

# 2010-2011 VIREC Database and Methods Cyber Seminar Series



# **Using VA Corporate Data Warehouse to Assess Vitals**

**March 7, 2011**

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# Session Objectives

**At the end of this session, the participant will be able to:**

- Identify current approaches to assessing vitals using the Corporate Data Warehouse**
- Describe limitations of using the Corporate Data Warehouse to assess vitals**
- Describe recent research and methods used to assess vitals that have used the Corporate Data Warehouse**

# Session Outline

- **Overview of CDW**
- **Possible sources of error in CDW vitals data**
- **Evaluations of CDW data**
- **Case study: CDW anthropometric data**
- **Case study: CDW blood pressure data**
- **Recommendations**
- **Where to Go for More Help**

# Audience Poll

## (Heidi please convert to poll)

- **How would you rate your overall knowledge of the Corporate Data Warehouse (CDW)?**
  - 1 (No knowledge)
  - 2
  - 3
  - 4
  - 5 (Expert-level knowledge)

# White Board

- **What do you want to learn about the CDW or what data do you want to get from the CDW?**

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# Examples of research topics requiring information on “vitals” data

## ■ **Quality of Care**

- *Does patient BMI class predict receipt of recommended preventive screenings?*

## ■ **Healthcare disparities**

- *Is hypertension an independent predictor of survival disparity among African American and white veterans with schizophrenia?*

## ■ **Implementation research**

- *Can quality of chronic pain management be improved by implementation of the PCMH?*



# Corporate Data Warehouse

- **draws from several VHA clinical & administrative systems**
- **created to support administrative & research objectives**
- **historical data from FY 1999, current data added nightly**
- **additional domains will be added in future**
- **relational database, unlike some other national repositories in VHA**

