Building Your Dataset in CDW:

Joining tables within a domain

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Acknowledgements

- Richard Pham, BISL
- Feedback from colleagues at VIReC



CDW Cyberseminar Series

- This talk assumes that you have seen the previous cyberseminars:
 - First Time User's Guide to CDW: Getting Started with this Relational Database
 - Seeing the Data When You Can't See the Data:
 A Tour of Documentation of the CDW
 - Getting the Information You Need from CDW: Starter
 SQL Language



Poll #1: About You

Which of the following best describes your role in the VA? (Check all that apply)

- Research Investigator / PI
- □ Career Development Awardee
- □ Data Manager / Analyst
- ☐ Project Coordinator
- Operations / Partnered Research / QI
- Other



By the end of this talk,

We hope that a new CDW user will:

- Be able to understand the logic of joining tables/ views within a single CDW domain
- Be able to write a query that includes an "inner join" statement
- Be able to incorporate some "query best practices" for working with CDW



Topics Covered

- Review background concepts relavent to CDW:
 - Relational databases concepts
 - SQL Basics
 - SQL Best Practices
- The logic of an INNER JOIN using a simple example
- Step-by-step process of using CDW to join:
 - Two tables/views from a domain
 - Three tables/views from a domain



Background

A Conceptual Overview of Relational Data & SQL



Tables v. Views

- A table is a set of columns and rows that contain data elements.
- A view is the result of a procedure that pulls information out of a database into a virtual table; in simple terms it is a "virtual" table.

Sta3n	State	County	Country	PeriodOfService	Mari tal Status	InsuranceCove rage Flag	Religion
676	WISCONSIN	MILWAUKEE	UNITED STATES	PERSIAN GULF WAR	NEVER MARRIED	N	LUTHERAN
629	ARKANSAS	JEFFERSON	UNITED STATES	VIETNAM ERA	DIVORCED	U	BAPTIST
586	MISSISSIPPI	TIPPAH	UNITED STATES	PERSIAN GULF WAR	MARRIED	U	UNKNOWN/NO PREFERENCE
629	TEXAS	SMITH	UNITED STATES	POST-VIETNAM	SEPARATED	U	BAPTIST
636	NEBRASKA	LINCOLN	UNITED STATES	POST-KOREAN	*Missing*	U	*Missing*
623	OKLAHOMA	TULSA	UNITED STATES	PERSIAN GULF WAR	NEVER MARRIED	Υ	UNKNOWN/NO PREFERENCE
676	PENNSYLVANIA	LANCASTER	UNITED STATES	POST-VIETNAM	NEVER MARRIED	NULL	RO MAIN CATHOLIC CHURCH
623	OKLAHOMA	TULSA	UNITED STATES	VIETNAM ERA	MARRIED	Υ	BAPTIST
676	WISCONSIN	MONROE	UNITED STATES	PERSIAN GULF WAR	MARRIED	Υ	BAPTIST
636	CALIFORNIA	CALAVERAS	UNITED STATES	PERSIAN GULF WAR	MARRIED	U	CHRISTIAN (NON-SPECIFIC)
676	WISCONSIN	PORTAGE	UNITED STATES	OTHER NON-VETERANS	*Missing*	NULL	*Missing*
674	TEXAS	ANDERSON	UNITED STATES	WORLD WAR II	WIDOWED	Υ	UNKNOWN/NO PREFERENCE
695	WISCONSIN	WAUKESHA	UNITED STATES	VIETNAM ERA	MARRIED	Υ	*Missing*
674	TEXAS	HARRIS	UNITED STATES	VIETNAM ERA	DIVORCED	U	PROTESTANT, NO DENOMINATION



SELECT and FROM

- SELECT allows a programmer to list the columns (variables) that they would like to see in the results of their query
 - Each column name should be followed by a comma except the last one in the list
 - This limits the size of your request (a best practice)
- FROM identifies the table/view from which the columns will be collected
 - The name of the view should be written in this format "database.schema.table"

WHERE statements

- The command WHERE allows a user to limit their search to include only a chosen subset of the data.
- When working with large fact tables in CDW, you will want limit the size of your requests for information (another best practice).

```
SELECT column1, column2, column3
FROM Database.Schema.Table
WHERE column1 = X ; -- note this is just an example of the kind of
-- criteria one might specify in a where
-- statement.
```



TOP

- When first drafting your SQL query, another best practice is to test the logic of your query on a small number of rows (a.k.a., cases).
- The command "TOP" is added to the SELECT statement and is followed by the number of rows selected by the programmer.

