The Good, Bad and Ugly: Ten Years of Experience With the Veteran's Administration Electronic Medical Record

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OVERVIEW

- Description of the VA System
- Implementation
- Nurse's Attitudes toward CPRS
- A Theoretical Shortcut
- Evidence regarding impact of CPRS on the work of nursing
- Lessons Learned/Recommendations

Description of the VA System

- The largest healthcare system in the United States (163 hospitals and 869 clinics)
- About 25% of the population is potentially eligible
- In 2008, VHA satisfaction was rated 85 for inpatient treatment, compared with 77 for private hospitals.
- VHA outperformed Medicare on 12 of 13 indicators in 2000.
- VHA provided better care as compared with commercial managed care systems in all 7 measures of quality for diabetes in 2009.

Description of the VA System

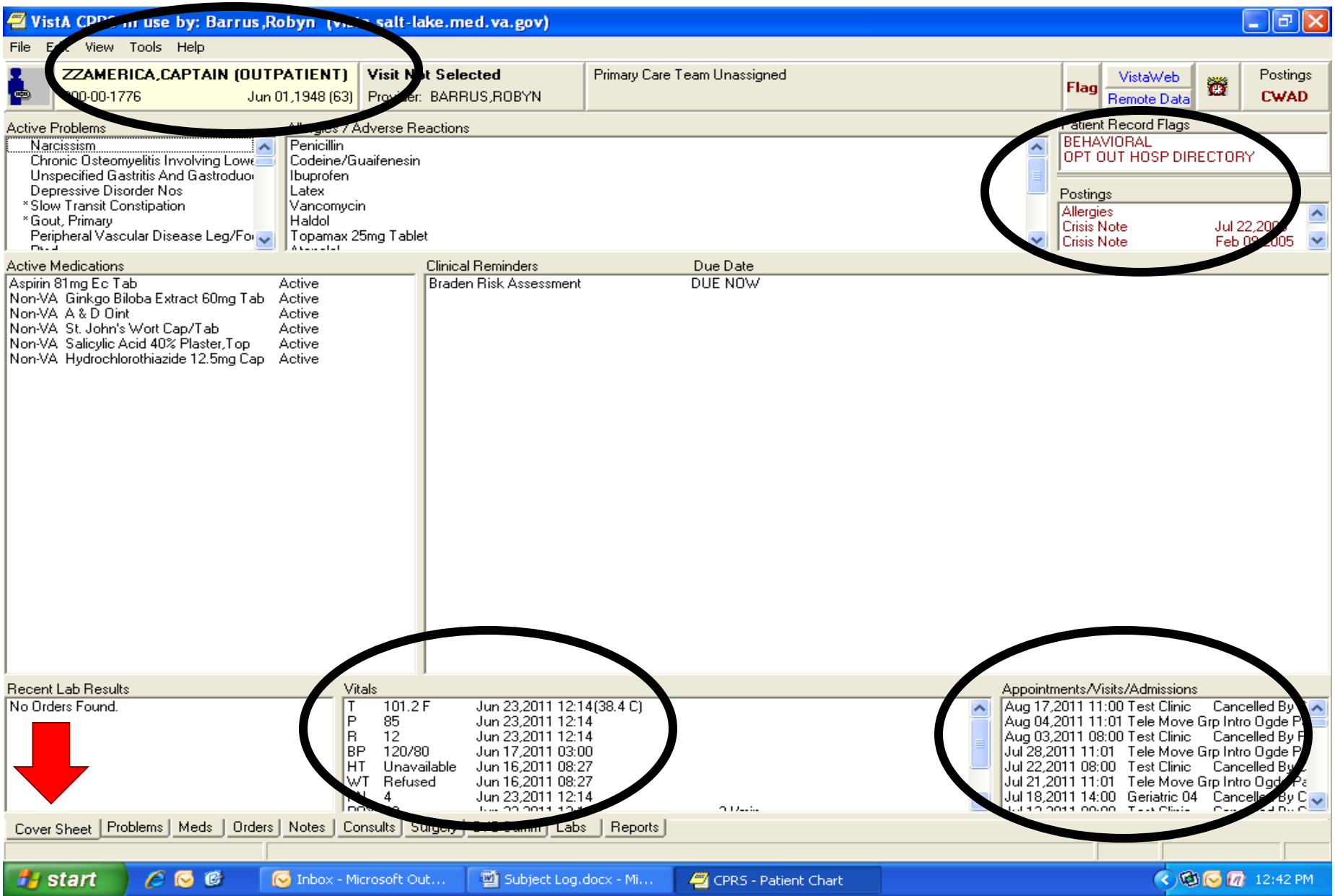
- The overarching system is called: *"The VA Information Systems and Technology Architecture (VistA)"*

- The component dealing with the patient record display to physicians is called the *"Computerized Patient Record System (CPRS)"*