# Data found in the CDW

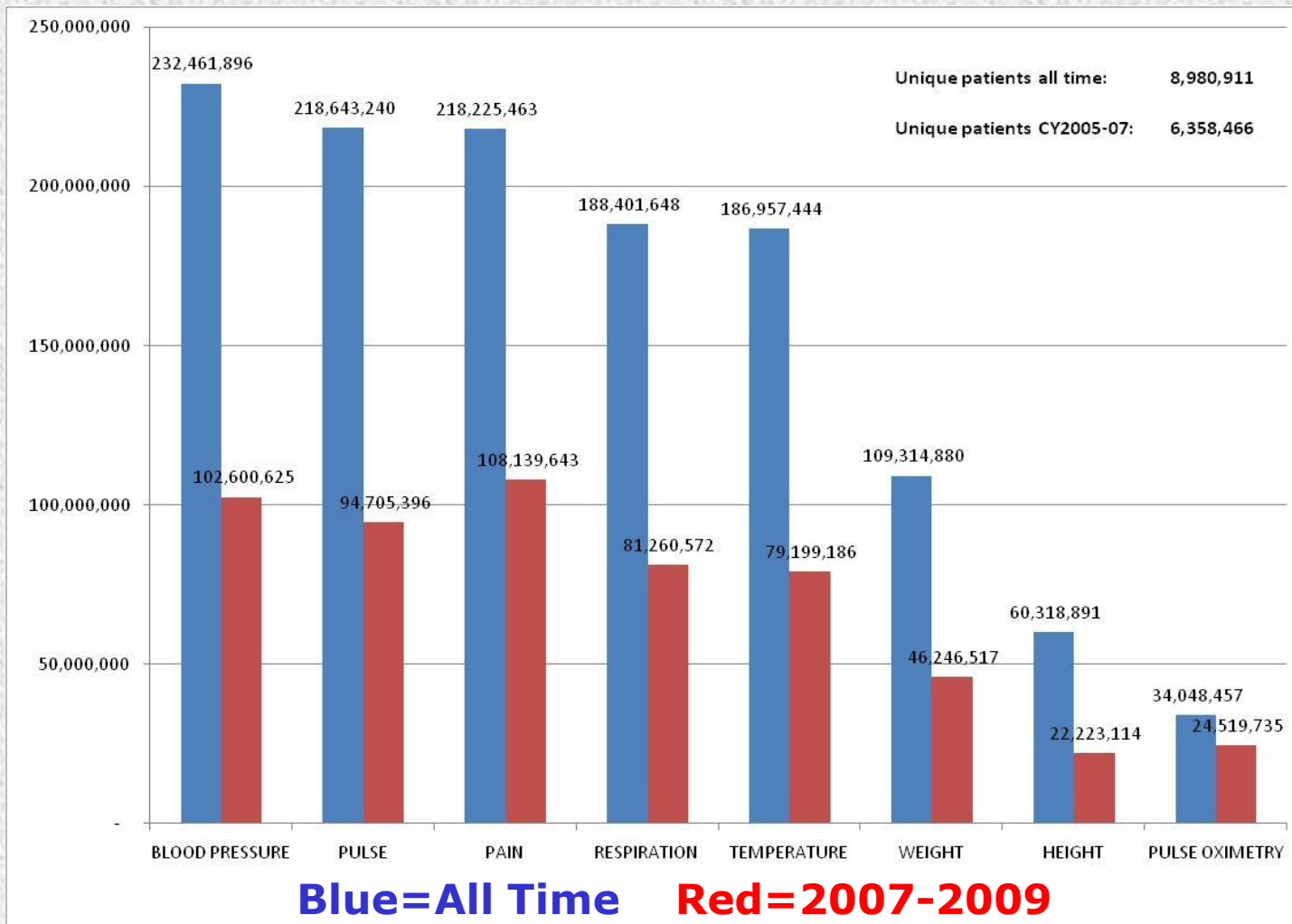
- Patient demographics (VistA/All time)
- Staff demographics (VistA/All time)
- Outpatient encounters (NPCD/10/1/1999)
  - All ICD9 Codes
  - All CPT Codes
- **Vital Signs** (RDW/From 10/1/1999)
- Allergies (RDW/From 10/1/1999)
- Outpatient Pharmacy (RDW/From 10/1/1999)
  - Loading
- Surgical Procedures (VistA/All time)
- Non VA Meds (VistA/All time)
- Prosthetics (VistA/All time)

# Vital Signs Available from CDW

(with abbreviations used in the CDW database)

- Audiometry (AU)
- Blood pressure (BP)
- Circumference/girth (CG)
- Central venous pressure (CVP)
- Fundal height (FH)
- Fetal heart tones (FHT)
- Hearing (HE)
- Height (HT)
- Pain (PA)
- Pulse oximetry (PO)
- Respiration (RE)
- Temperature (TE)
- Tonometry (TO)
- Vision corrected (VC)
- Ventilator minute volume (VMV)
- Ventilator tidal volume (VTV)
- Vision uncorrected (VU)
- Weight (WT)

# Vital Sign History (VistA/RDW)



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# Tracing Path of CDW Data

- **Vitals data assessed & entered into CPRS**
- **Data stored in local VistA systems**
- **Transmitted by HL 7 messages to 1 of 4 Regional Data Repositories (RDW's)**
- **CDW extracts, transforms, and loads data from RDW's into its SQL data fields**

# Tracing Path of CDW Data

- **CDW is regularly updated (refreshed)**
- **Does not hold stable reference files**
- **Errors & out of range values are not cleaned**

# Possible Sources of Error

- **Measurement/Reporting**
- **Data Entry**
- **Data Transfer or Extraction**



# Possible Sources of Error: Measurement/Reporting

- **Equipment incorrectly calibrated**
- **Reliance on patient self-report vs. clinician measurement**
- **Values rounded “up” or “down”**
- **Patients measured inconsistently with or without shoes, clothing, etc.**
- **Last entered height carried forward**
- **Weights and/or heights less likely to be measured for specific patient populations**

