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

*EMR = Electronic Medical Record

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

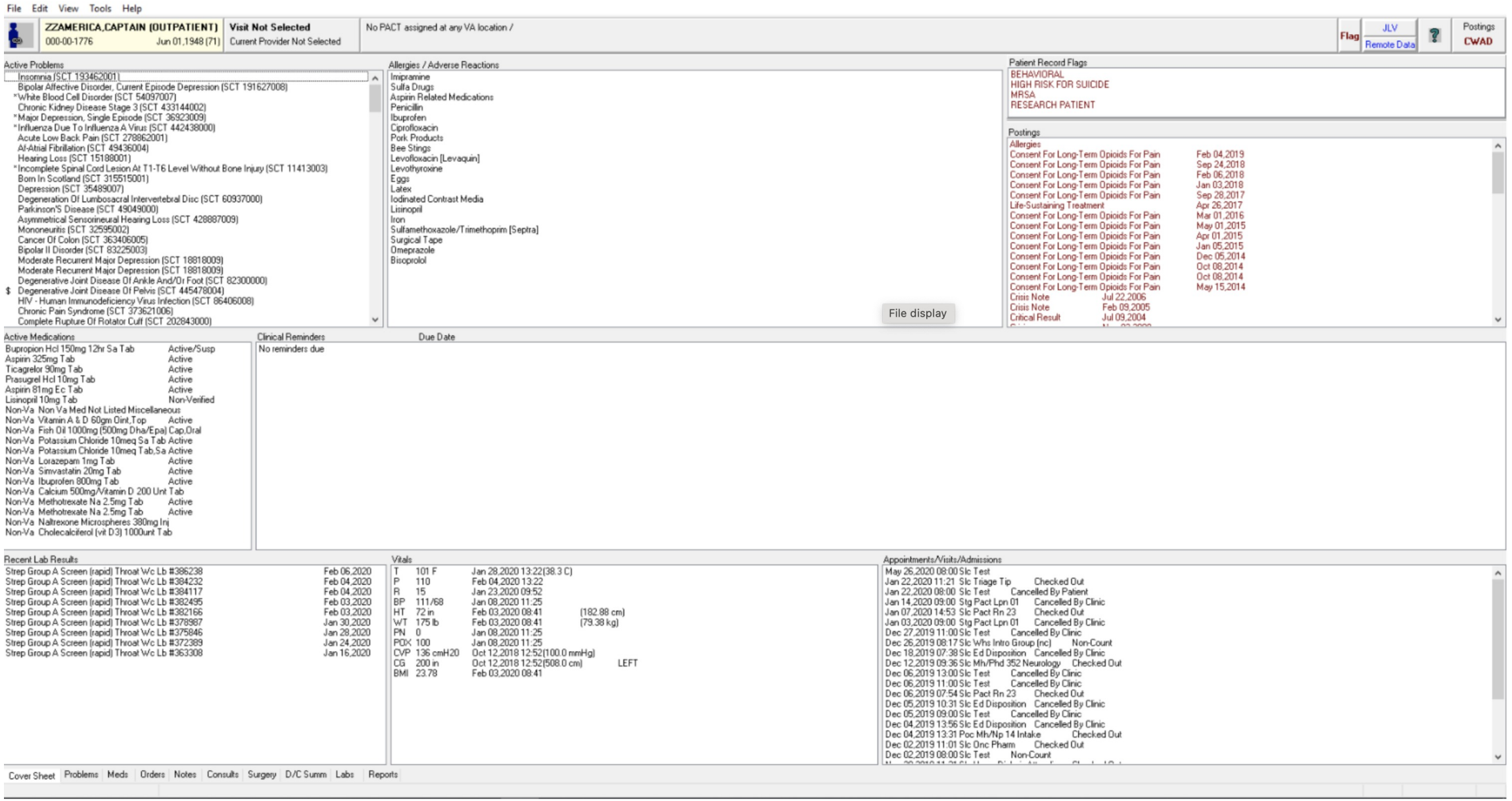
Improve health care quality and patient safety

Support clinical research projects

Lead the data revolution in health care

Medical Data Pipeline - Overview

VA Computerized Patient Record System (CPRS)