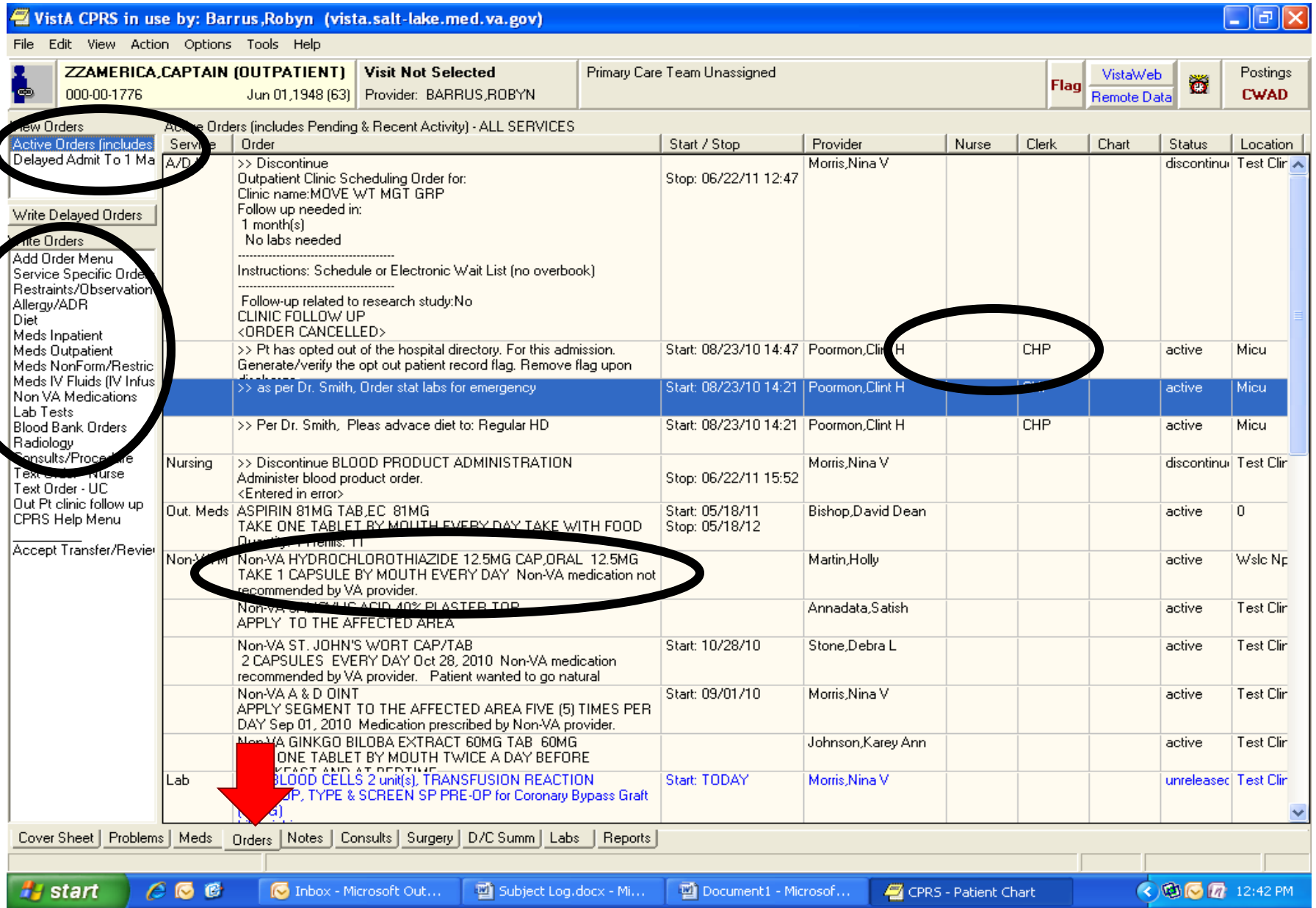
ViSTA and CPRS

- Full Provider Order Entry (all orders)
- Electronic Documentation
  - Templates
  - Inserted Objects
- Most widely used in the world
  - Half of all electronic hospitals in the US use VISTA
- Order Checks, Decision Support & Clinical Reminders
- Linked to teams/guidelines – highly customizable
- Has won multiple awards for innovation

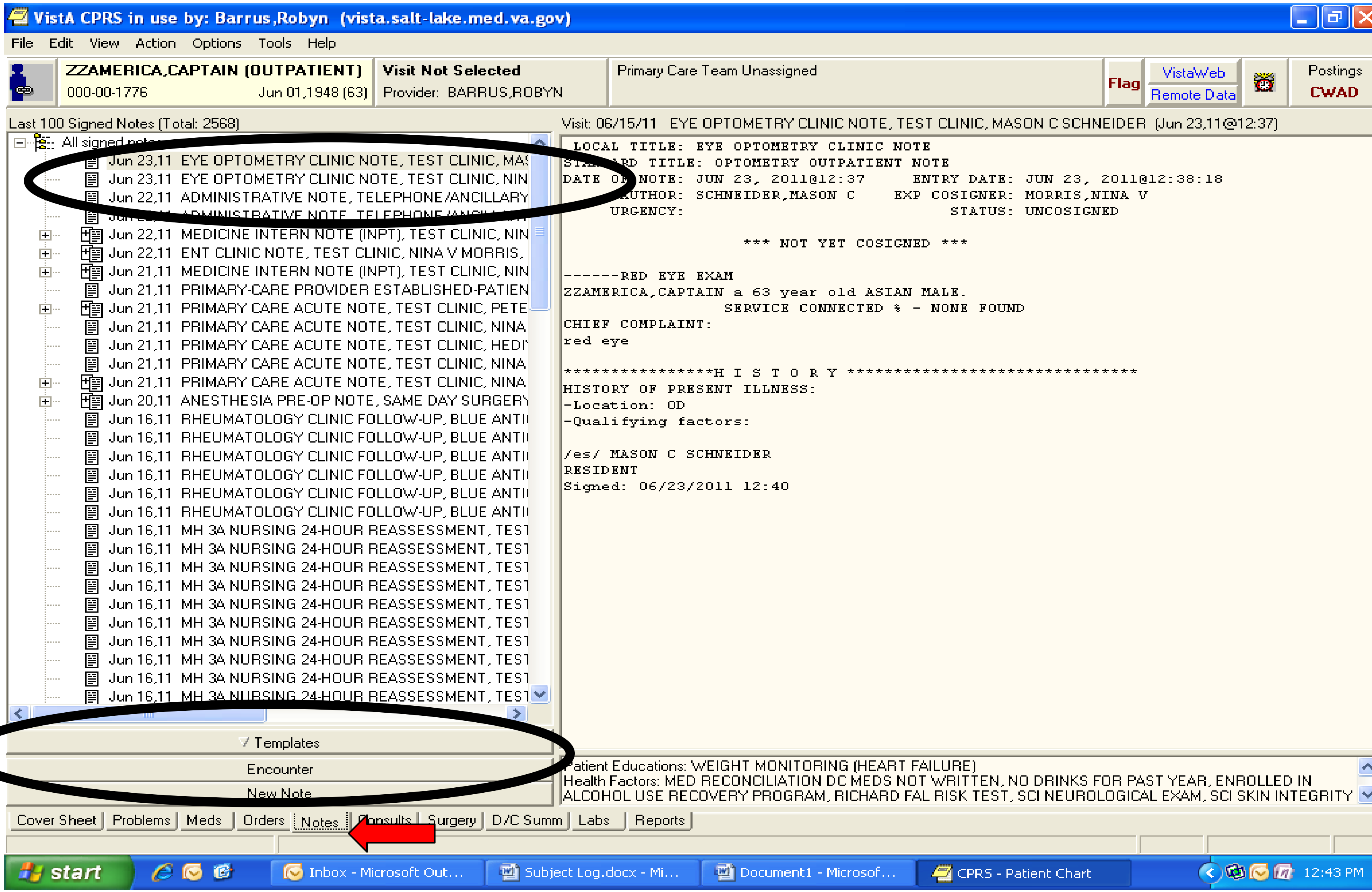
CPRS Patient Summary Cover



ORDERS TAB


VistA CPRS in use by: Barrus,Robyn (vista.salt-lake.med.va.gov)
File Edit View Action Options Tools Help
ZZAMERICA,CAPTAIN (OUTPATIENT)
000-00-1776 Jun 01,1948 (63)
Visit Not Selected
Provider: BARRUS,ROBYN
Primary Care Team Unassigned
Flag
VistaWeb
Remote Data
Postings
CWAD
View Orders
Active Orders (includes
Delayed Admit To 1 Ma
Write Delayed Orders
Write Orders
Add Order Menu
Service Specific Orde
Restraints/Observation
Allergy/ADR
Diet
Meds Inpatient
Meds Outpatient
Meds NonForm/Restric
Meds IV Fluids (IV Infus
Non VA Medications
Lab Tests
Blood Bank Orders
Radiology
Consults/Procedure
Text Order - Nurse
Text Order - UC
Out Pt clinic follow up
CPRS Help Menu
Accept Transfer/Revie
Active Orders (includes Pending & Recent Activity) - ALL SERVICES
Service
Order
Start / Stop
Provider
Nurse
Clerk
Chart
Status
Location
A/D
>> Discontinue
Outpatient Clinic Scheduling Order for:
Clinic name:MOVE WT MGT GRP
Follow up needed in:
1 month(s)
No labs needed
Instructions: Schedule or Electronic Wait List (no overbook)
Follow-up related to research study:No
CLINIC FOLLOW UP
<ORDER CANCELLED>
Stop: 06/22/11 12:47
Morris,Nina V
discontinu
Test Clir
>> Pt has opted out of the hospital directory. For this admission. Generate/verify the opt out patient record flag. Remove flag upon
Start: 08/23/10 14:47
Poormon,Clin H
CHP
active
Micu
>> as per Dr. Smith, Order stat labs for emergency
Start: 08/23/10 14:21
Poormon,Clint H
active
Micu
>> Per Dr. Smith, Pleas advace diet to: Regular HD
Start: 08/23/10 14:21
Poormon,Clint H
CHP
active
Micu
Nursing
>> Discontinue BLOOD PRODUCT ADMINISTRATION
Administer blood product order.
<Entered in error>
Stop: 06/22/11 15:52
Morris,Nina V
discontinu
Test Clir
Out. Meds
ASPIRIN 81MG TAB,EC 81MG
TAKE ONE TABLET BY MOUTH EVERY DAY TAKE WITH FOOD
Start: 05/18/11
Stop: 05/18/12
Bishop,David Dean
active
0
Non-VA M
Non-VA HYDROCHLOROTHIAZIDE 12.5MG CAP,ORAL 12.5MG
TAKE 1 CAPSULE BY MOUTH EVERY DAY Non-VA medication not recommended by VA provider.
Martin,Holly
active
Wslc Np
Annadata,Satish
APPLY TO THE AFFECTED AREA
active
Test Clir
Non-VA ST. JOHN'S WORT CAP/TAB
2 CAPSULES EVERY DAY Oct 28, 2010 Non-VA medication recommended by VA provider. Patient wanted to go natural
Start: 10/28/10
Stone,Debra L
active
Test Clir
Non-VA A & D OINT
APPLY SEGMENT TO THE AFFECTED AREA FIVE (5) TIMES PER DAY Sep 01, 2010 Medication prescribed by Non-VA provider.
Start: 09/01/10
Morris,Nina V
active
Test Clir
Non-VA GINKGO BILOBA EXTRACT 60MG TAB 60MG
ONE TABLET BY MOUTH TWICE A DAY BEFORE
Johnson,Karey Ann
active
Test Clir
Lab
BLOOD CELLS 2 unit(s), TRANSFUSION REACTION
P, TYPE & SCREEN SP PRE-OP for Coronary Bypass Graft
Start: TODAY
Morris,Nina V
unreleasec
Test Clir
Cover Sheet
Problems
Meds
Orders
Notes
Consults
Surgery
D/C Summ
Labs
Reports
start
Inbox - Microsoft Out...
Subject Log.docx - Mi...
Document1 - Microsof...
CPRS - Patient Chart
12:42 PM