# Possible Sources of Error: Data Entry

- **Transposition of numbers**
- **Keying of number adjacent to intended target**
- **Addition/deletion of digits**
- **Erroneous transformation of values**

# Possible Sources of Error: Data Transfer or Extraction

- **Specific to the VA, the “same” anthropometric data entered into CPRS may exist at several levels**
  - local VistA systems
  - VISN data warehouses (directly from VistA or from a collector/feeder database on a SQL server connected to VistA)
  - CDW (from VistA via RDW)

# Possible Sources of Error: Data Transfer or Extraction

- **Variations between sources can arise**
  - Data can be lost in transmission
  - Different filters can result in inclusion of slightly different subsets of data
  - Refresh differences - VistA/CDW constantly changing; updates not done simultaneously by all warehouses

# Possible Sources of Error: Data Transfer or Extraction

- **Numeric data can be redefined as character data or “rounded” if stored with smaller number of decimal places**
  - Out-of-range & outlier values not cleaned in CDW, data appear in both text & numeric form
  - Text field “as is” from VistA extraction
  - Numerical field based on a very conservative transformational algorithm

# Possible Sources of Error: Data Transfer or Extraction

## ■ Programmer error

- Programmer may misinterpret variables or cases needed or investigator may mis-specify needs
- Research team may fail to request variable to differentiate inpatient from outpatient measurements

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# Evaluation of CDW Data: Administrative Project

- **VHA Support Service Center (VSSC)**
  - 1) Compared CDW data fields to one another and to overall patient utilization over time to see if populated as expected
  - 2) Examined data for biologically implausible values
  - 3) Compared data from 10 facilities (CDW vs. VISN warehouse)



# Evaluation of CDW Data: are CDW data fields populated as expected over time?

<b>Comparison of VHA utilization and CDW data over 4 years</b>				
	2004 N	2005 N	2006 N	2007 N
<b>Unique Patients</b>	<b>4,976,773</b>	<b>5,094,494</b>	<b>5,188,836</b>	<b>5,230,452</b>
<b>Blood Pressure</b>	<b>31,598,526</b>	<b>33,029,724</b>	<b>34,293,140</b>	<b>35,276,799</b>
<b>Circumference/Girth</b>	<b>11,004</b>	<b>16,933</b>	<b>82,482</b>	<b>125,577</b>
<b>Central Venous Pressure</b>	17,344	16,018	64,988	79,737
<b>Height</b>	<b>8,534,729</b>	<b>8,521,504</b>	<b>7,435,312</b>	<b>6,266,231</b>
<b>Pain</b>	32,130,438	34,926,122	36,150,234	37,062,161
<b>Pulse Oximetry</b>	3,233,096	3,869,444	7,746,200	12,903,893
<b>Pulse</b>	29,468,149	30,613,107	31,590,314	32,501,113
<b>Respiration</b>	25,680,395	26,623,272	27,117,212	27,519,501
<b>Temperature</b>	25,358,389	26,100,279	26,382,625	26,715,839
<b>Weight</b>	<b>14,764,754</b>	<b>15,258,657</b>	<b>15,490,210</b>	<b>15,497,385</b>

Adapted from Perrin R, Bates J, Noel PH, Copeland LA, Lancaster B. National Clinical Data for VA Research: the VA Corporate Data Warehouse. Workshop. February, 2008 National HSR&D Meeting, Baltimore, MD.