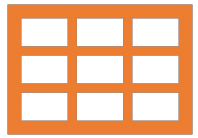


*GUI: Graphical User Interface

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

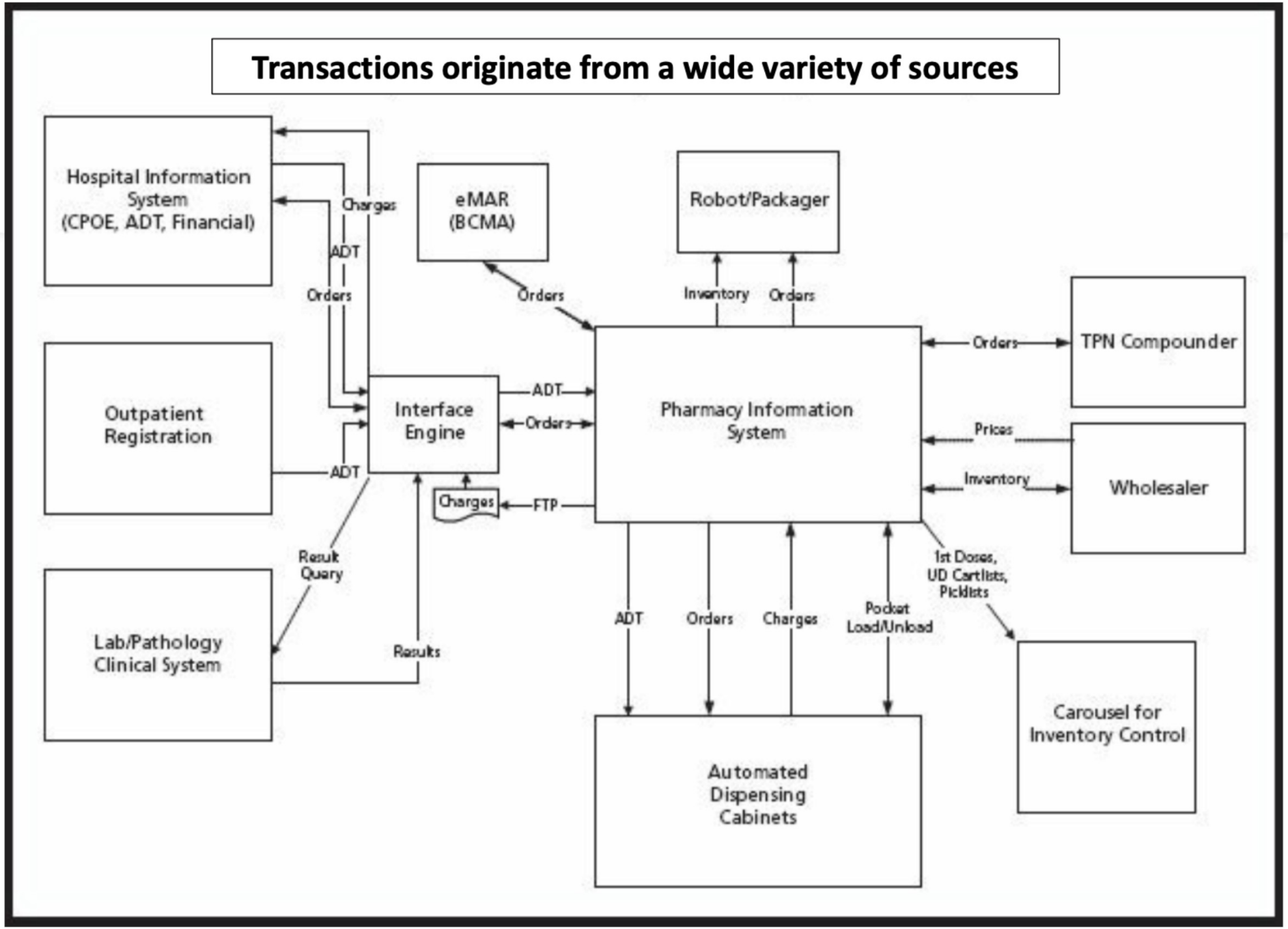
What type of data is this PowerPoint?