Progress Notes Tab



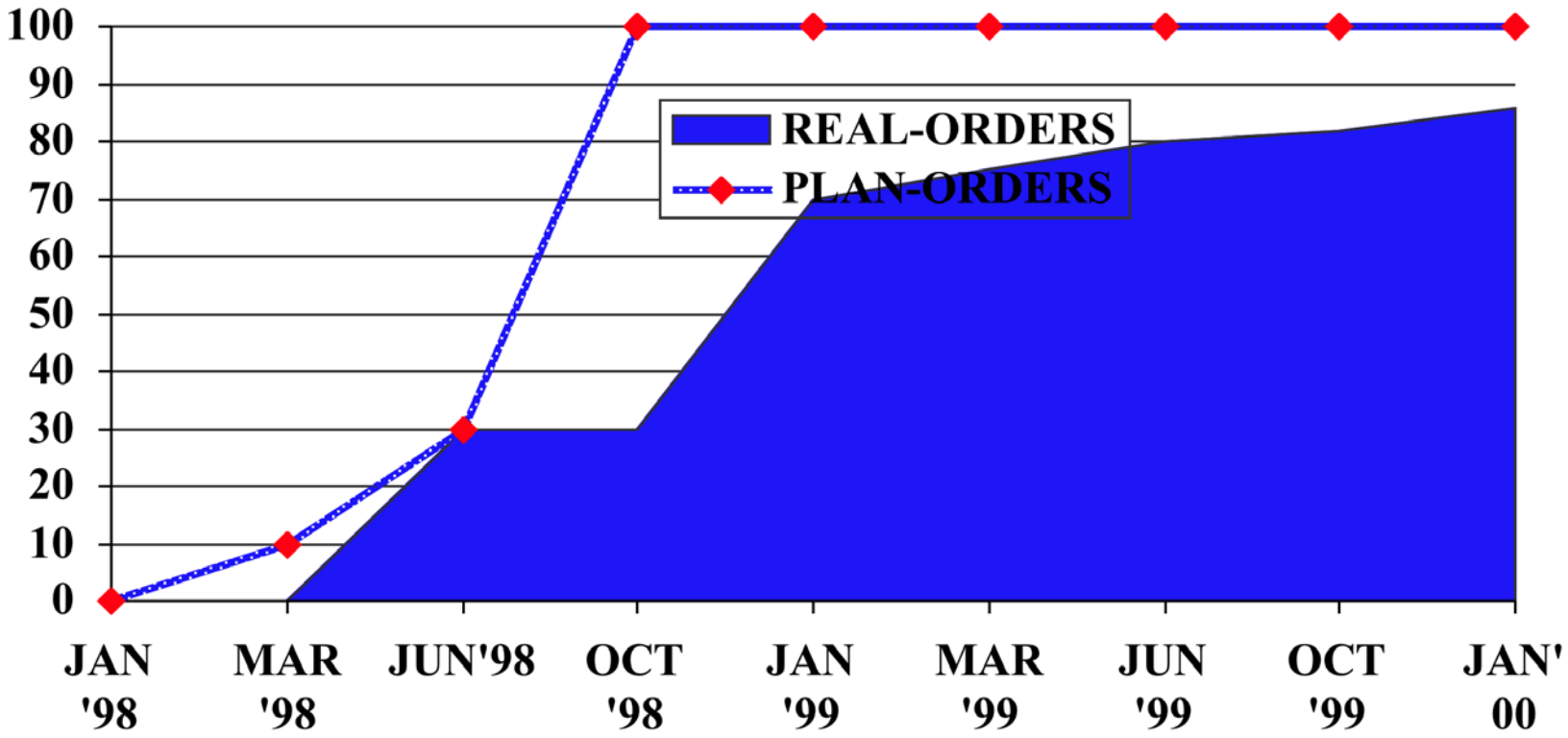
CPRS Implementation

- Pre 1986: Early Electronic Record (DHCP)
- (1992-1995): Installation of T1 lines to all sites
- (finished in 1995): Upgrade to a new architecture and GUI interface
- (1997- 2002): Mandated implementation of CPRS with Provider Order Entry and Text
- Each site took an average of 2 years