SELECT TOP 100 column1, column2, column3

FROM Database.Schema.Table1

WHERE column2 > 10; -- new example



USE & GO

- Another helpful shortcut is USE.
- It is followed by **GO**.
- It allows the user to choose their database at the beginning of the query, so there is no need to repeat the name of the database throughout the query.

USE Database

GO

SELECT TOP 25 column1, column2, column3

FROM Database. Schema. Table

WHERE column3 IS NOT NULL; -- new example



Dimension & Fact Tables

- Dimension tables are typically smaller tables holding non-sensitive, supporting information that is meant to be accessed repeatedly
 - Fact tables tend to be large tables containing substantive data about the topic of interest and include sensitive information



Joining Keys

- Primary Key –A column in every table that uniquely identifies each row.
- Foreign Key –These are column(s) in a table that correspond to or reference a primary key in another table.



Simple Example, Joining Keys

Store.CustomerTable

CustomerKey (PK)	LastName	FirstName	Address	CityState	Zipcode
1	Jones	Marianna	123 Oak St	Bee, AR	70788
2	Frank	Josie	11 Pine Ave	Flip, OK	30032
3	Plank	Bill	230 5 th St.	Miner, TX	11201

Dim.ItemTable

Store.PurchasesTable

1

Date

1/1/2014

1/1/2014

2/2/2014

2/2/2014

3/3/2104

3/3/2014

ItemKey (PK)	Item	 PurchaseKey (PK)	ItemSoldKey (FK)	CustomerKey (FK)
1	Shirt	1	1	1
2	Pants	2	2	1
3	Skirt	3	3	2
4	Sweater	4	4	2
		5	1	3

6

Poll #2: Your CDW Experience

Rate your level of experience with CDW data on a scale of 1 to 5...

```
1 Not worked with it at all
```

2

3

4

5 Very experienced with CDW



The Logic of an Inner Join

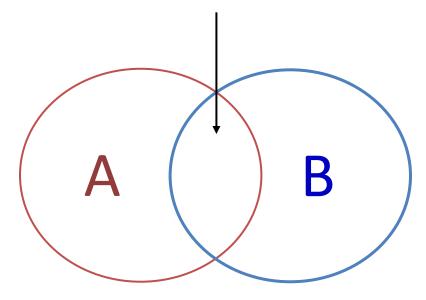
Using a simple example.



Inner Join

This lecture will focus on the SQL command, INNER JOIN, that keeps only those records/ rows that match/exist in both of the tables being joined.

Inner Joins include only the content where table A and table B overlap





INNER JOIN & ON in SQL

- INNER JOIN clause(s) follow the FROM clause
 - INNER JOIN Database.Schema.Table
- ON should be followed by the name of the two linking keys with an equal sign in the middle.
 - ON LinkingKey1 = LinkingKey2

SELECT column1, column2, column3

FROM Database.Schema.Table1

INNER JOIN Database.Schema.Table2

ON LinkingKey1 = LinkingKey2;



Joining, Best Practice

- Join the dimension tables to the fact tables when possible
- Put the fact table into the FROM statement and the dimension table into the JOIN statement

USE Database

GO

SELECT column1, column2, column3

FROM Schema. Table 1 -- fact table here

INNER JOIN Schema. Table 2 -- dimension table here

ON LinkingKey1 = LinkingKey2;



Example 1

SELECT Item , Date
FROM Store.PurchasesTable
INNER JOIN Dim.ItemTable
ON ItemSoldKey = ItemKey ;

Dim.ItemTable

ItemKey (PK)	Item
(1 K)	
1	Shirt

2 Pants

3 Skirt

4 Sweater



Store.PurchasesTable

PurchaseKey (PK)	ItemSoldKey (FK)	CustomerKey (FK)	Date
1	1	1	1/1/2014
2	2	1	1/1/2014
3	3	2	2/2/2014
4	4	2	2/2/2014
5	1	3	3/3/2104
6	1	3	3/3/2014

Example 2, Fails

Store.CustomerTable

CustomerKey (PK)	LastName	FirstName	Address	CityState	Zipcode
1	Jones	Marianna	123 Oak St	Bee, AR	70788
2	Frank	Josie	11 Pine Ave	Flip, OK	30032
3	Plank	Bill	230 5 th St.	Miner, TX	11201

Store.PurchasesTable

	PurchaseKey (PK)	ItemS (FK)	oldKey	CustomerKey (FK)	Date
SELECT LastName , FirstName	e, Date			1	1/1/2014
FROM Store.CustomerTable				1	1/1/2014
INNER JOIN Store.Purchases	esTable			2	2/2/2014
inverto o in Store. I dichases i				2	2/2/2014
ON CustomerKey = Custom				3	3/3/2104
				3	3/3/2014

Why Example 2 Fails

SELECT LastName , FirstName, Date

These column names may not be unique to these tables in the database

FROM Store.CustomerTable

INNER JOIN Store.PurchasesTable

ON CustomerKey = CustomerKey;



The software is confused by the duplicate names



How to distinguish the keys and columns

- In SQL, you can add the name of the table in front of the column or key to distinguish it from others of the same name.
- For columns :
 - Store.CustomerTable.LastName
 - Store.PurchasesTable.Date
- For joining keys:
 - Store.CustomerTable.CustomerKey
 - Store.PurchasesTable.CustomerKey



Repairing the problem with table names...

```
SELECT Store.CustomerTable.LastName,
Store.CustomerTable.FirstName,
Store.PurchasesTable.Date
FROM Store.CustomerTable
INNER JOIN Store.PurchasesTable
ON Store.CustomerTable.CustomerKey =
Store.PurchasesTable.CustomerKey;
```



Alias (Shortened Names)

- You may provide a shortened name to substitute for the name of the table/view by assigning an "alias" using "AS" in SQL:
 - FROM Store.CustomerTable AS A
 - INNER JOIN Store.PurchasesTable AS B
- Use that alias on the columns and joining keys instead of the table name
 - A.LastName , A.FirstName , B.Date
 - A.CustomerKey , B.CustomerKey



Example 2, Succeeds

Store.CustomerTable

CustomerKey (PK)	LastName	FirstName	Address	CityState	Zipcode
1	Jones	Marianna	123 Oak St	Bee, AR	70788
2	Frank	Josie	11 Pine Ave	Flip, OK	30032
3	Plank	Bill	230 5 th St.	Miner, TX	11201

Store.PurchasesTable

	PurchaseKey (PK)	ItemS (FK)	oldKey	CustomerKey (FK)	Date
SELECT A.LastName , A.FirstName, B.Date				1	1/1/2014
FROM Store.CustomerTable AS	FROM Store.CustomerTable AS A			1	1/1/2014
INNER JOIN Store.PurchasesTable AS B				2	2/2/2014
	TILLIE OTTI DEGLET AT CHASCS TABLE TAS B			2	2/2/2014
ON A.CustomerKey = B.Cus	stomerKey = B.CustomerKey;			3	3/3/2104
				3	3/3/2014

An Inner Join in CDW

A step-by-step guide.



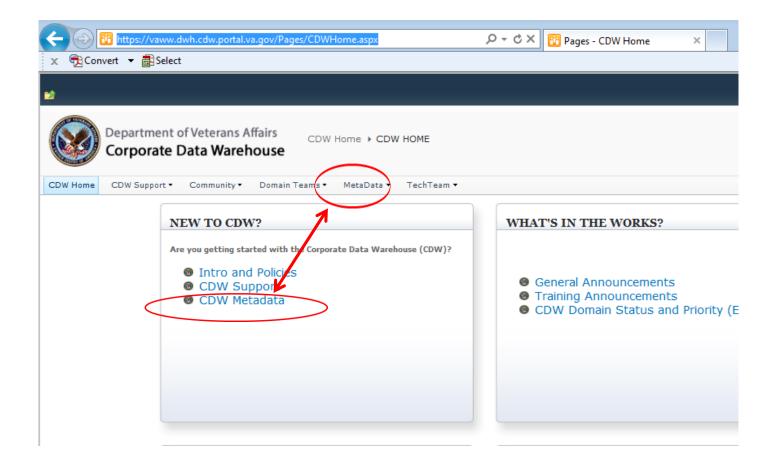
Preparing to use the data

For today's example, we will look at CPT codes associated with outpatient procedures.

