

# **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

# Why specialize in health 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

# Databases & Healthcare – Case Study

## Background

- VA CARES is an oncology pharmacist-led telehealth medication management program
- Primarily serves rural Veterans receiving oral antineoplastic therapies prescribed by non-VA providers

## Problems

- Lots of pre-enrollment data needed along with status tracking
- The VA CARES team would like to track upcoming telehealth visits and other data across 3 medical centers
- 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 visit data across 3 medical centers and reminds clinicians to reach out
- Retrieved data captured in clinician notes to support implementation scientist's cost savings analyses



# Medical Data Pipeline - Overview

# VA Computerized Patient Record System (CPRS)

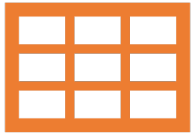
<a href="#">File</a> <a href="#">Edit</a> <a href="#">View</a> <a href="#">Tools</a> <a href="#">Help</a> <b>ZAMERICA,CAPTAIN (OUTPATIENT)</b> <b>Visit Not Selected</b> No PACT assigned at any VA location / 000-00-1776    Jun 01,1948 (71)    Current Provider Not Selected		<b>Flag</b> <a href="#">JLV</a> ?    Postings <a href="#">Remote Data</a> <b>CWAD</b>	
<b>Active Problems</b> 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 278862001) Af-Atrial Fibrillation (SCT 49436004) Hearing Loss (SCT 15188001) *Incomplete Spinal Cord Lesion At T1-T6 Level Without Bone Injury (SCT 11413003) Born In Scotland (SCT 315515001) Depression (SCT 35489007) 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 19818009) Moderate Recurrent Major Depression (SCT 19818009) Degenerative Joint Disease Of Ankle And/Or 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)		<b>Allergies / Adverse Reactions</b> Imipramine 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	<b>Patient Record Flags</b> BEHAVIORAL HIGH RISK FOR SUICIDE MRSA RESEARCH PATIENT
		<b>Postings</b> 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 May 15,2014 Crisis Note Jul 22,2006 Crisis Note Feb 09,2005 Critical Result Jul 09,2004	
<b>Active Medications</b> 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 50gm Oint Top Active Non-Va Fish Oil 1000mg (500mg Dhs/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	<b>Clinical Reminders</b> No reminders due	<b>Due Date</b>	
<b>Recent Lab Results</b> 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 #394117 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 #378987 Jan 30,2020 Strep Group A Screen (rapid) Throat Wc Lb #375846 Jan 28,2020 Strep Group A Screen (rapid) Throat Wc Lb #372389 Jan 24,2020 Strep Group A Screen (rapid) Throat Wc Lb #363308 Jan 16,2020	<b>Vitals</b> 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) PN 0 Jan 08,2020 11:25 POX 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	<b>Appointments/Visits/Admissions</b> 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	
Cover Sheet   Problems   Meds   Orders   Notes   Consults   Surgery   D/C Summ   Labs   Reports			

\*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
- **Records management:** The process of retaining transactions for future use
- Communicate completed work to other users

# 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

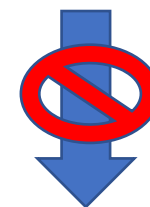
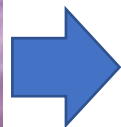
No predefined model