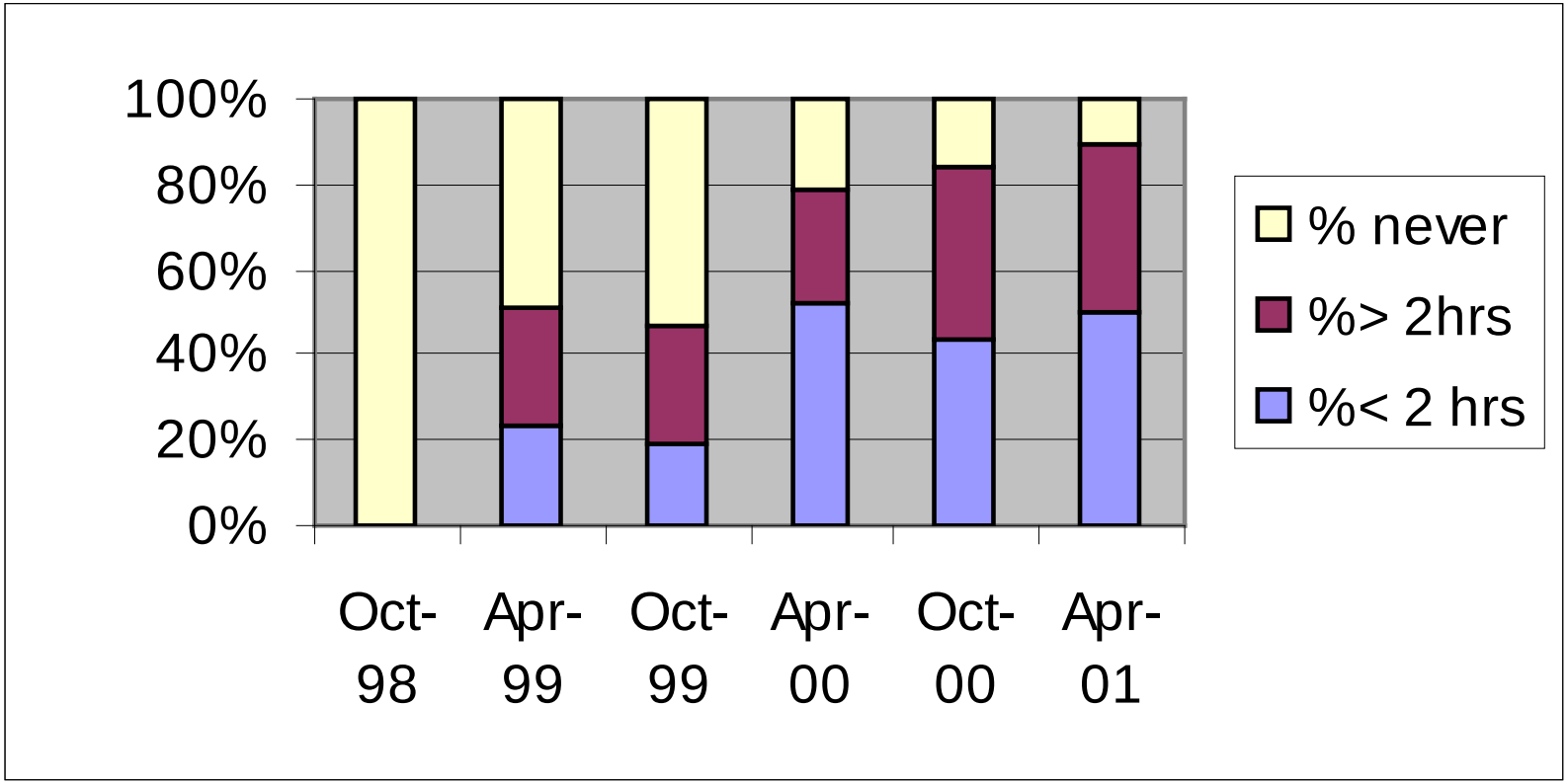
IMPLEMENTATION

- Training
  - Nurses had the least computer experience
- Involvement
  - Nurses were the least involved initially, but much more involved later
- Implementation Indicators involved nursing
- Nurses were leaders in the computer-clinician liaison role

Implementation Tracking:
Orders Entered by Providers

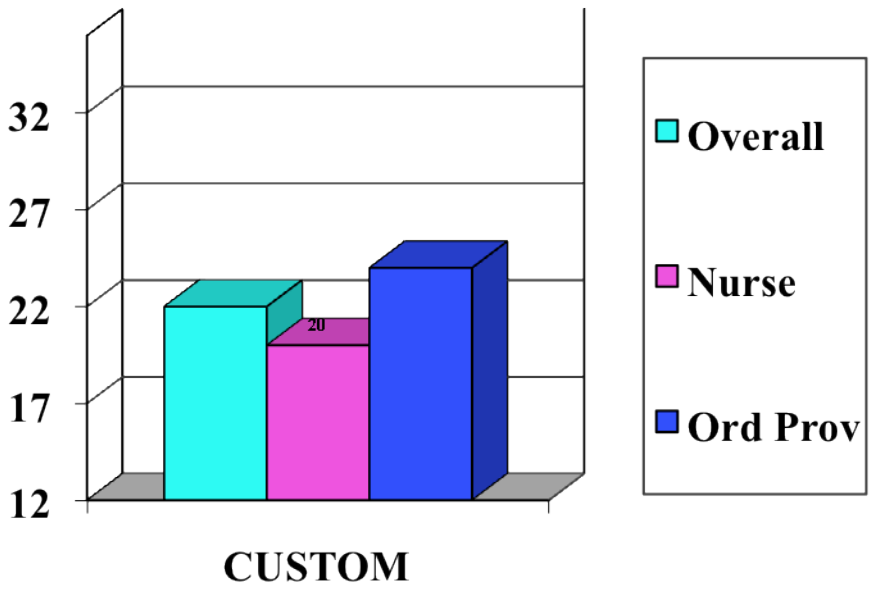


RN ORDER VERIFICATION:
In Hours



ADOPTION BEHAVIORS

Personal Customization

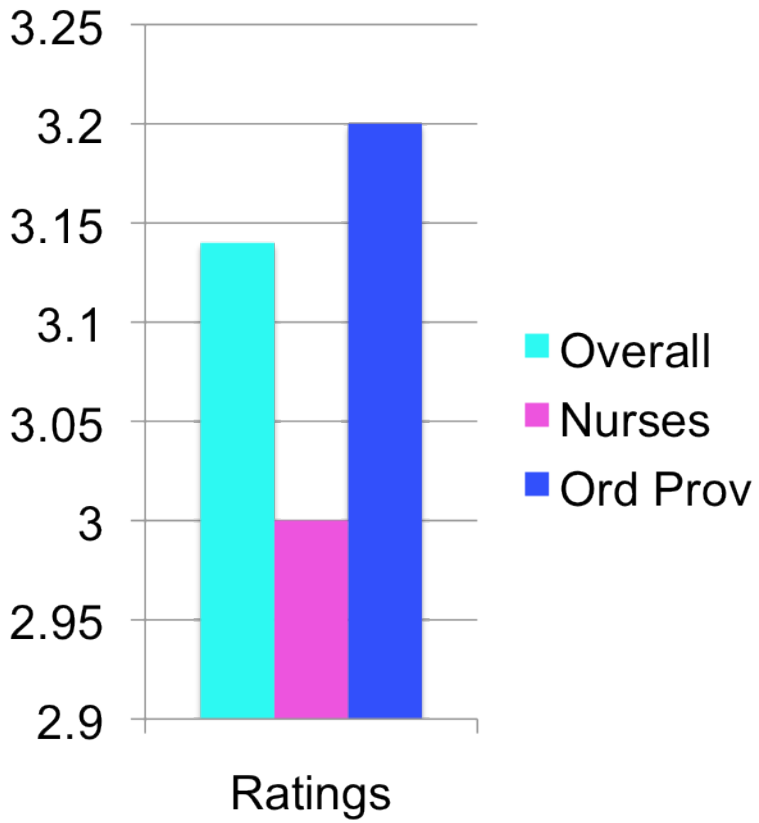


- Self- Ratings (1-3)
- 1= Not using
- 3= Using Frequently
- Possible = 36
- 12 items (examples)
  - Note Templates
  - Alert own lab results
  - Make own Patient List
- Score is total sum
- No sig differences

ATTITUDE: *Perceived Usability*

- Three Questions
  - Easy to use
  - Easy to learn
  - Easy to get around in
- Summed & scaled from 1 to 5

Significant differences bet/roles with nurses rating much less.