# Evaluation of CDW Data: Research Project

- **HSR&D-funded IIR (*Obesity Care Practices in Veterans Healthcare Administration*)**
  - 1) Compared number & values of CDW vs. VISN warehouse height & weight data
  - 2) Examined implausible variation in repeated measurements recorded in the CDW on the same day, and on the same year, for the same individuals



# Evaluation of CDW Data: CDW vs. VISN data warehouse

**Percent concordance in # of wt records for N\* individuals appearing in both CDW & VISN data warehouses for 3 Fiscal Years (FY)**

	VISN A	VISN C	VISN E	VISN F
	N (%)	N (%)	N (%)	N (%)
<b>FY2002</b>	<b>97,375 (98.6)</b>	<b>81,125 (62.3)</b>	<b>106,010 (99.3)</b>	<b>158,088 (99.5)</b>
<b>FY2004</b>	<b>34,815 (98.3)</b>	<b>31,988 (98.5)</b>	<b>47,572 (99.2)</b>	<b>77,233 (99.4)</b>
<b>FY2006</b>	<b>30,812 (97.5)</b>	<b>28,289 (97.5)</b>	<b>41,944 (98.4)</b>	<b>68,592 (98.2)</b>

\*Note: FY2002 data based on patients with > 1 pc visits in FY2002, FY2004 & FY2006 data based on pc patients identified as obese in FY2002



# Evaluation of CDW Data: Implausible variation in repeated measurements

<b>Frequency distribution of differences in minimum &amp; maximum CDW hts recorded same day &amp; same year (FY2006)</b>		
<b>Difference in inches</b>	<b>occurrences of individuals with <math>\geq 2</math> hts recorded same day N=33,424</b>	<b>individuals with <math>\geq 2</math> hts recorded same year N=539,489</b>
	<b>N (%)</b>	<b>N (%)</b>
<b>difference = 0</b>	<b>29,319 (87.72)</b>	<b>469,226 (86.98)</b>
<b>0 &lt; difference <math>\leq</math> 1</b>	<b>1,771 ( 5.30)</b>	<b>42,186 ( 7.82)</b>
<b>1 &lt; difference <math>\leq</math> 2</b>	<b>764 ( 2.28)</b>	<b>14,302 ( 2.65)</b>
<b>2 &lt; difference <math>\leq</math> 10</b>	<b>1,207 ( 3.61)</b>	<b>11,063 ( 2.05)</b>
<b>Difference &gt; 10</b>	<b>363 ( 1.09)</b>	<b>2,712 ( 0.50)</b>

# Overall findings from administrative & research project evaluations

- **Weights > Heights > WC**
- **Some anomalies identified & corrected as result of administrative project**
- **Concordance between the number & values of hts & wts stored in CDW & VISN warehouses generally 97.5%-99.9%**
- **Biologically implausible values noted, as well as biologically improbable variation**

# Summary

- **In spite of occasional anomalies, CDW appears to reliably reflect hts & wts recorded in VistA/VISN-level sources**
- **Probable data errors appear to be present in both data sources**
- **CDW valuable & useful source of nationwide vital sign & anthropometric data**

**Noel et al., JRRD 2010;47(8):739-250**



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# Case Study: Anthropometric Data

## Obesity Care Practices in the Veterans Health Administration (HSR&D IIR 05-121)

### Study Objectives

- describe variations in VHA obesity care practices
- identify factors that predict these variations
- examine the impact of care practices on BMI trends & other clinical outcomes

Noel et al., JGIM 2010;25(6):510-516.



# Challenges

- **Height (& weight) data inherently variable over time**
- **To detect changes in height & weight that are “real” vs. those due to error**
- **When errors detected or suspected**
  - find valid/consistent way to eliminate or neutralize OR to understand how it may affect findings/interpretation

# Methods

## Original plan:

- **Identify obese cohort BMI  $\geq 30$  in FY2002 (and follow through FY2006):**
  - last recorded weight in FY02
  - last recorded height in FY02 (or 1<sup>st</sup> available in FY03-FY06)
- **Included use of filtering scheme to remove “biologically implausible” weights (Das et al., 2005)**
  - deleted all weights  $\geq 700$  lbs &  $\leq 75$  lbs
  - deleted all heights  $\geq 84$  in &  $\leq 48$  ins