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

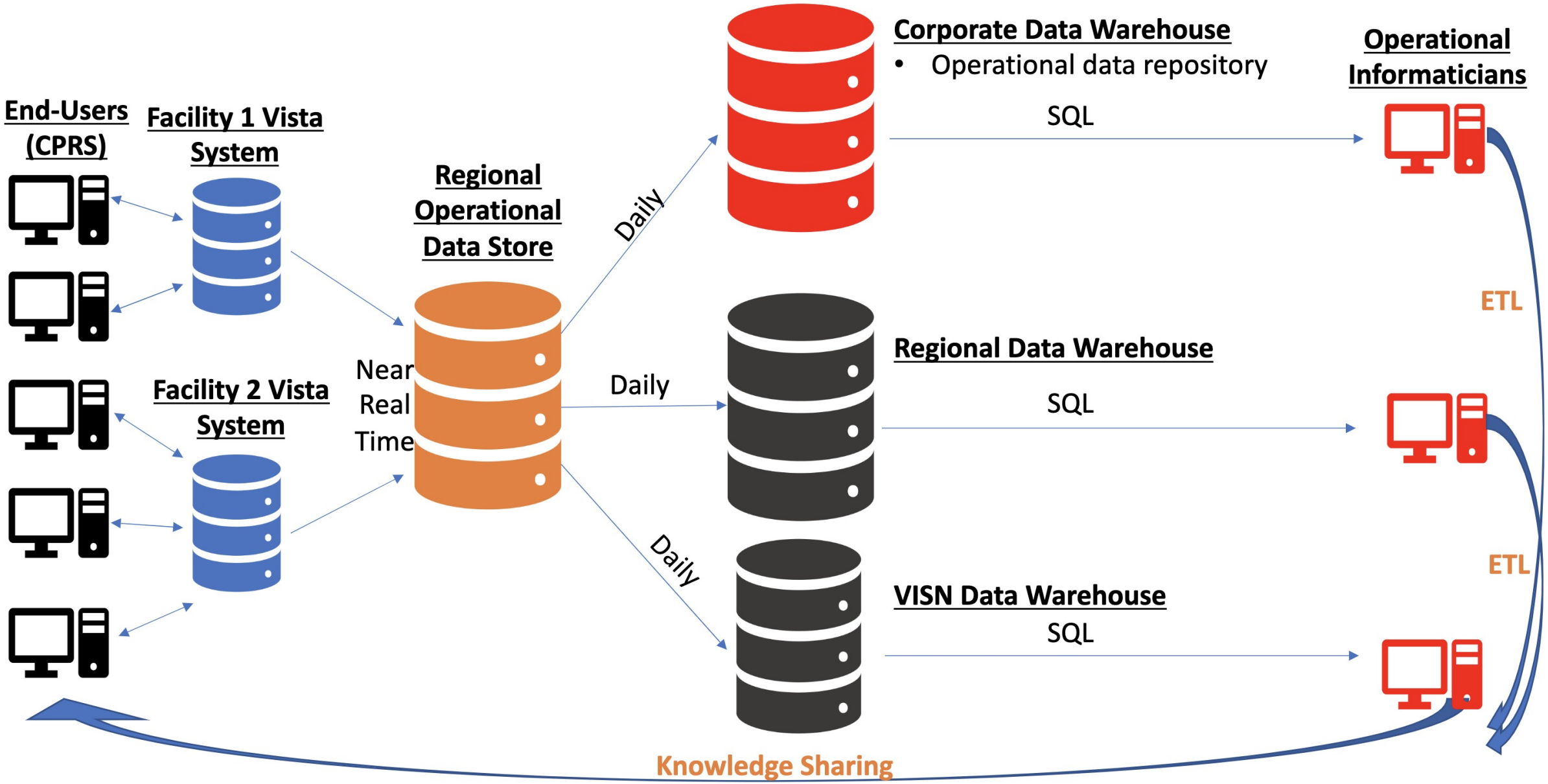


Where do all these transactions go?

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

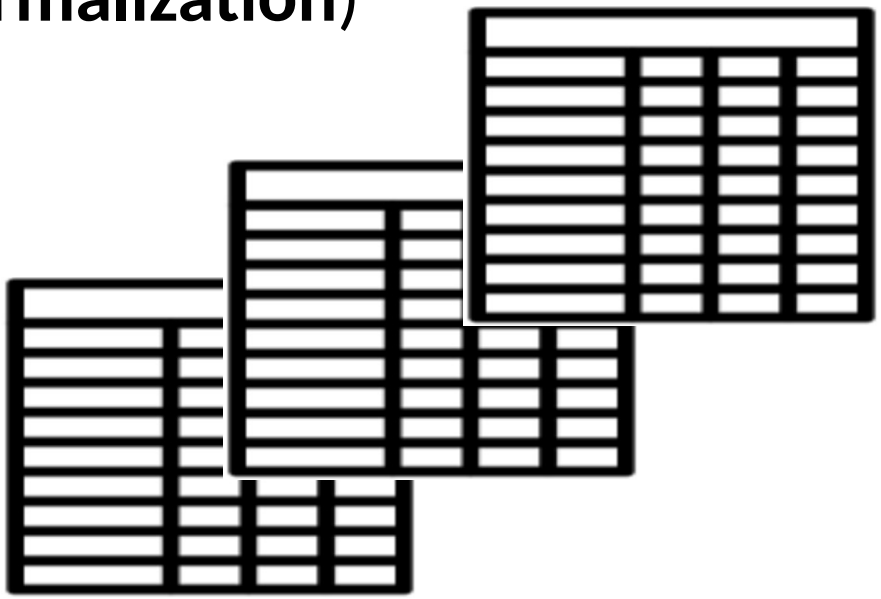
VA Data Warehousing Architecture



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

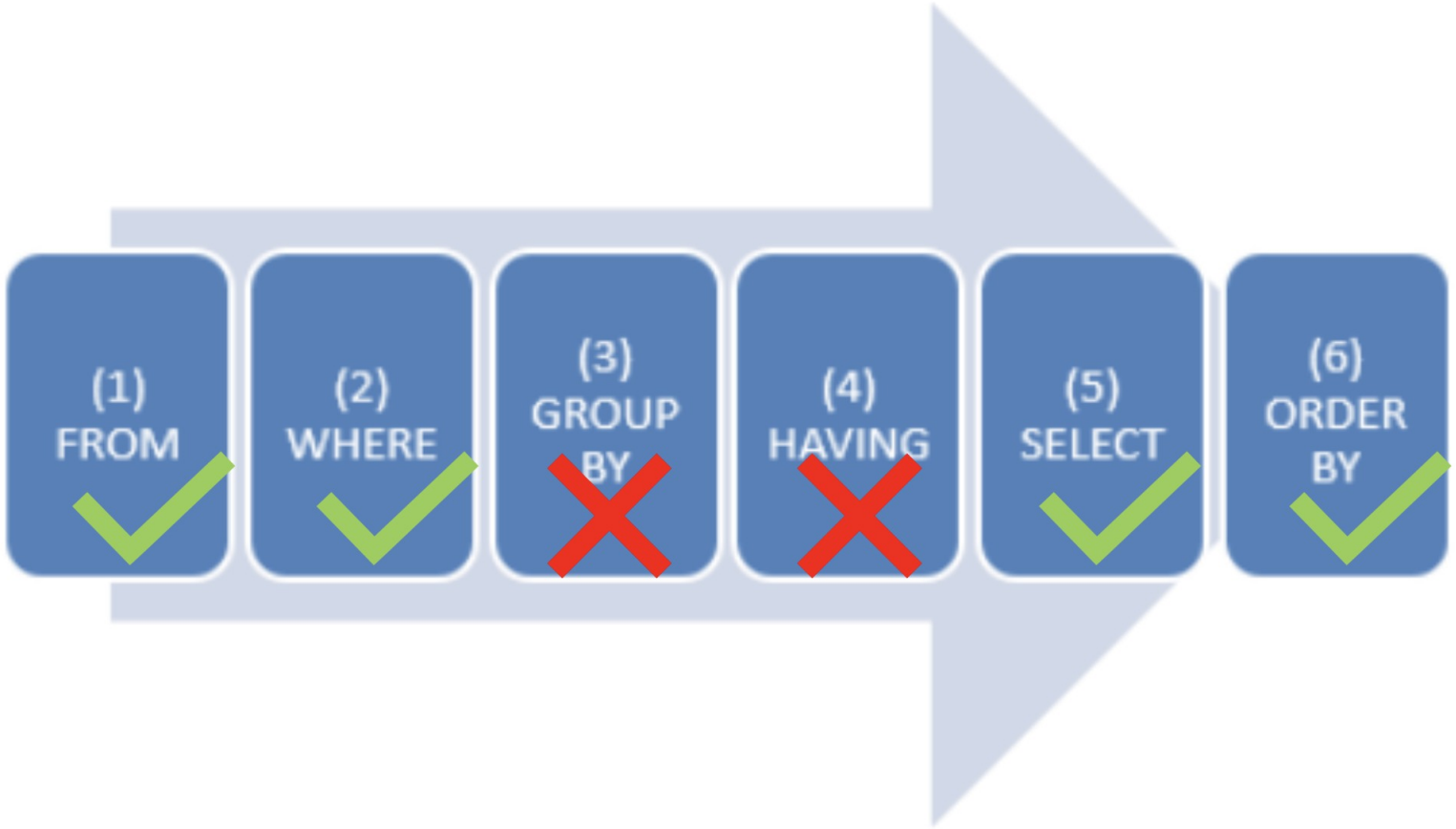
What is SQL?