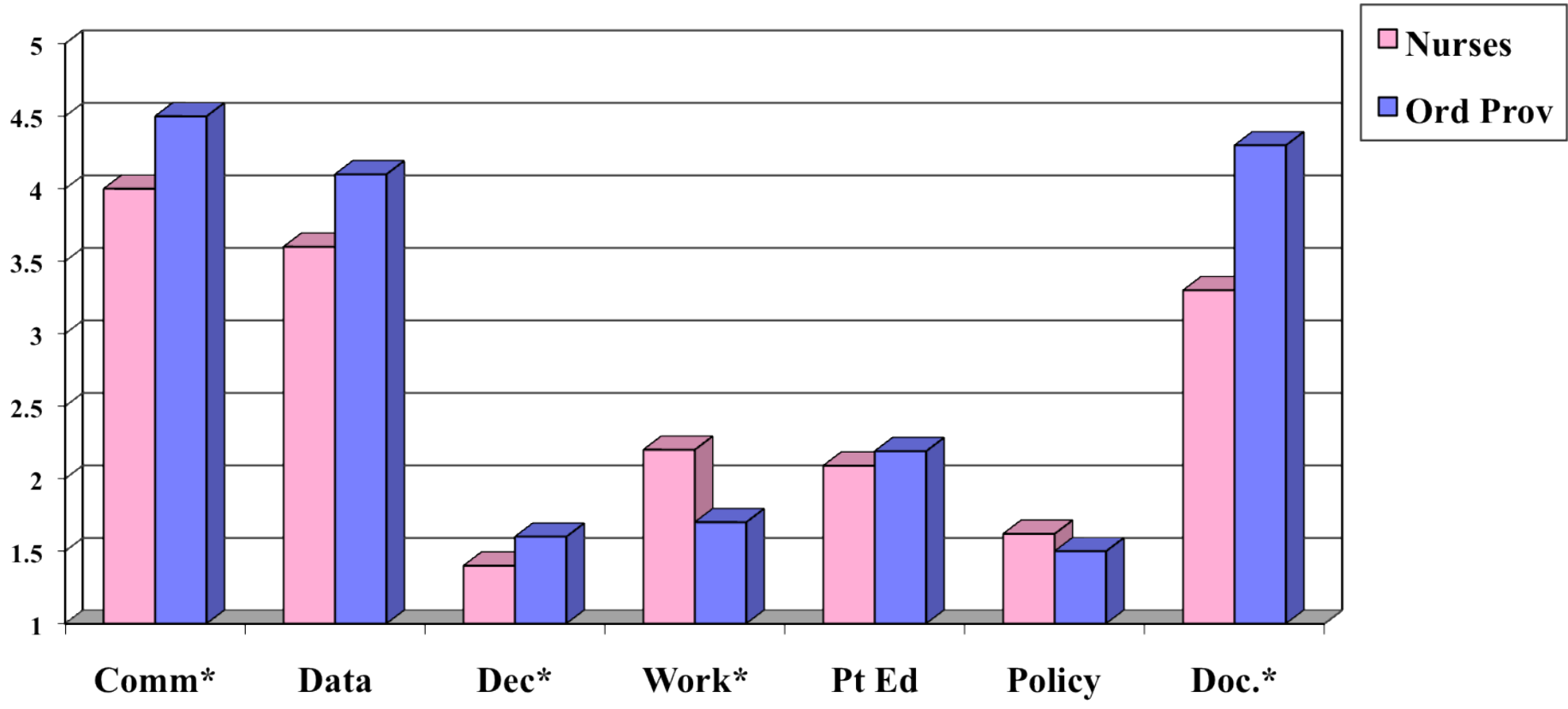
User Satisfaction for Information Tasks

How well does the system help me:

- ***Communicate*** with other providers e.g. discharge planning, changes in patient status.
- ***Data***: find patient data and history for review.
- ***Decision Making***: organize and correlate data to make complex decisions.
- ***Workload***: find information about workload of myself and others.
- ***Patient Education***: Providing information and teaching to patients
- ***Policy and Procedures***: Access to local policies
- ***Documentation of Events***: Documenting/Coding

User Satisfaction for Information Tasks

Standardized Ratings of 7 Information Tasks



*** indicates significant differences between groups**

Impact of CPRS on the Work of Nursing

What IS the work of Nursing?

- Institute of Medicine (IOM) report on Patient Safety, the work of nursing is described as two-fold:
  - Surveillance and rescue
  - Coordination and integration of care and services across multiple providers

(IOM, 2004)

National Academies Press Report

"Today, clinicians spend a great deal of time and energy searching and sifting through raw data about patients and trying to integrate these data with their general medical knowledge to form relevant mental abstractions and associations relevant to the patient's situation. Such sifting efforts force clinicians to devote precious cognitive resources to the details of data and make it more likely that they will overlook some important higher-order consideration."

Stead, W.W., Lin, H.S., ed. *Computational Technology for Effective Health Care: Immediate Steps and Strategic Directions. 2009, National Academies Press:* Washington, D.C

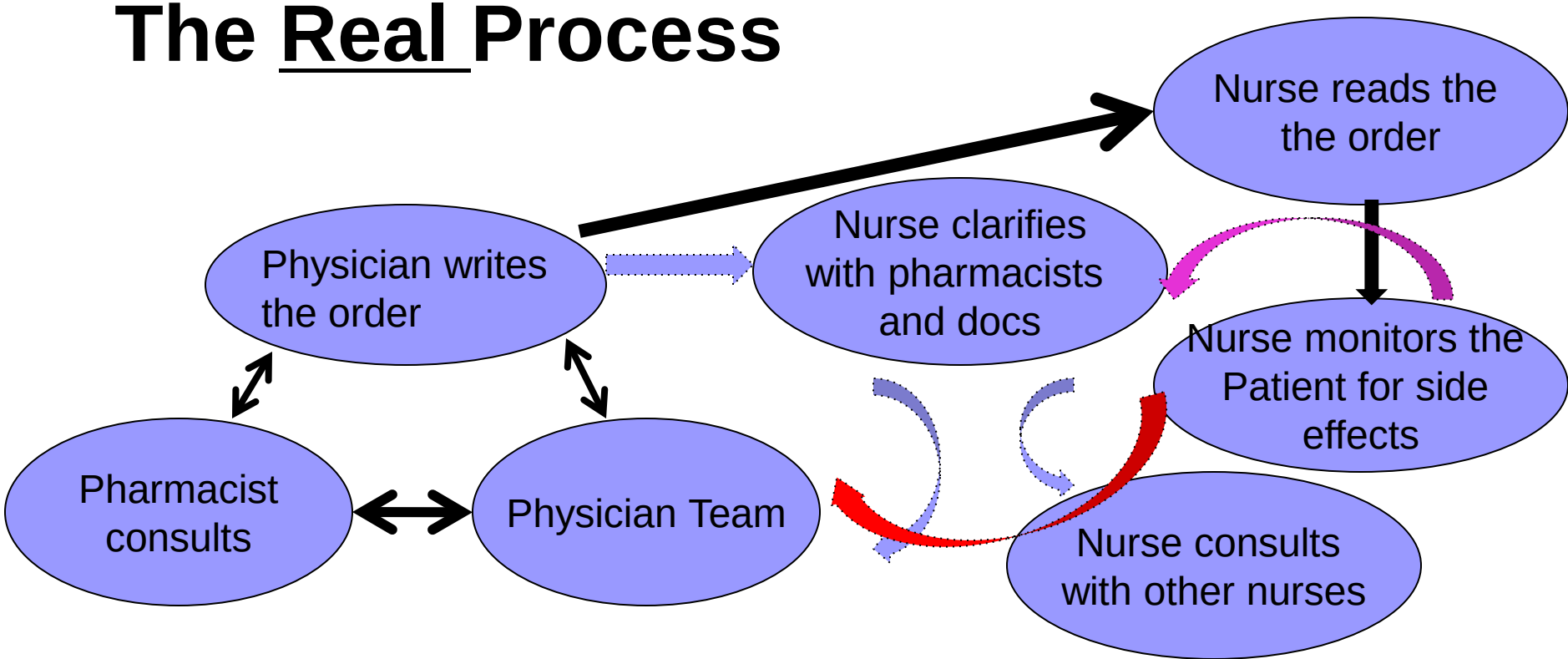
***EXAMPLE*:**
MEDICATION MANAGEMENT

Medication Management is a Problem

- Adverse Drug Events (ADEs) are defined as “harm resulting from a drug” (both error and non-error)
  - #1 or #2 cause of error in most studies of patient safety
  - emphasis has been on ordering, but
  - failure to monitor the most frequent (prevent)
  - 65% to 85% not detected (failure to rescue)
  - Incidence ranges from 3% to 32% of all patients
- Those with >= 1 ADE stay longer, cost more and are 2x more likely to die
- Symptom data is an indicator of 50-75% of ADEs

The Perceived Medication Management Process

The Real Process



Adverse Drug Event Study (VA)

- Concurrent review of 937 patient admissions with 435 clinically significant ADEs
- 25% patients had at least one ADE
- 35% of ADEs remained undetected
- 31% were only found in nursing notes
- Most common ADEs: **

Constipation	Hypotension	Hemorrhage
Hyperkalemia	Hypoglycemia	Somnolence/Delirium

Nebeker JR, Hoffman JM, Weir CR, Bennett CL, Hurdle JF. High rates of adverse drug events in a highly computerized hospital. *Arch Intern Med. May 23 2005;165(10):1111-1116*

Conclusions Relevant to Nursing

- Nursing documentation not accessible
  - In long templates
  - Not read by other providers
  - In Bar-Code Medication Administration
- Nurses noted symptoms, but rarely linked them to actual event
- BCMA did not display lab/symptoms

Quality of Electronic Documentation

TOPIC: Medication management across roles

METHODS: 9 focus groups across 3 sites (n=21 nurses, 18 physicians and 19 pharmacists)

RESULTS (5 nursing themes):

1) working in chaos and complexity;

2) seeking the big picture;

3) navigating partnerships;

4) customizing communication; and

5) accountability of knowing without authority for decision making.

Weir, C, "***Minimizing Harm from ADEs by Improving Nurse-Patient Communication"*** VA HSR&D NRI 05-275

“….they’re on so many medications so oftentimes it’s hard to know which one it is”

“....if you look at their assessments, it’s 3 sentences: patient stable, denies complaints; DC in one week. What’s the plan?”

“Nurses feel that they are where the “buck stops:”“… It looks like the potassium is high so sometimes we have to remind the doctor especially if the patient is taking potassium.”

“I avoid reading nursing notes, just pages of blank fields”

“There is so much stuff put into a note, I can’t find what I need.”

“...: Well, there’s nursing judgment with every potential phone call and if you decide to call the doctor, get your vital signs, get your stat, get your ducks in a row.”

“…with him you have to basically carry them by the hand and say, “This is what I need you to do,”

Conclusions Relevant to Nursing

- Nursing documentation unreadable, increasing dependence on verbal
- Nurses act as “project managers” and enhance ordering, monitoring, etc
- Nurses are not aware of big picture, goals of care or therapeutic plan
- Very little decision-support available to help nurses decide when to call, what symptoms related to ADEs, etc.

CLINICAL REMINDERS: *Distributed Workload*

- Clinical Reminders is software that identifies patients and criteria for screening/monitoring.
  - Usually outpatient
  - Used for Coumadin, Diabetes, and all clinics
- Nurses are integral to workflow (but varies)
  - Nurses may run INR and diabetic clinics
  - Sometimes do screening/ hand-off positives to docs
  - Workflow assignments not imbedded in CR – lots of paper work-arounds

Saleem, J, et al. J Am Med Inform Assoc. 2005;12:438–447

Example of Work-Around (outpatient):

- A list of the patient's CRs was automatically printed at check-in with the clerk.
- The nurses used printout to assess CRs during intake and recorded results on paper. The patient took it in to the provider.
- Later in the day, the nurse recorded the information in the CPRS later in the day!!!!
- What's wrong?
  - Nurses collect information in "stove pipes" – not integrated
  - Nurse's record it twice

MEDICATION MANAGEMENT: Ethnographic Observation

- ***Setting***:
  - Veteran's Hospital (122- Bed Tertiary care setting
  - Two Medical-Surgical Inpatient wards
- ***Participants***:
  - *Physicians* – 12 randomly from 4 housestaff teams
  - *Nurses* – 19 nurses selected randomly
  - *Pharmacists* – 8 clinical pharmacists observed twice

METHODS

- ***Time Sampling*** - 2 hours randomly sampled from 0600 to 10pm
- ***Procedures*** – recorded every "communication event" on PC pad in ATLAS@
- ***Categorization of <u>mode</u> of events***
  - Verbal - Page - Group/Rounds - Computer - Phone

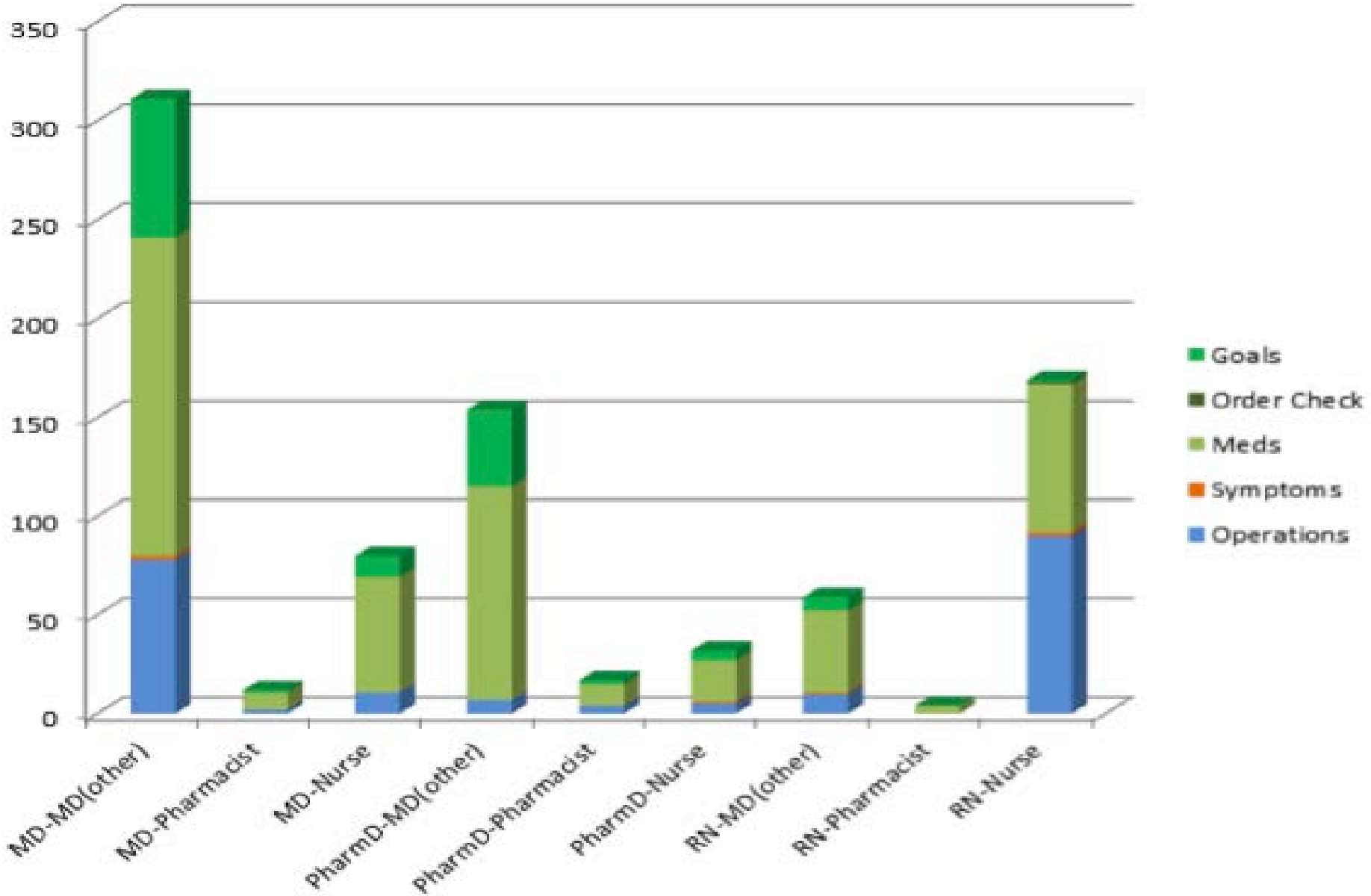
METHODS – Topic Categories

- Medication Management
  - Orders: Clarification / Request for Change
  - Teaching / Discussing / Consultation
  - Adverse Drug Events (prevention/identification)
- Operations
  - Procedures/ Equipment
  - Staffing / Admission / Transfer
- Symptoms / Patient Status
- Informal Conversation
- Information Needs /Asking for Help

RESULTS

- *Communication events were highly frequent*
  - Physicians - 22/hr (72% verbal)
  - Nurses - 16/hr (92% verbal)
  - Pharmacists – 12/hr (61% verbal)

- *Medication Management topics were the most frequent topics across all roles.*
  - Physicians – 79%
  - Nurses – 61%
  - Pharmacists – 82%


350
300
250
200
150
100
50
0
MD-MD(other)
MD-Pharmacist
MD-Nurse
PharmD-MD(other)
PharmD-Pharmacist
PharmD-Nurse
RN-MD(other)
RN-Pharmacist
RN-Nurse
Goals
Order Check
Meds
Symptoms
Operations

SOCIAL NETWORK ANALYSIS: *Received Communication*

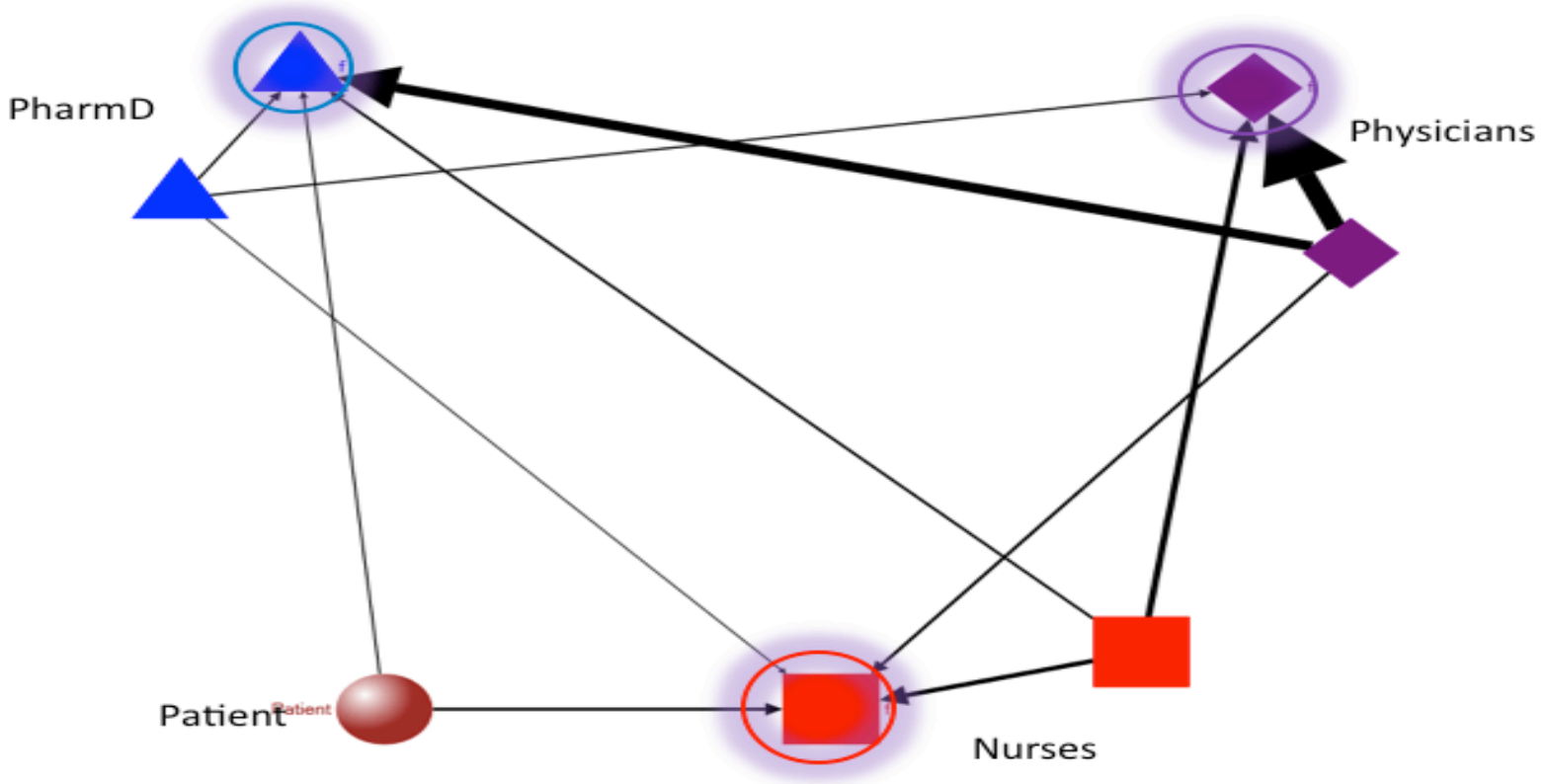


Figure 2. SNA of received communication events (arrow directed toward receiver).

Created by NodeXL (http://nodexl.codeplex.com)

SOCIAL NETWORK ANALYSIS:
Initiated Communication

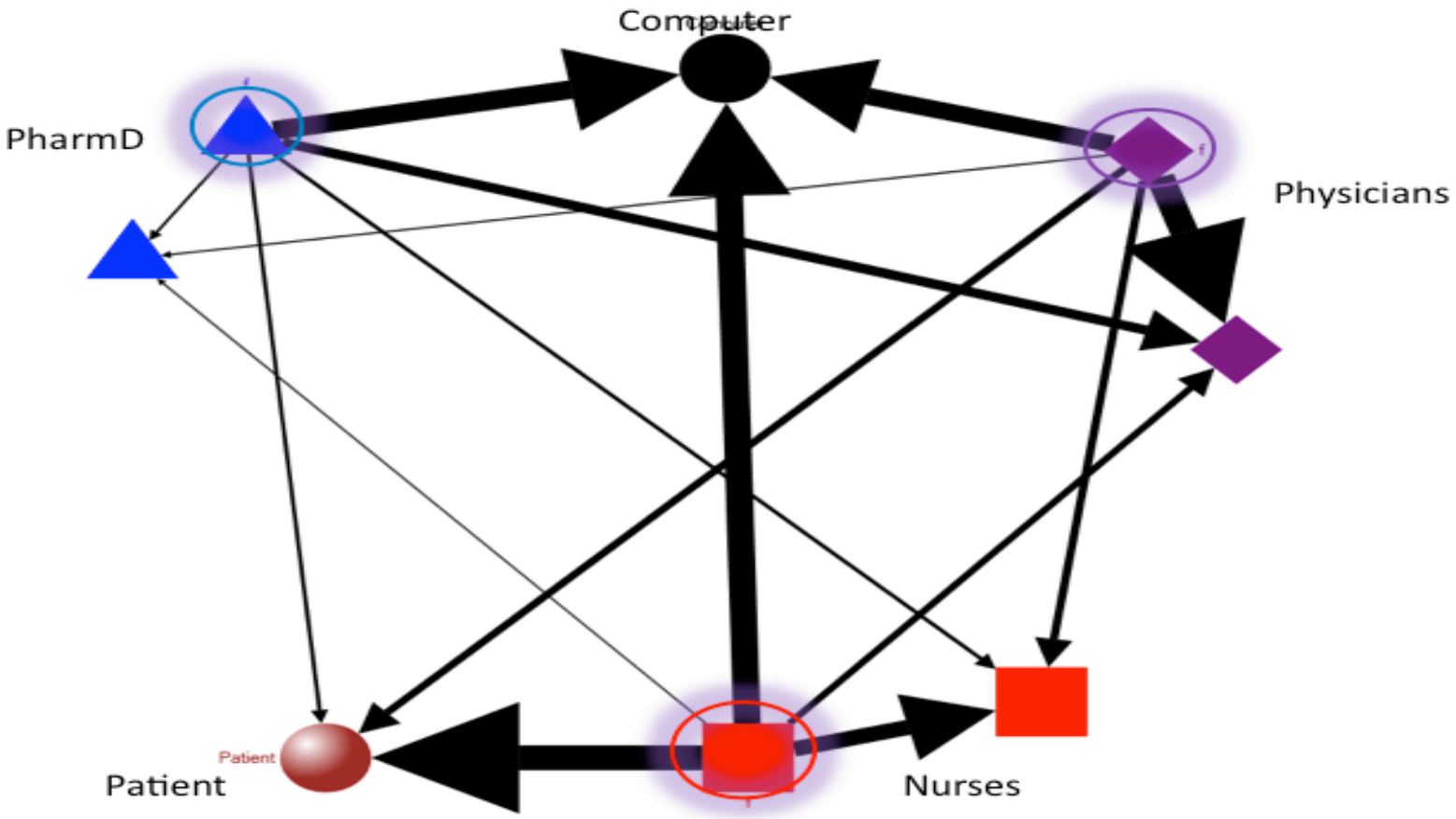
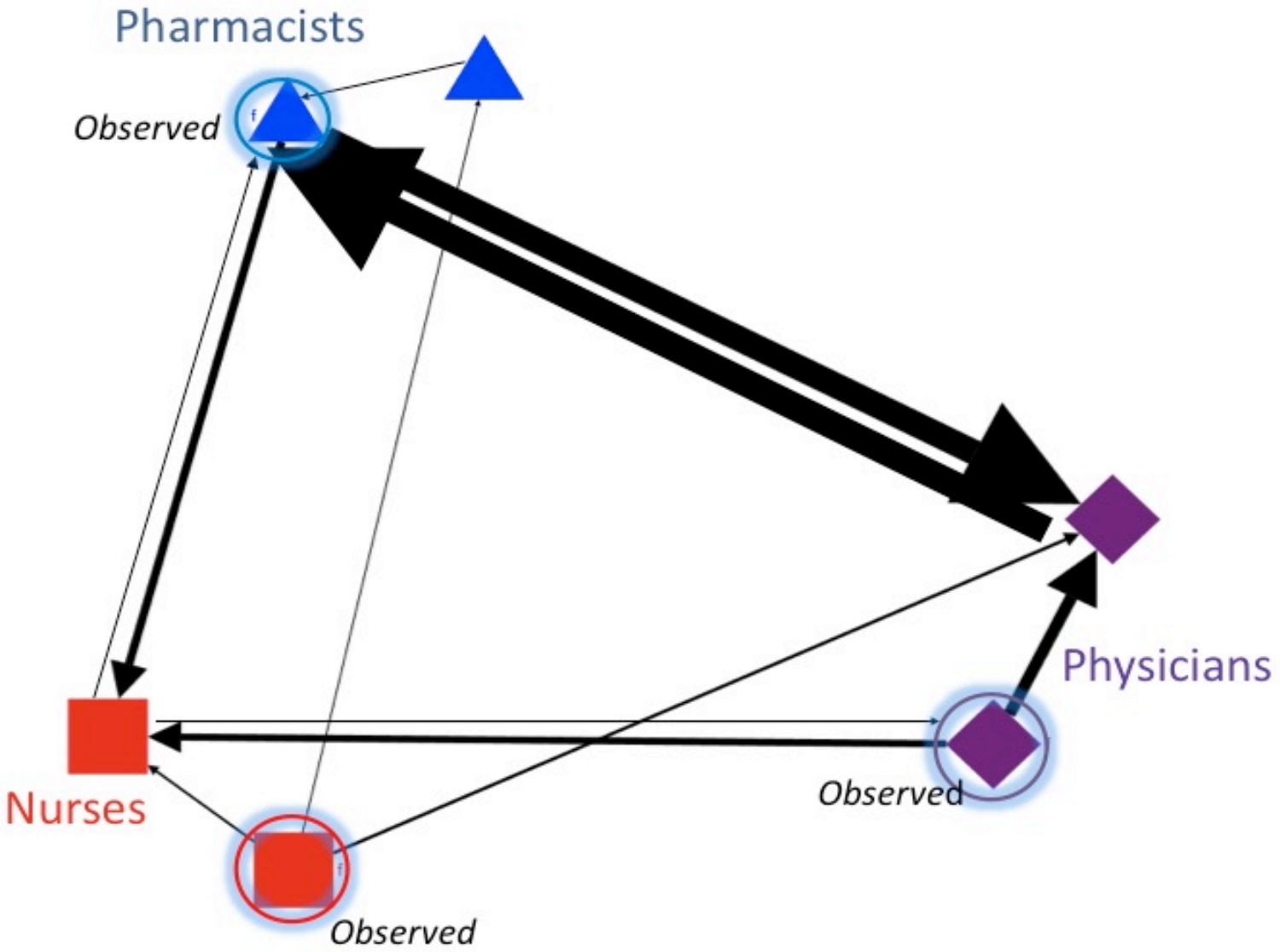


Figure 1. SNA of initiated communication events (arrow direction).

Created by NodeXL (http://nodexl.codeplex.com)

Adverse Drug Events



Conclusions Relevant to Nursing

- Nurses rarely are told goals of care
- Nurses are rarely informed of adverse drug events
- Nurses do most of the talking to patients
- Medication management is a very common topic

Usability Issues, etc

- BCMA interface found to have multiple problems
- Electronic documentation very difficult to use – a lot of templates, but little info
- Data input requires multiple redundancies
- Nursing data very hard to extract by other providers (scattered about)
- Patient assessment tool very slow, requires non-relevant forced fields

So, what are we to make of all these findings?

We need some theory to help us interpret the results and to provide usable findings to inform future design

A Few Theoretical Points to Consider

- Memory is really two processes
  - Associative
  - Symbolic

ASSOCIATIVE PROCESSING

- **Associative Learning**: Gradual accretion of knowledge through progressive associations; expert performance is an example.
- **Thinking**: fast, pattern-completion, effortless
- **Awareness**: Not required for performance
- **Errors**: common heuristics or “rules of thumb”
- **Change**: change is slow, hard; like “breaking bad habits.”

VERY RESISTANT TO IMPACT OF COGNITIVE LOAD

SYMBOLIC MEMORY PROCESSING

- **Symbolic Learning**: Fast increase in knowledge through rules/symbols/language.
- **Thinking**: slow, effortful, requires attention
- **Awareness**: Required for performance
- **Errors**: miss-identified task, not understanding
- **Change**: change may be fast

HIGHLY SENSITIVE TO COGNITIVE LOAD

IMPLICATIONS for Nursing

- Both types of cognition are “working” simultaneously.
- Information Systems should NOT use more cognitive resources, but should allow more.
- Errors are often due to mismatch
- Humans prefer to minimize cognitive load, hence they do what they know as much as possible.
- Adaptive strategies or “work-arounds” are geared to “think less.”
- Experts use less attention and effort.

The Work of Nursing:

1) Surveillance and rescue

2) Coordination and integration of care and services across multiple providers

What kinds of cognition need support?

- Attention
- Sense-making or Knowledge Processes
- Decision-Making / Planning
- Social Coordination/ Team Work

COGNITIVE SUPPORT FOR:
Surveillance and Rescue Needs to:

- Monitor key indicators constantly
- Be able to attend to unusual or emerging events
- Rapidly identify and classify the event
- Know how to respond and decide what to do

Monitor key indicators constantly

- Monitoring is very hard for humans to do
- Monitoring requires knowing what is important – goals of care, current concerns
  - Prior knowledge
  - Decision support
  - Policies & Procedures

CPRS Support for Monitoring
(should be imbedded/automatic)

- CPRS does not link goals of care with orders
- Scientific info about side effects not patient specific and linked (infobuttons)
- BCMA does link labs to meds
- Physiological monitoring tools are not integrated
- CPRS actually increases cognitive load

CPRS Support for Attending to unusual or emerging events

- