems

Insomnia [SCT 193462001]

Bipolar Affective Disorder, Current Episode Depression [SCT 191627008]

*White Blood Cell Disorder [SCT 54097007]

Chronic Kidney Disease Stage 3 [SCT 433144002]

*Major Depression, Single Episode [SCT 36923009]

*Influenza Due To Influenza A Virus [SCT 442438000]

Acute Low Back Pain [SCT 49436004]

Al-Atrial Fibrillation [SCT 15188001]

Hearing Loss [SCT 15188001]

*Incomplete Spinal Cord Lesion At T1-T6 Level Without Bone Injury [SCT 11413003]

Born In Scotland [SCT 315515001]

Depression [SCT 36489007]

Degeneration Of Lumbosacral Intervertebral Disc [SCT 60937000]

Parkinson'S Disease [SCT 49049000]

Asymmetrical Sensorineural Hearing Loss [SCT 428887009]

Mononeuritis [SCT 32595002]

Cancer Of Colon [SCT 363406005]

Bipolar II Disorder [SCT 83225003]

Moderate Recurrent Major Depression [SCT 18818009]

Moderate Recurrent Major Depression [SCT 18818009]

Degenerative Joint Disease Of Ankle And/Ot Foot [SCT 82300000]

Degenerative Joint Disease Of Pelvis [SCT 445478004]

HIV - Human Immunodeficiency Virus Infection [SCT 86406008]

Chronic Pain Syndrome [SCT 373621006]

Complete Rupture Of Rotator Cuff [SCT 202843000]

Allergies / Adverse Reactions

Impramine

Sulfu Drugs

Aspirin Related Medications

Penicillin

Ibuprofen

Ciprofloxacin

Pork Products

Bee Stings

Levofloxacin [Levaquin]

Levothyroxine

Eggs

Latex

Iodinated Contrast Media

Lisinopril

Iron

Sulfamethoxazole/Trimethoprim [Septra]

Surgical Tape

Omeprazole

Bisoprolol

Patient Record Flags

BEHAVIORAL

HIGH RISK FOR SUICIDE

MRSA

RESEARCH PATIENT

Postings

Allergies

Consent For Long-Term Opioids For Pain Feb 04, 2019

Consent For Long-Term Opioids For Pain Sep 24, 2018

Consent For Long-Term Opioids For Pain Feb 06, 2018

Consent For Long-Term Opioids For Pain Jan 03, 2018

Consent For Long-Term Opioids For Pain Sep 28, 2017

Life-Sustaining Treatment Apr 26, 2017

Consent For Long-Term Opioids For Pain Mar 01, 2016

Consent For Long-Term Opioids For Pain May 01, 2015

Consent For Long-Term Opioids For Pain Apr 01, 2015

Consent For Long-Term Opioids For Pain Jan 05, 2015

Consent For Long-Term Opioids For Pain Dec 05, 2014

Consent For Long-Term Opioids For Pain Oct 08, 2014

Consent For Long-Term Opioids For Pain Oct 08, 2014

Crisis Note Jul 22, 2006

Crisis Note Feb 09, 2005

Critical Result Jul 09, 2004

Active Medications

Bupropion Hcl 150mg 12hr Sa Tab Active/Susp

Aspirin 325mg Tab Active

Ticagrelor 90mg Tab Active

Prasugrel Hcl 10mg Tab Active

Aspirin 81mg Ec Tab Active

Lisinopril 10mg Tab Non-Verified

Non-Va Non Va Med Not Listed Miscellaneous

Non-Va Vitamin A & D 60gm Oint Top Active

Non-Va Fish Oil 1000mg (500mg Dha/Epa) Cap Oral

Non-Va Potassium Chloride 10meq Sa Tab Active

Non-Va Potassium Chloride 10meq Tab Sa Active

Non-Va Lorazepam 1mg Tab Active

Non-Va Simvastatin 20mg Tab Active

Non-Va Ibuprofen 800mg Tab Active

Non-Va Calcium 500mg/Vitamin D 200 Unt Tab

Non-Va Methotrexate Na 2.5mg Tab Active

Non-Va Methotrexate Na 2.5mg Tab Active

Non-Va Naltrexone Microspheres 380mg Inj

Non-Va Cholecalciferol [vit D3] 1000unt Tab

Clinical Reminders

No reminders due

Due Date

Recent Lab Results

Strep Group A Screen (rapid) Throat Wc Lb #386238 Feb 06, 2020

Strep Group A Screen (rapid) Throat Wc Lb #384232 Feb 04, 2020

Strep Group A Screen (rapid) Throat Wc Lb #384117 Feb 04, 2020

Strep Group A Screen (rapid) Throat Wc Lb #382495 Feb 03, 2020

Strep Group A Screen (rapid) Throat Wc Lb #382166 Feb 03, 2020

Strep Group A Screen (rapid) Throat Wc Lb #378967 Jan 30, 2020

Strep Group A Screen (rapid) Throat Wc Lb #375846 Jan 28, 2020

Strep Group A Screen (rapid) Throat Wc Lb #372369 Jan 24, 2020

Strep Group A Screen (rapid) Throat Wc Lb #363308 Jan 16, 2020

Vitals

T 101 F Jan 28, 2020 13:22 (38.3 C)

P 110 Feb 04, 2020 13:22

R 15 Jan 23, 2020 09:52

BP 111/68 Jan 08, 2020 11:25

HT 72 in Feb 03, 2020 08:41 (182.88 cm)

WT 175 lb Feb 03, 2020 08:41 (79.38 kg)

FN 0 Jan 08, 2020 11:25

POC 100 Jan 08, 2020 11:25

CVP 136 cmH2O Oct 12, 2018 12:52 (100.0 mmHg)

CG 200 in Oct 12, 2018 12:52 (508.0 cm) LEFT

BMI 23.78 Feb 03, 2020 08:41

Appointments/Visits/Admissions

May 26, 2020 08:00 Slc Test

Jan 22, 2020 11:21 Slc Triage Tip Checked Out

Jan 22, 2020 08:00 Slc Test Cancelled By Patient

Jan 14, 2020 09:00 Stg Pact Lpn 01 Cancelled By Clinic

Jan 07, 2020 14:53 Slc Pact Rn 23 Checked Out

Jan 03, 2020 09:00 Stg Pact Lpn 01 Cancelled By Clinic

Dec 27, 2019 11:00 Slc Test Cancelled By Clinic

Dec 26, 2019 08:17 Slc Whs Intro Group (nc) Non-Count

Dec 18, 2019 07:38 Slc Ed Disposition Cancelled By Clinic

Dec 12, 2019 09:36 Slc Mh/Phd 352 Neurology Checked Out

Dec 06, 2019 13:00 Slc Test Cancelled By Clinic

Dec 06, 2019 11:00 Slc Test Cancelled By Clinic

Dec 06, 2019 07:54 Slc Pact Rn 23 Checked Out

Dec 05, 2019 10:31 Slc Ed Disposition Cancelled By Clinic

Dec 05, 2019 09:00 Slc Test Cancelled By Clinic

Dec 04, 2019 13:56 Slc Ed Disposition Cancelled By Clinic

Dec 04, 2019 13:31 Poc Mh/Np 14 Intake Checked Out

Dec 02, 2019 11:01 Slc Onc Pharm Checked Out

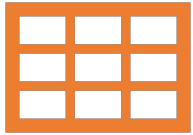
Dec 02, 2019 08:00 Slc Test Non-Count

* GUI: Graphical User Interface

Transactional Data

- Any information entered into the electronic medical record (EMR)
- Single transactions are the base unit of the entire EMR
- Communicate completed work to other users
- **Records management:** The process of retaining transactions for future use

Transactional Data Structure



Structured data

Fits a pre-defined model

Much easier to process/query

Examples: dates, lab data, SSNs, phone numbers, NDCs



Semistructured data

Contains both structured and unstructured data

Example: cellphone photos



Unstructured data

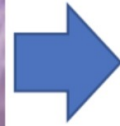
No predefined model

Much more process intensive to query

Example: raw text, video, audio recordings

What type of data is this PowerPoint?

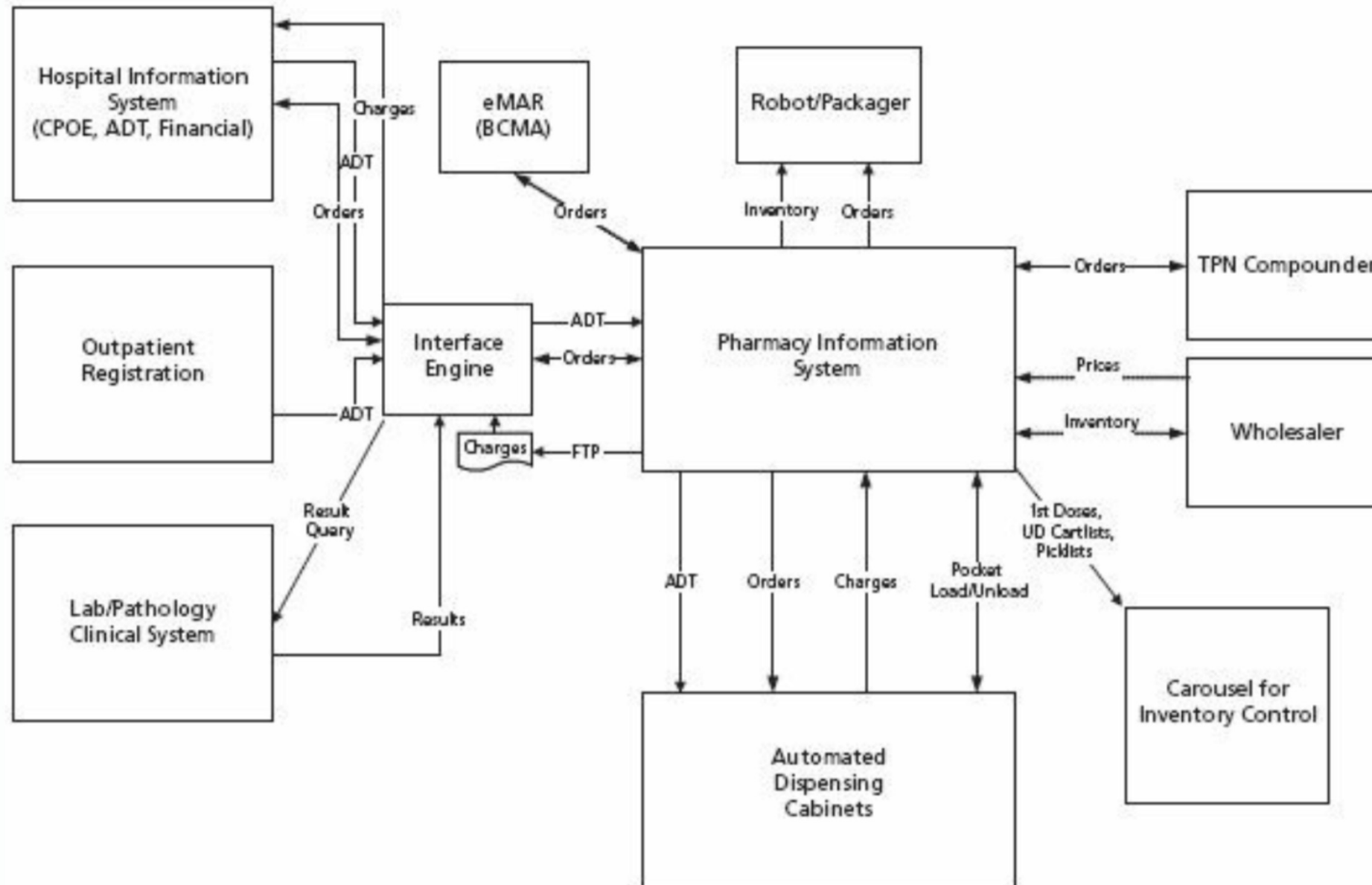
Transactional Data: Structured Lab data entry



Collection Date/Time	Test	Result / Status	Flag	Units	Ref Range
Dec 09, 2019	25 OH VITAMIN D	63		ng/mL	30 - 100

Every EMR has it's own specific limitations

Transactions originate from a wide variety of sources





Where do all these
transactions go?