# Limitations of Data: Impact on Cohort Identification

Patients with:	N (%)
$\geq 1$ primary care visits in FY2002 in 6 VISNs	1,053,228
$\geq 1$ wts & $\geq 1$ hts recorded in FY2002	844,066 (80.1%)
$\geq 1$ wts in FY2002 & $\geq 1$ hts in FY2003-FY2006	89,018 (8.5%)
sufficient ht & wt data to calculate BMI	933,084 (88.6%)

# Limitations of Data: Impact on Cohort Identification

**Due to extreme BMI values, modified plan to id obese cohort:**

## ■ **Weights**

- divided baseline FY into quarters
- calculated median weight for each quarter

## ■ **Heights**

- used modal ht FY2002-FY2006
- for patients with  $\geq 2$  or more modal hts, averaged if difference btw modes was  $\leq 3$  ins

## ■ **Baseline BMI**

- Used median of median wts for FY2002 & modal ht FY2002-2006

# Limitations of Data: Impact on Outcome Assessment

## Original plan:

- **BMIs across 5-year study period**
  - BMI based upon average quarterly wt for each of 20 quarters

## Modified plan:

- **BMIs across 5 year study period**
  - BMI based upon median quarterly wt for each of 20 quarters
  - same modal ht (from FY2002-FY2006) applied across 5 years

# Blood Pressure Data

- **Unable to identify any publications using CDW BP data**
- **Kerr et al J Qual Improv 2002; 28:555-565 used BP values from VA Ann Arbor from VistA**
- **Valid values for QUERI-DM:**
  - 75 <= systolic <=250
  - 25 <= diastolic <=180
  - Usually use last value in period

# Late-life Patients with Schizophrenia

Of **2.5M records** for BP from FY02-FY05, representing 36,876 unique patients [IIR-05-326]:

- **14,000 w/o valid numeric data for both diastolic and systolic pressures**
- **0.7% had extreme non-missing values**
  - systolic 0-39 (n=9,081), systolic 0-75 (n=12,956)
  - diastolic 0-10 (n=13,396), diastolic 0-25 (n=14,070)
- **Very low values were primarily 0**
  - Systolic : n=8,927 of 12,956; diastolic: n=13183 of 14070
- **Few high values (n=119 sys 250-299, n=13 dias 180-299)**

# Late-life Patients with Schizophrenia

**the cohort originally matched to CDW : N=39,226**  
**the cohort with valid BP & location in CDW: N=33,271**

## **LOCATION:**

- **70% of readings from inpatient encounters**
- **30% of readings from outpatient encounters**
  - (6% were missing location)
  
- **11,606 inpatients with valid location + valid BP**
- **32,069 outpatients with valid location + valid BP**



# Case Study: Blood Pressure Data

Is htn an indep pred of survival among black and white pts with schiz?

Depends on what you look at.

Average measures generally protective or ns (inverse association)

Maxima were positively associated with relative odds of death

Minima were inversely associated with relative odds of death

<u>Effect</u>	<u>OR</u>	<u>95% wald CI</u>
Black	0.73	0.68 - 0.78
Female	0.59	0.49 - 0.70
age10	2.09	2.03 - 2.15
Max OP Sys x10	1.03	1.02 - 1.04
... <i>in another model</i> --		
Min IP Dias x10	0.79	0.76 - 0.82
... <i>in another model</i> --		
Avg OP Dias x10	0.86	0.82 - 0.90

NOTE: PROC LOGISTIC is modeling the probability that died=1 (n=34094)

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# Recommendations

- **Consider pros & cons of using repository of data derived from routine clinical encounters**
- **Strategies may be helpful for controlling or minimizing impact of error - impossible to eliminate all**
- **“Missing” data may limit usefulness of CDW for certain types of questions or patient populations**
- **Incumbent upon researchers to be aware of limitations of data & potential impact on findings**



# Recommendations

**Carefully examine each data file supplied by any repository**

- **Do number of records and values make clinical sense?**
- **Are there unusual variations over time or by facility?**
- **Many measures to choose from – consider clinical implications of each**



# Recommendations

**Approaches for dealing with error or “missing” data may vary depending upon clinical population or research question**

- **Select range filters that make sense for particular patient population**
- **Delete same day measurements or inpatient measurements?**
- **Is measure needed for specific time frame and/or are repeated measurements needed over time?**

# Suggestions When Requesting CDW Data

## ■ **Programming Issues**

- SQL view is simplest option for transferring (if SQL programmer on study team)
- Be specific in request & re-iterate specifications if time passes or CDW programmer changes
- Research programmer may require guidance on which cases to throw out or how to summarize multiple values in meaningful way

## ■ **Other Issues**

- Because of the size of these files, assess server space needs in advance of receipt of data; how many copies in what formats will you need to create?

# How to Acquire CDW Extracts

- **The NDS website**  
(<http://vaww4.va.gov/NDS/DataAccess/Researchers/RESCDW.asp>) describes these 3 methods for accessing CDW data:
- **Data used on CDW Platform** –access forms include Form 9957, Privacy and DSS Non-Disclosure if required, CDW Rules of Behavior
- **Data used in VINCI** –access forms, VINCI Rules of Behavior
- **Data delivered as an extract for use on local Research VA secure servers** –access forms, CDW Rules of Behavior
  - NDS expects the PI to control the data locally and track who has access to the data. If research staff will assist in obtaining the extract by downloading or file transfer from the CDW platform, these individuals will need to complete the access forms and sign CDW Rules of Behavior.

# References for Further Info

- Noël PH, Copeland LA, Pugh MJ, Kahwati L, Tsevat J, Nelson K, Wang CP, Bollinger M, Hazuda H. Obesity Diagnosis and Care Practices in the Veterans Health Administration. *JGIM* 2010;25(6):510-516.
- Noël PH, Copeland LA, Perrin RA, Lancaster AE, Pugh MJ, Wang CP, Bollinger MJ, Hazuda HP. VHA Corporate data warehouse height and weight data: Opportunities and challenges for health services research. *JRRD*. 2010;47(8):739-750.



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# Current Research Data Request Process to Access/Obtain Data from CDW

- **Contact CDW to confirm data availability**
- **Request access through VHA National Data Systems / DART**
  - <http://vaww4.va.gov/NDS/DataAccess/Researchers/RESCDW.asp>
  - Contact Irma McCaffrey  
([Irma.McCaffrey@va.gov](mailto:Irma.McCaffrey@va.gov))
  - Process involves a review by the VHA Privacy Office

# Current Research Data Request Process

- **Once approved by VHA**
  - Arrange data set creation with CDW team
  - Establish Data Transfer Agreement (DTA) with CDW team
    - File format (e.g. SQL, .txt)
  
- **Is direct access to CDW possible? No.**
  
- **Secure transfer of data**

# VIREC Help

- **VIREC Webpage**

- <http://vaww.virec.research.va.gov/>

- <http://www.virec.research.va.gov>

- Information on VA data sources and how to access data
- Documentation on some VA datasets

- **CDW Meta-data Webpage**

- <http://vhacdwa09.vha.med.va.gov:8080/>



# VIReC Help (cont'd)

## ■ HSRData Listserv

- Join at the VIReC Web site
- [http://vaww.virec.research.va.gov/Support/HSRData-L\\_Listserv.htm](http://vaww.virec.research.va.gov/Support/HSRData-L_Listserv.htm)
- Discussion among >500 data stewards, managers, and users
- Past messages in archive (on intranet)

## ■ VIReC Help Desk

- VIReC staff will answer your question and/or direct you to available resources on topics
- [VIReC@va.gov](mailto:VIReC@va.gov)
- (708) 202-2413 [8:00am to 4:30pm CST]



**Questions?**

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