- 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 [Column1Name]
, [Column2Name]
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

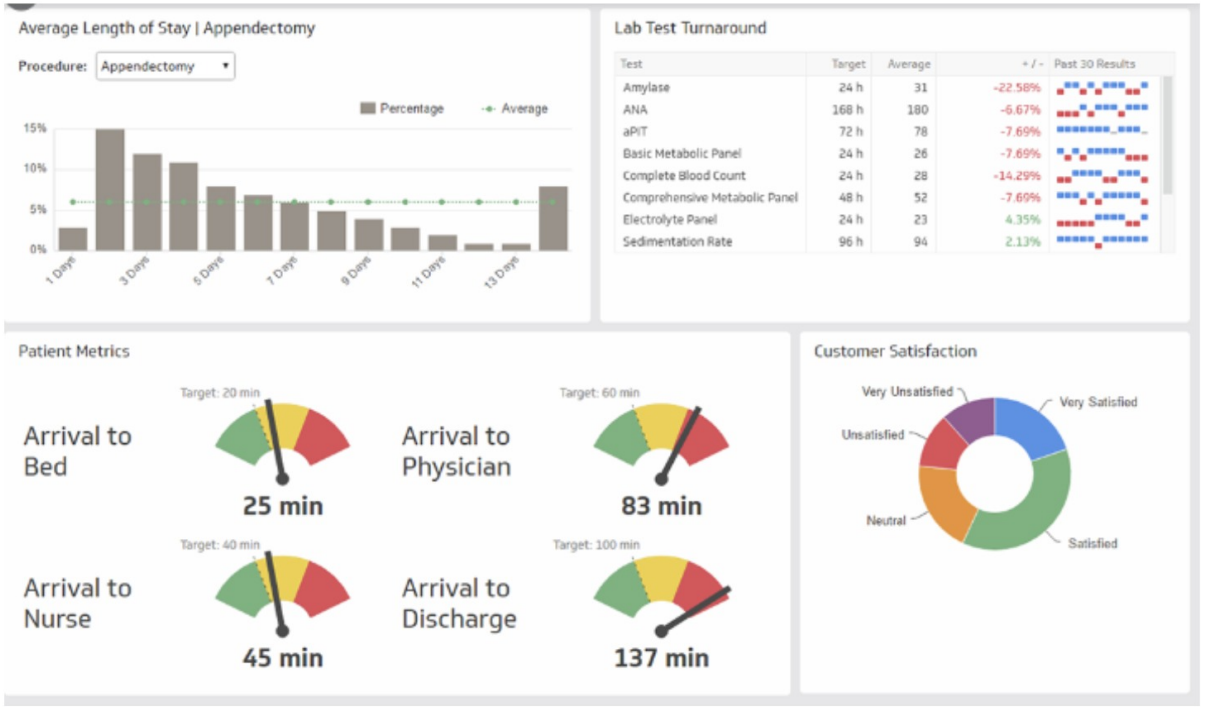
Indicates which column(s) the results will be sorted by

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

Clinical Dashboards and Performance Reports

- Electronic reports can be built to share data pulled using SQL

- 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

Passey D, Healy R, Qualls J, Hamilton C, Tilley E, Burningham Z, Sauer B, Halwani A. Development and implementation of a pharmacist-led telehealth medication management program for veterans receiving oral antineoplastic therapies through the MISSION Act, *American Journal of Health-System Pharmacy.* 2022 Jun;79(11):835-843.

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?