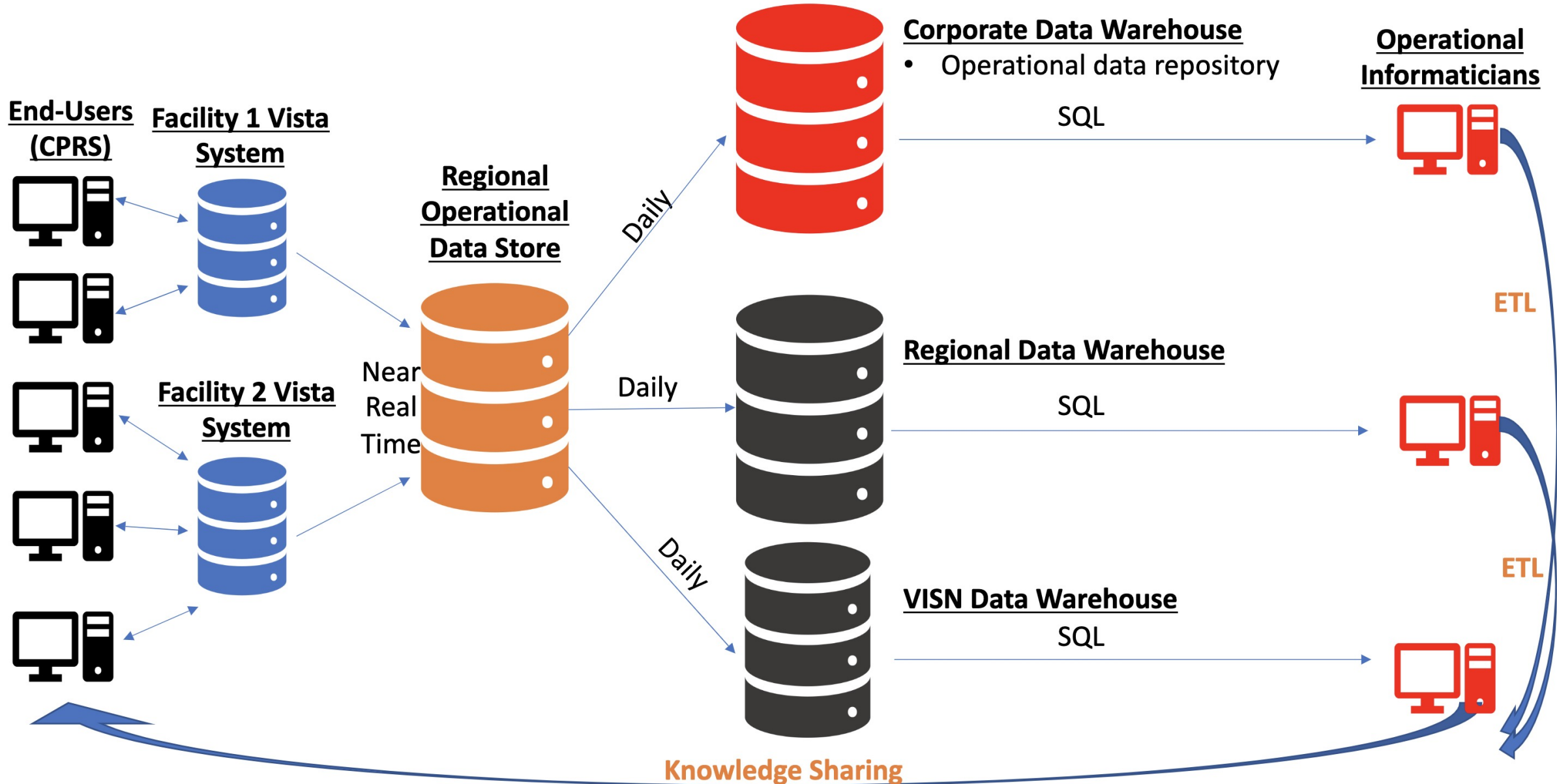


The short answer: Data Warehouse(s)

- Contains football fields of servers
- Gathers, transforms, and stores health data in databases
- Access to the data warehouse grants users the ability to provide accurate management information and supporting data analysis



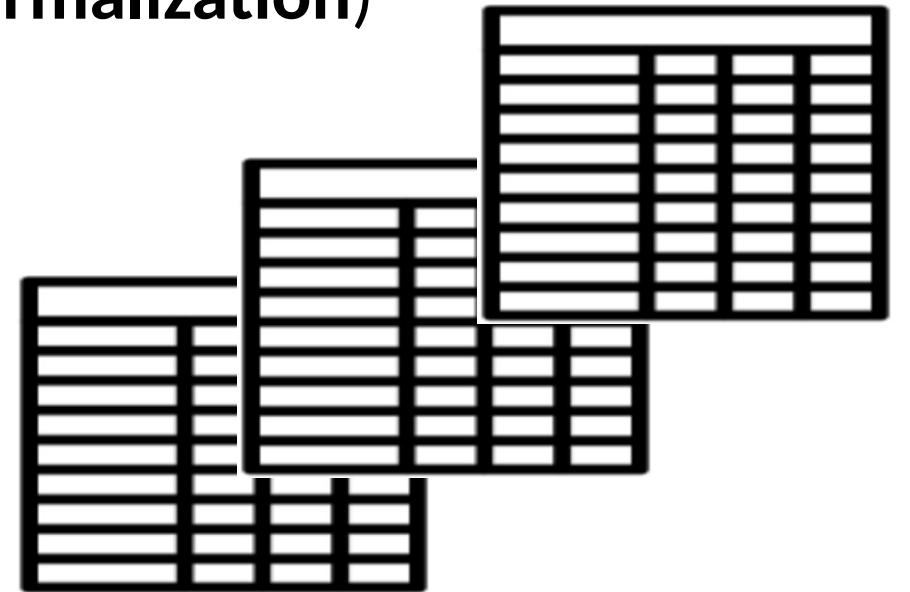
VA Data Warehousing Architecture



The Relational Database

- A database is a repository of data
- Structured data is typically stored in tables similar to spreadsheets
- Tables can be joined/linked together through shared columns
- Goal is to store a piece of data only once (**normalization**)

Why not have one spreadsheet with all the data in it?



Denormalized Data

Table Name: RxFill							
PatientName	Age	DrugName	FillDate	Qty	DaysSupply	FormularyFlag	PricePerUnit
Smith,John	55	Atorvastatin	2021-01-05	30	30	Y	0.05
Smith,John	55	Atorvastatin	2021-02-10	30	30	Y	0.05
Johnston,Smith	65	Metformin	2021-01-05	60	30	Y	0.01
Johnston,Smith	65	Metformin	2021-02-11	60	30	Y	0.01

- Note how the yellow columns contain duplicate data
- Increases required storage space and data processing time
- This duplication becomes non-trivial when this data model is applied to millions of patient records

Normalized/Relational Database Diagram

Table Name: RxFill					
RxFill_ID	Patient_ID	Drug_ID	FillDate	Qty	DaysSupply
1	1	1	2021-01-05	30	30
2	1	1	2021-02-10	30	30
3	2	2	2021-01-05	60	30
4	2	2	2021-02-11	60	30

Patient_ID

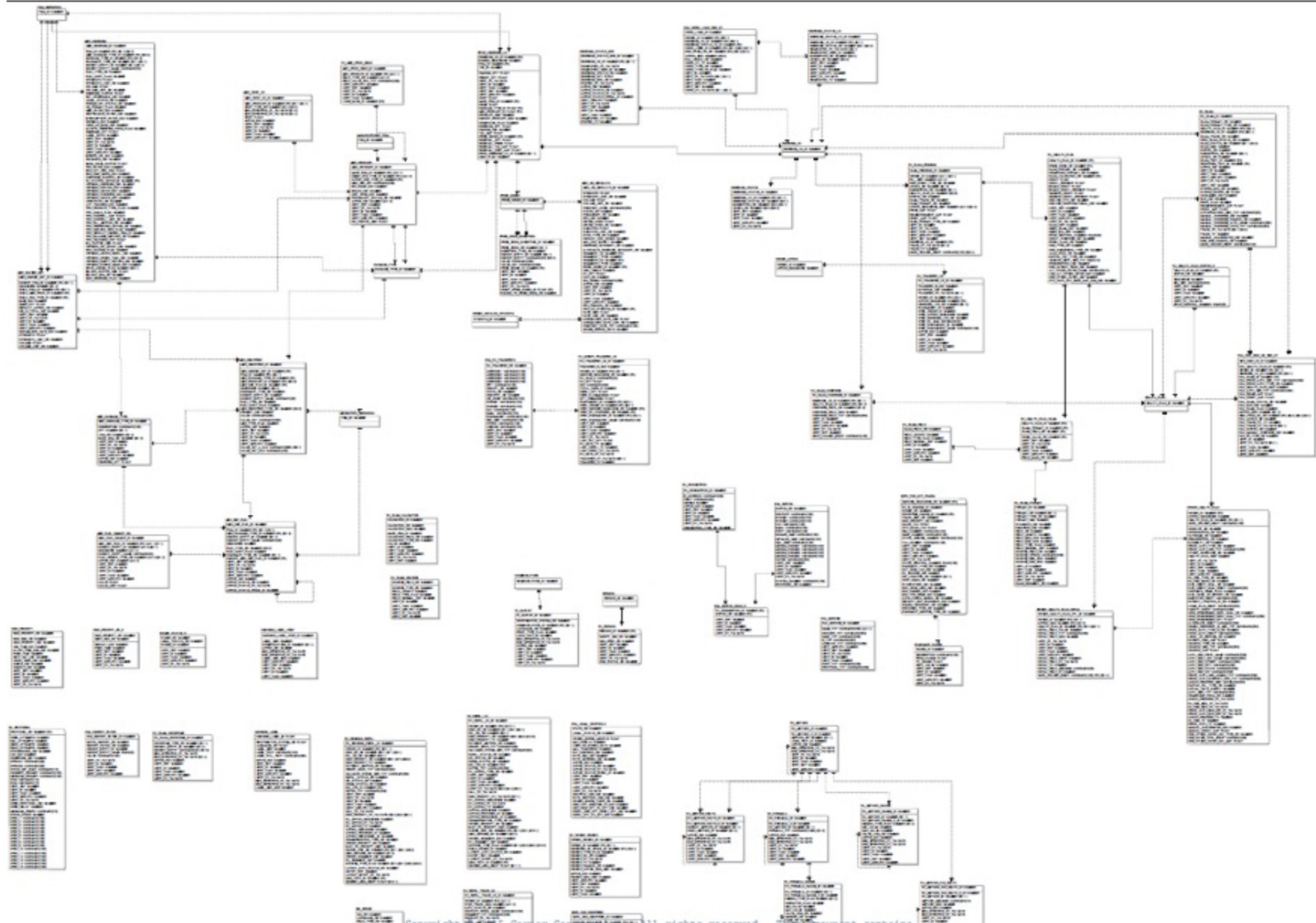
Drug_ID

Table Name: Patient		
Patient_ID	PatientName	Age
1	Smith,John	55
2	Johnston,Smith	65

Table Name: Drug			
Drug_ID	DrugName	FormularyFlag	PricePerUnit
1	Atorvastatin	Y	0.05
2	Metformin	Y	0.01

What other supporting tables might you find in a pharmacy database?

Pharmacy Relational Database Diagram Example





Retrieving Structured Medical Data



Examples with practice
database

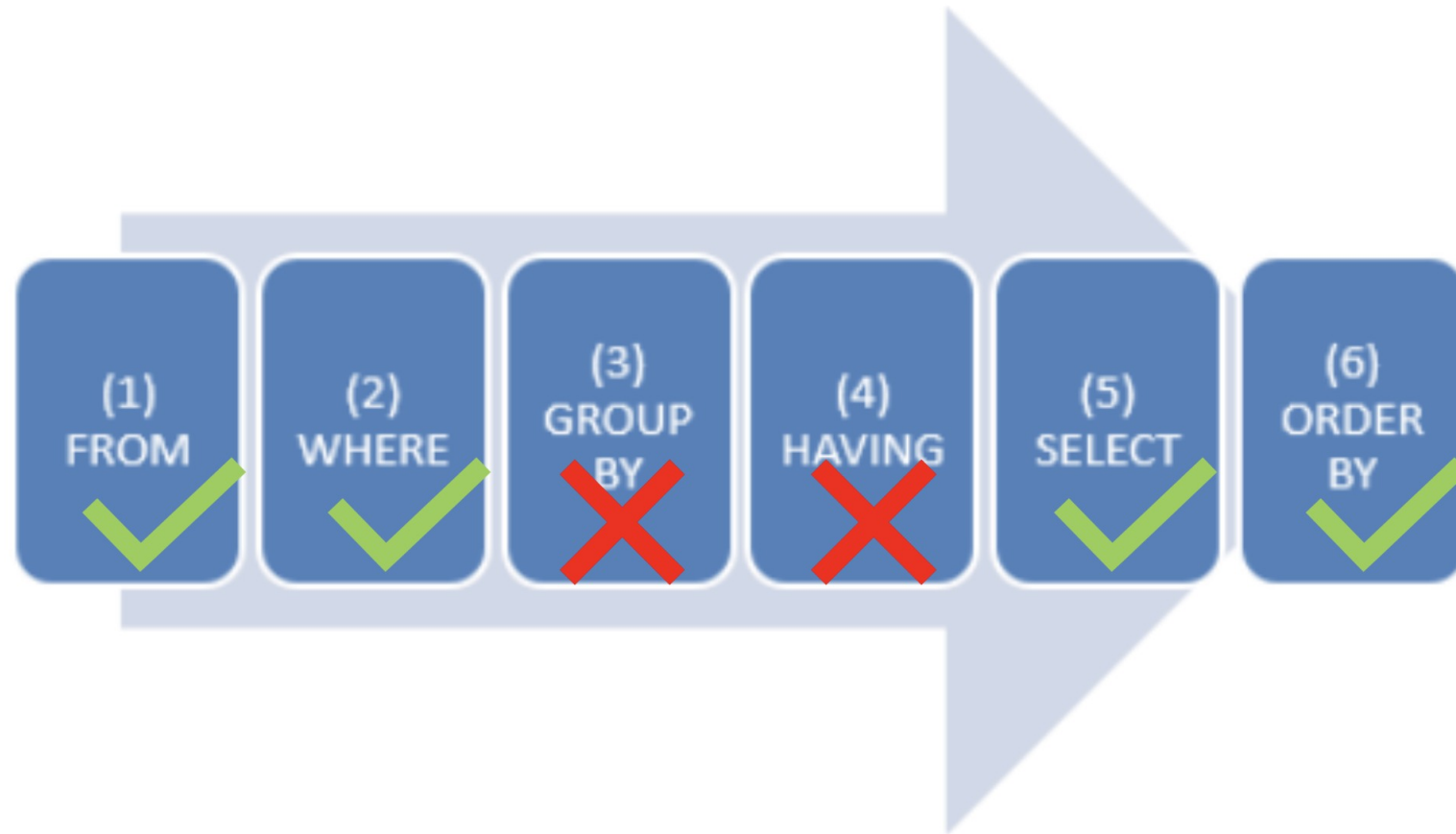
What is SQL?

- Structured Query Language
- Used to communicate with data within a database
- Code is written in an user-interface that is connected to the database
- Critical data operations:
 - Accessing
 - Updating
 - Inserting
 - Manipulating
 - Modifying

Basic structure of a SQL query

```
Select [ColumnName]  
        , [ColumnName]  
From [DatabaseName].[Schema].[Table]  
Where ....[insert expressions for column filtering here]  
Order by [ColumnName];
```

Order of processing



FROM Clause

Indicates which database table the query will retrieve data from

Format:

FROM Database.Schema.TableName

Select *

From Pharm.mockpharmacydata

Where DispensedDate >= '2019-10-01'

Order by DispensedDateTime;



WHERE Clause Comparison Operators

Applies filters to the table

Comparison	Symbol
Equal to	=
Greater than	>
Lesser than	<
Greater than or equal to	>=
Less than or equal to	<=
Not equal to	<>

Select *

From Pharm.mockpharmacydata

Where DispensedDate >= '2019-10-01'

Order by DispensedDateTime;

SELECT Clause

Indicates which database column(s) will appear in the results set

Tip: **Select *** means “select all columns”

```
Select [Column1]  
      ,[Column2]  
      ,.....
```

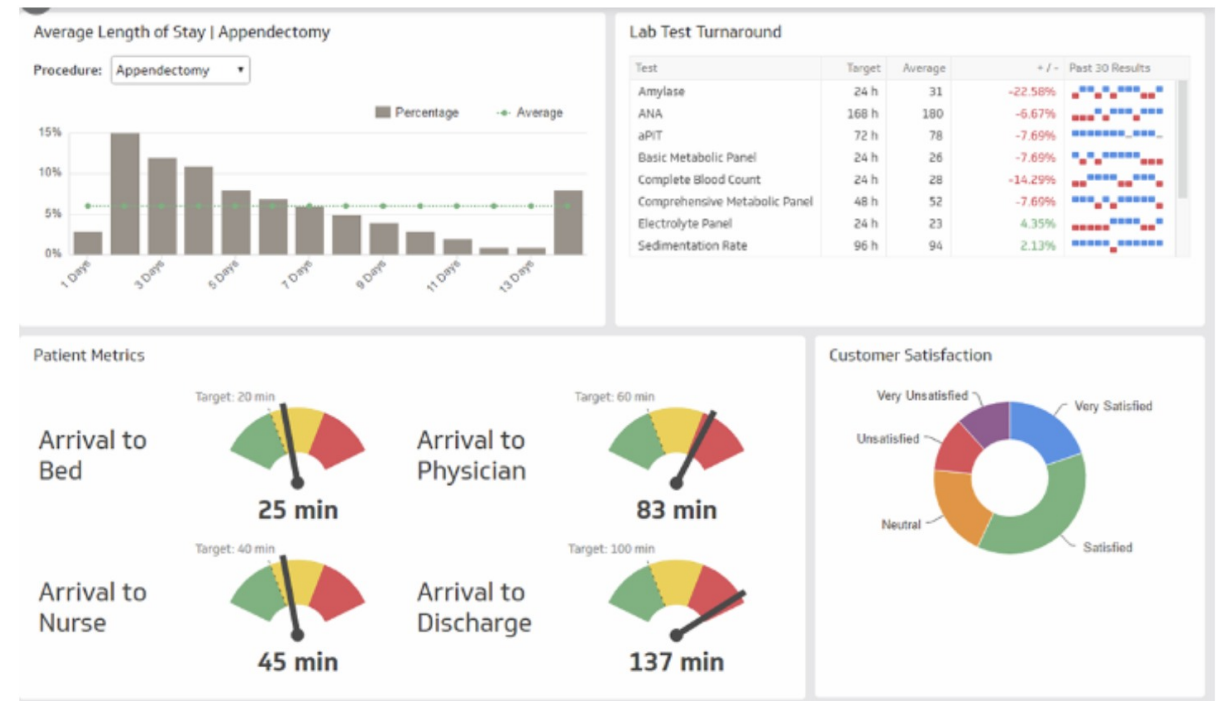
```
From Pharm.mockpharmacydata  
Where DispensedDate >= '2019-10-01'  
Order by DispensedDateTime;
```

ORDER BY Clause

Indicates which column(s) the results will be sorted by

```
Select [Column1]
      ,[Column2]
      ,.....
From Pharm.mockpharmacydata
Where DispensedDate >= '2019-10-01'
Order by DispensedDateTime;
```

- Many software applications exist:
 - SQL Server Reporting Services (SSRS)
 - Power BI (Business Intelligence)
 - Pyramid Analytics
 - Tableau



Databases & Healthcare – Case Study

Background

- VA CARES: a pharmacist-led telehealth oncology med management program supporting 3 medical centers
- Serves rural Veterans receiving oral antineoplastic therapies prescribed by non-VA providers

Problems

- Asynchronous pre-enrollment data needed along with process tracking
- Need to determine if there are cost-savings associated

Solution

- Developed an internal patient enrollment app to track status and data needed from non-VA providers
- Developed a dashboard that tracks patient data
- Retrieved data captured in clinician notes to support implementation scientist's cost savings analyses



Key Points

- Pharmacists are well positioned to merge clinical and data knowledge
- Understanding the fundamentals of how data is captured and retrieved allows for rapid analysis of your patient population
- Structured Query Language (SQL) allows you to interact with a database
- Data can be presented to leadership/clinicians to support decision-making

Next steps (optional)

- Follow the [steps outlined in my GitHub repository](#) to create your first database
- Follow the [DataManipulationScript.sql](#) to practice executing and writing queries
- Review the data, ask questions about the data, attempt to answer those questions using SQL

Questions?