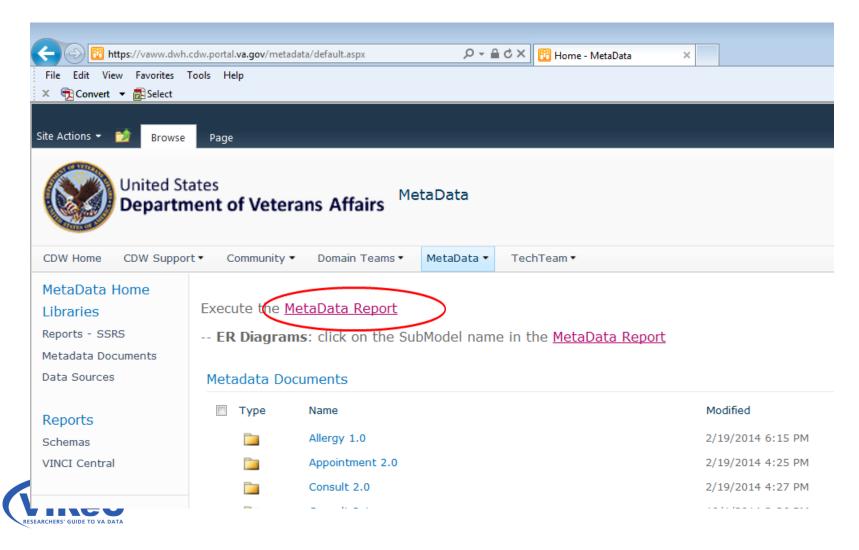
- 1. Go to the CDW Metadata Report to find information on your concepts of interest.
- 2. Look at "table level" metadata report to find columns.
- 3. Look at the ER Diagram to discover relationships between tables.



1. Go to the CDW Metadata Report



1. Go to the CDW Metadata Report (Con't)



2. Metadata Reports for Each Domain

CDW Metadata Contains a grouped list of available CDW ER Diagrams and members. ImageDescription ⊞ Allergy 1.0 Image Date: 01 Feb 2014 Image Date: 03 Mar 2015 Image Date: 03 Oct 2014 Image Date: 11 Aug 2014 ■ Data Profiling 1.0 Image Date: 21 Feb 2014 ■ Dental 1.0 Diagram 1 of 2 Image Date: 11 Aug 2014 ■ Dental 1.0 Diagram 2 of 2 for Analytics Image Date: 11 Aug 2014 ⊕ Dimensions A Through D 10/3/2014 Image Date: 03 Oct 2014 ■ Dimensions E Through K 10/3/2014 Image Date: 03 Oct 2014 ■ Dimensions L Through R Image Date: 17 Dec 2014 ⊕ Dimensions L Through R 10/3/2014 Image Date: 03 Oct 2014 ⊕ Dimensions S Through Z 10/3/2014 Image Date: 03 Oct 2014 **⊞** Encounter 1.0 Image Date: 29 Oct 2013

- Each domain is listed in alphabetical order
- Scroll down to find the Outpatient Domain
- Click plus sign in the box to the left of the domain name to see metadata reports for each table/view

To Outpatient Domain

Image Date: 11 Mar 2015

Image Date: 20 Nov 2013

Image Date: 24 Feb 2015



■ Health Factor 2.0

2. Metadata for each table

m_inpatient 2.1 Diagram 1 of 5	Image Date: 20 Aug 2014
⊞ <u>Lab Microbiology 1.0</u>	Image Date: 11 Aug 2014
⊞ <u>LabChem 2.0</u>	Image Date: 11 Aug 2014
⊞ Mental Health 1.0	Image Date: 21 Feb 2014

☐ Outpatient 2.0

Expand to see table level metadata reports on the right

DWViewName	Field Count	FileMan File Data Source	View
<u>Dim.AppointmentStatus</u>	9	APPOINTMENT STATUS (409.63)	DWVi View
<u>Dim.AppointmentType</u>	9	APPOINTMENT TYPE (409.1)	DWVi View
<u>Dim.ClinicalTerm</u>	17	EXPRESSIONS (757.01)	DWVi View
<u>Dim.ClinicalTermType</u>	6	EXPRESSION TYPE (757.011)	DWVi View
<u>Dim.CPT</u>	16	CPT (81)	DWVi View
<u>Dim.CPTCategory</u>	10	CPT CATEGORY (81.1)	DWVi View
<u>Dim.EducationTopic</u>	6	EDUCATION TOPICS (9999999.09)	DWVi View
<u>Dim.Exam</u>	7	EXAM (9999999.15)	DWVi



What's in Outpat. VProcedure?

- By reading the table level metadata reports on CDW's SharePoint site, I can see that Outpat.VProcedure contains:
 - ✓ the date of the procedure
 - ✓ the date of the encounter
 - ✓ comments related a procedure performed during an encounter



What's in Dim.CPT?

- The metadata report tells us that this table contains:
 - ✓ Current Procedural Terminology (CPT) Code, name and description
 - ✓ A CPT Category and Major Category
 - ✓ The dates that the CPT code became active and went inactive
 - ✓ The appropriate age range and gender for applicable CPT codes



3. Entity Relationship Diagrams

□ Image Date: 20 Aug 2014
□ Lab Microbiology 1.0 Image Date: 11 Aug 2014
□ LabChem 2.0 Image Date: 11 Aug 2014
□ Mental Health 1.0 Image Date: 21 Feb 2014

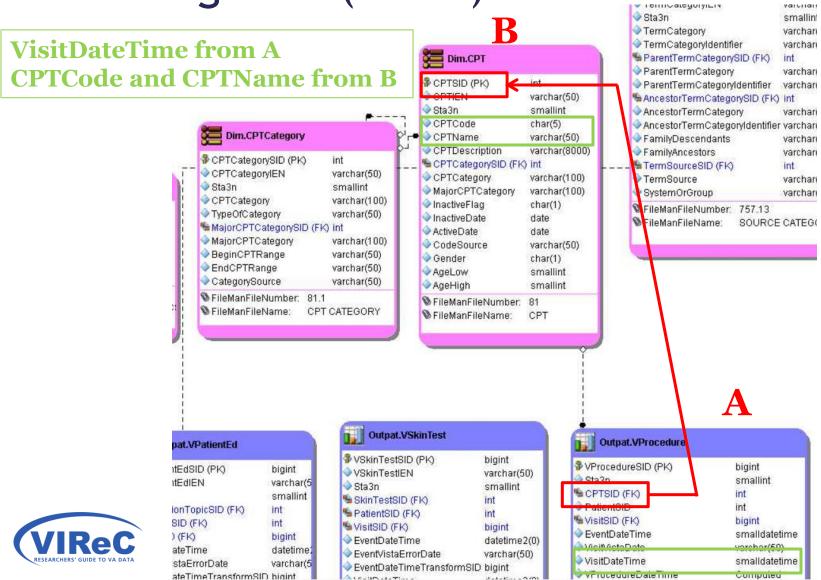
☐ Outpatient 2.0

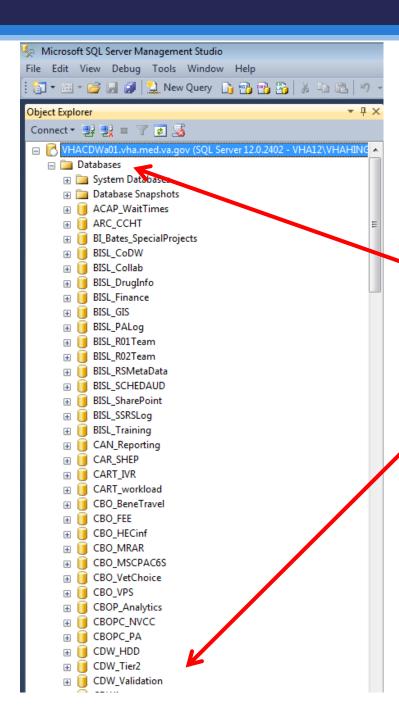
Click the domain name to open the ER Diagram

DWViewName	Field Count	FileMan File Data Source	View
<u>Dim.AppointmentStatus</u>	9	APPOINTMENT STATUS (409.63)	DWVi View
Dim.AppointmentType	9	APPOINTMENT TYPE (409.1)	DWVi View
<u>Dim.ClinicalTerm</u>	17	EXPRESSIONS (757.01)	DWVi View
<u>Dim.ClinicalTermType</u>	6	EXPRESSION TYPE (757.011)	DWVi View
<u>Dim.CPT</u>	16	CPT (81)	DWVi View
Dim.CPTCategory	10	CPT CATEGORY (81.1)	DWVi View
Dim.EducationTopic	6	EDUCATION TOPICS (9999999.09)	DWVi View
<u>Dim.Exam</u>	7	EXAM (9999999.15)	DWVi



3. ER Diagrams (con't)



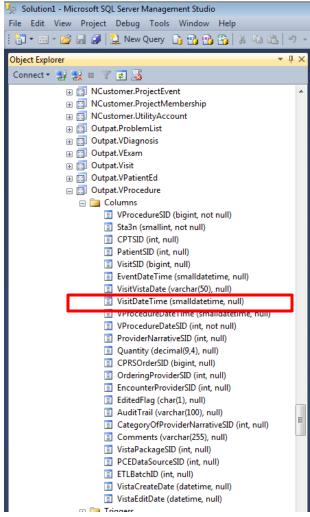


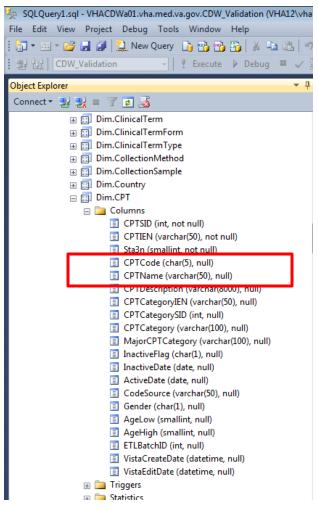
In SSMS, access your server and expand "Databases"

Then, scroll down to find "CDWWork"

Note: this example uses this example accesses the VHACDWaO1 server, but data users will have access to a variety of servers.

Finding Your Views in CDWWork







Note: this example shows the Outpat.Vprocedure fact table in the CDWWork folder, but a research extract of a fact table may be placed in a research folder with a project-specific name.

Joining 2 CDW Views/Tables

- Use INNER JOIN/ON clause after FROM clause
- Use AS to alias tables, columns and joining keys
- Put the fact table into the FROM statement and the dimension table into the JOIN statement

USE Database

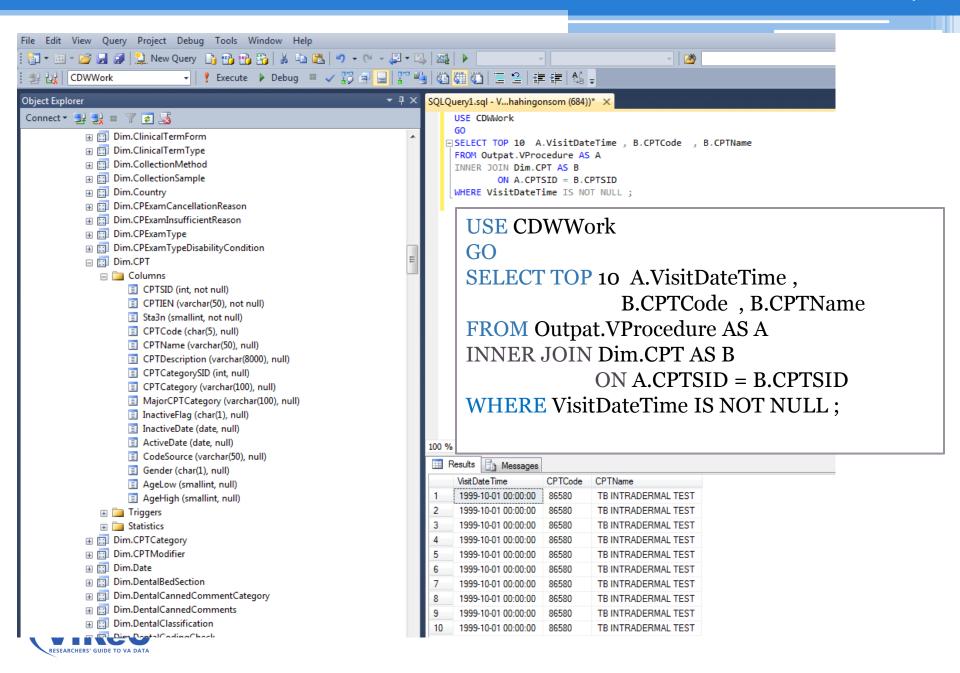
GO

SELECT A.column1, B.column2

FROM Schema. View1 AS A -- fact table here

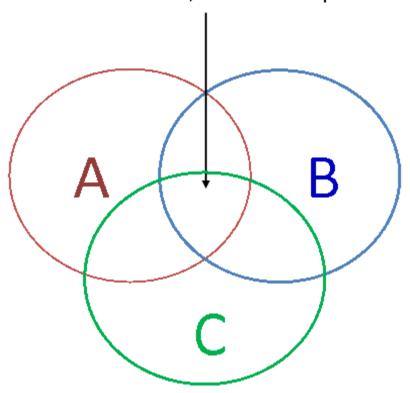
INNER JOIN Schema. View 2 AS B -- dimension table here

ON A.LinkingKey1 = B.LinkingKey2;



Inner Join with three tables/views

Inner Joins include only the content where tables A, B and C overlap

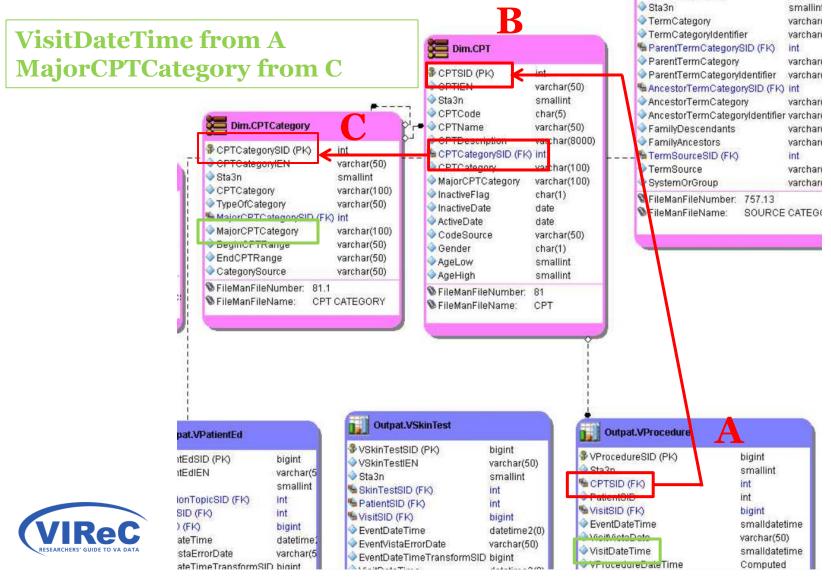




valulial

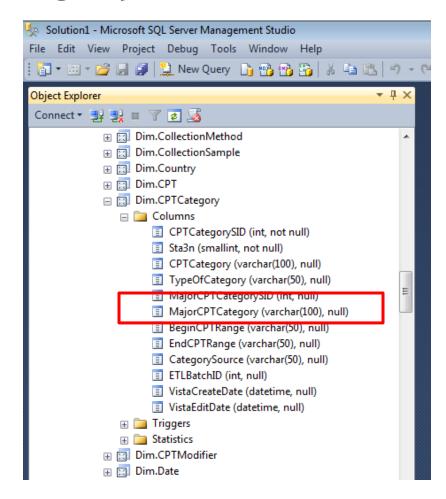
▼ FeITH CategoryILI4

Joining 3 views/tables



What's in Dim.CPTCategory?

- By reading the metadata report for Dim.CPTCategory, I can see that it contains:
- ✓ the CPT category
- ✓ the CPT major category
- ✓ the type of category (major or sub-category)
- ✓ the source of the category (CPT or HCPCS)
- ✓ restrictions on the range of codes that are appropriate





Joining 3 CDW Views/Tables

 Add an additional INNER JOIN/ON clause after the first INNER JOIN clause

```
USE Database

GO

SELECT A.column1, B.column2, C.column3

FROM Schema. View1 AS A -- 1<sup>st</sup> table

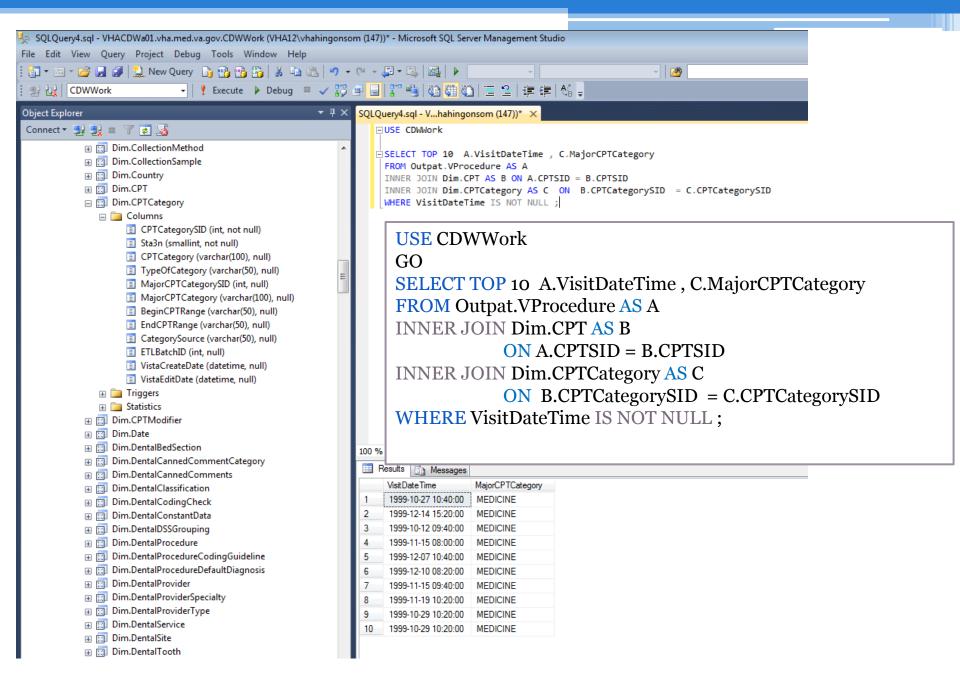
INNER JOIN Schema.View2 AS B -- 2<sup>nd</sup> table

ON A.LinkingKey1 = B.LinkingKey2

INNER JOIN Schema.View3 AS C -- 3<sup>rd</sup> table

ON B.LinkingKey3 = C.LinkingKey4;
```





Summary/Conclusions

- INNER JOIN can be used to pull together fields/columns from many tables/views.
- Best practices such as joining dimension tables to fact tables, using aliases and reducing the size of query with WHERE will lead to greater success in working with CDW.



Best Practice: INNER JOIN (not JOIN)

- SQL Server allows the use of just the word JOIN. If your code ever needs to be exported to any other database system now or in the future, using JOIN by itself IS NOT recommended.
- Not recommended
 SELECT TOP 10 A.VisitDateTime, B.MajorCPTCategory
 FROM Outpat.VProcedure AS A
 JOIN Dim.CPT AS B
 ON A.CPTSID = B.CPTSID
 - Recommended
 SELECT TOP 10 A.VisitDateTime, B.MajorCPTCategory
 FROM Outpat.VProcedure AS A
 INNER JOIN Dim.CPT AS B
 ON A.CPTSID = B.CPTSID



Best Practice: INNER JOIN & ON (not FROM, WHERE, =)

- Statistical programs such as SAS, SPSS, and Stata permit using comma (,), equal (=), star-equal (*=), and equal-star (=*) for joins. This is not recommended in SQL Server.
- Not recommended (Permitted in SAS and SQL Server 2008)
 SELECT TOP 10 A.VisitDateTime, B.MajorCPTCategory
 FROM Outpat.VProcedure AS A, Dim.CPT AS B
 WHERE A.CPTSID = B.CPTSID;
- Recommended
 SELECT TOP 10 A.VisitDateTime , B.MajorCPTCategory
 FROM Outpat.VProcedure AS A
 INNER JOIN Dim.CPT AS B
 ON A.CPTSID = B.CPTSID;



Contact Information

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Questions?