Much more process intensive to query

Example: raw text, video, audio recordings

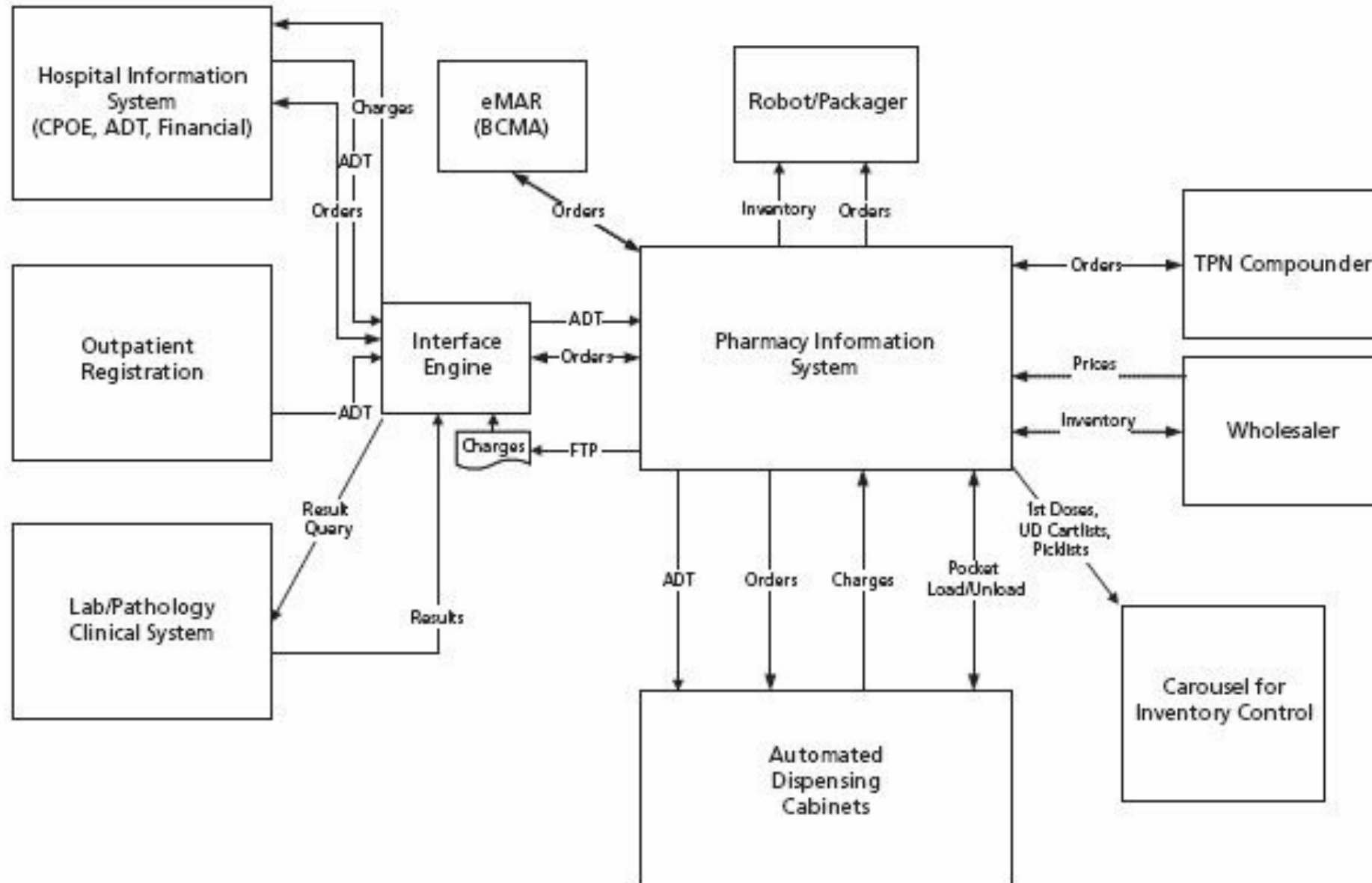


# Transactional Data: Structured Lab data entry



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

## Transactions originate from a wide variety of sources



# Planning Transactional Data Extraction

1. Why do you need this information?
2. What resources do you have available?
3. When is your deadline and what is the project timeframe?
4. Who is your base cohort?
5. Where is your target data currently located and which data points do you need?

# Methods to extract insights from transactional data

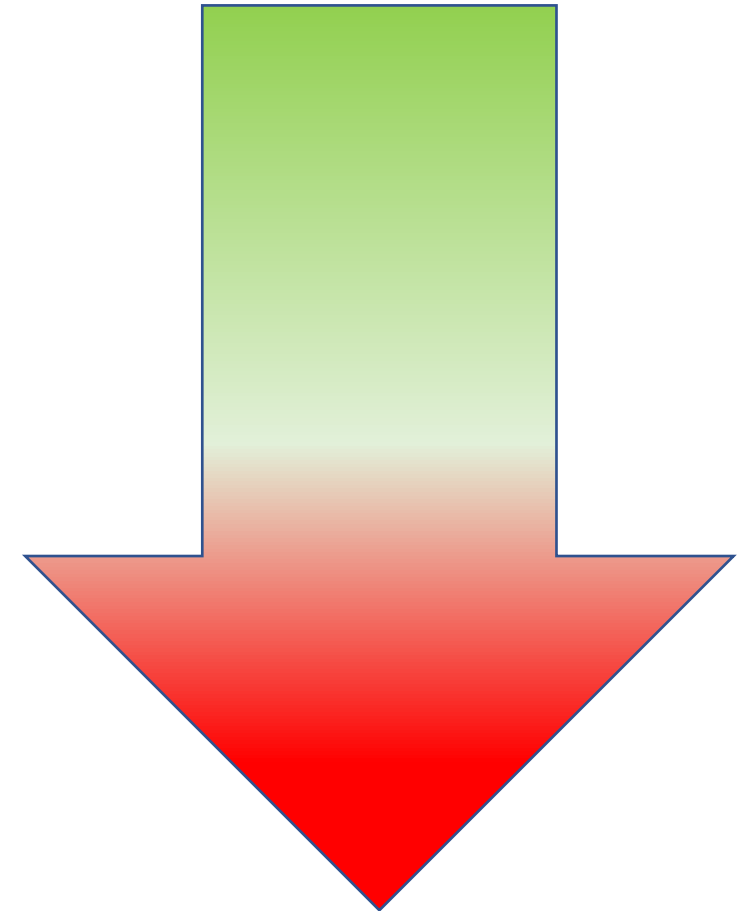
From least to most difficult:

Structured data:

1. Descriptive statistics
2. Statistical testing
3. Machine learning

Unstructured data:

1. Chart Review
2. Rule-based text mining
3. Advanced Natural Language Processing techniques





Where do all these  
transactions go?

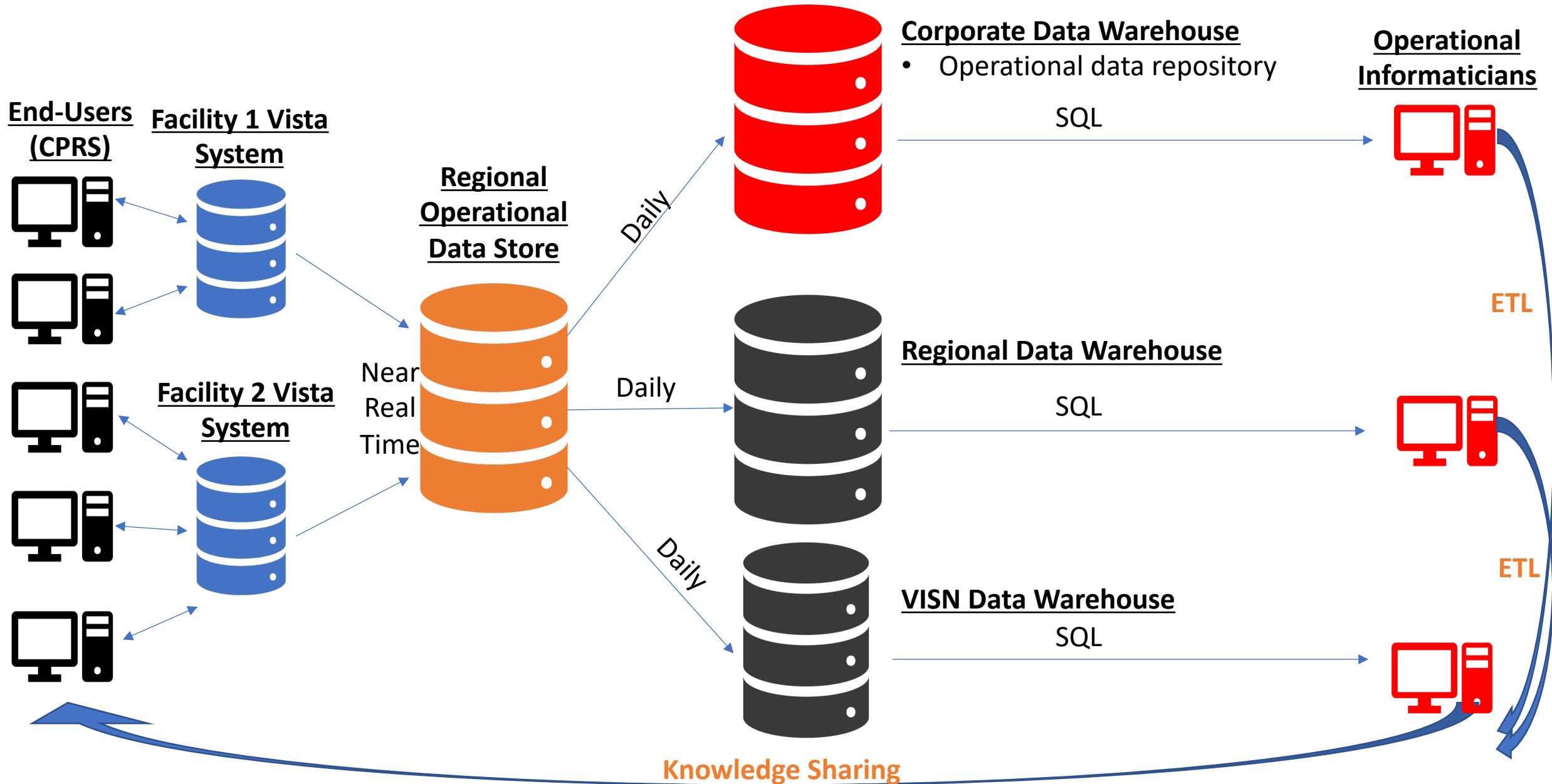


# The short answer: Data Warehouse(s)

- Consists of many servers and databases
- Efficiently gathers, transforms, and stores health data
- Access to the data warehouse grants users the ability to provide accurate management information and supporting data analysis

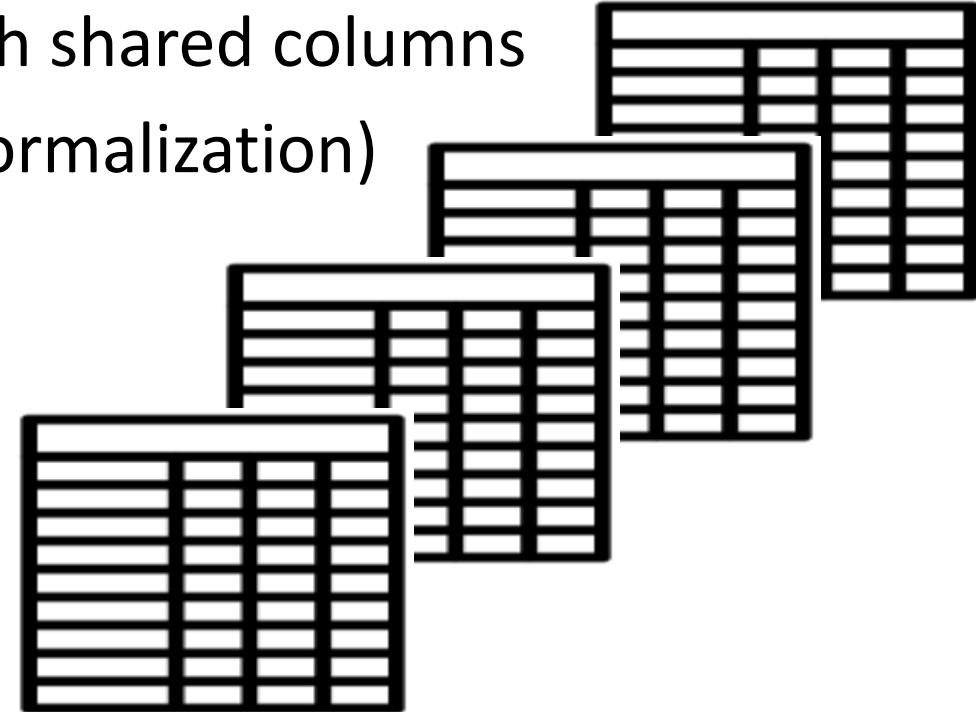


# VA Data Warehousing Architecture



# The Relational Database

- A database is a repository of data
- Allows data to be added, modified, and queried
- 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)



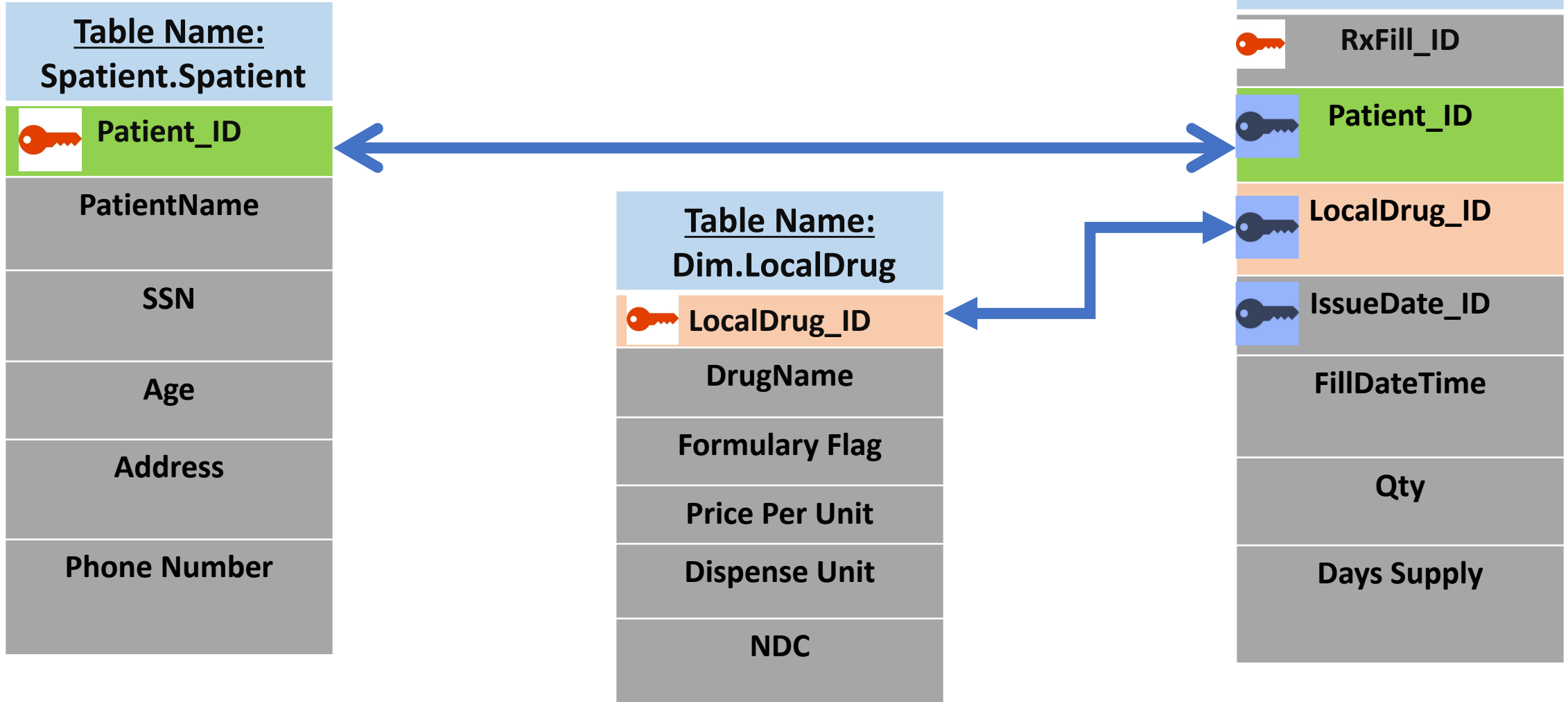


# Denormalized Data

Table Name: Rxout.RxFill									
RxFill_ID	PatientName	Age	DrugName	IssueDate	FillDate	Qty	DaysSupply	FormularyFlag	PricePerUnit
1	Smith,John	55	Atorvastatin	2021-01-01	2021-01-05	30	30	Y	0.05
2	Smith,John	55	Atorvastatin	2021-01-01	2021-02-10	30	30	Y	0.05
3	Smith,John	55	Metformin	2021-01-01	2021-01-05	60	30	Y	0.01
4	Smith,John	55	Metformin	2021-01-01	2021-02-11	60	30	Y	0.01

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

# Normalized/Relational Database Diagram



 = Primary Key;  = Secondary Key

# Pharmacy Relational Database Diagram Example





# Retrieving Structured Medical Data



Examples with practice  
database

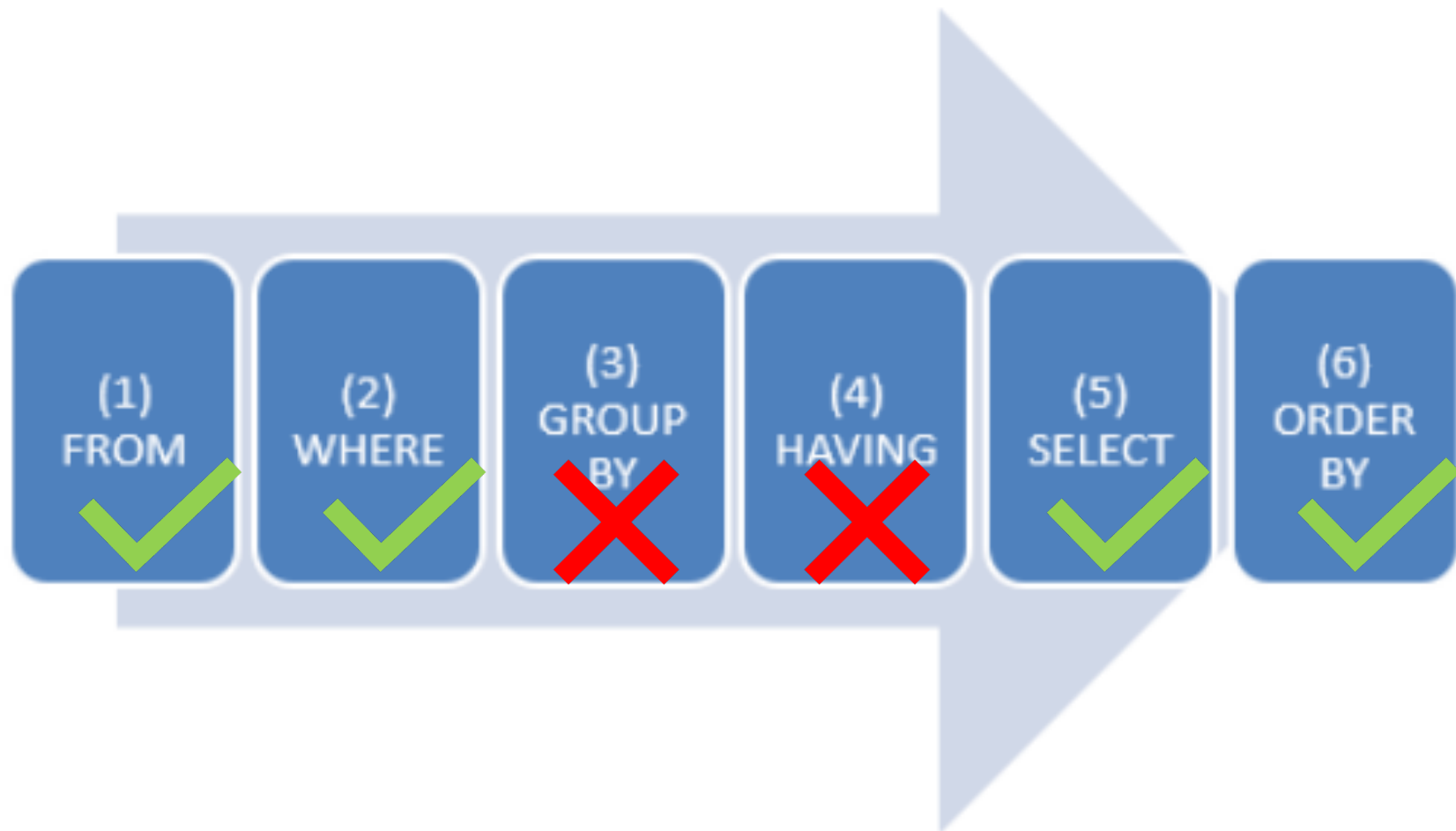
# What is SQL?

- 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];
```

# Logical Processing of SELECT





# FROM Clause

Indicates which database table(s) 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

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'

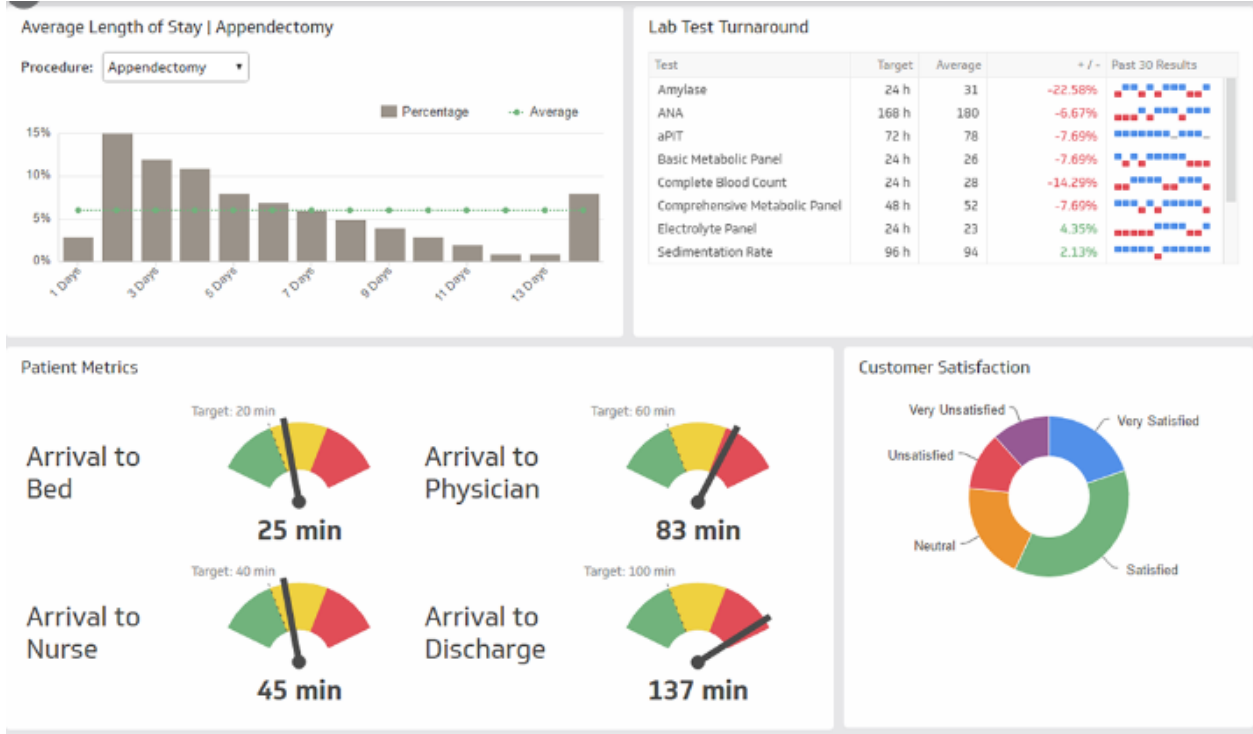
Order by DispensedDateTime;

# 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;
```

- SQL Server Reporting Services (SSRS)
- Power BI (Business Intelligence)
- Pyramid Analytics
- Tableau





# 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 step (optional)

- Follow the [steps outlined in my GitHub repository](#) to create your first database
- Follow the [DataManipulationScript.sql](#) to practice executing and writing queries
- Find open-source data online and import into your database.
  - [Humana Insurance Cost Transparency](#) for example
- Review the data, ask questions about the data, attempt to answer those questions using SQL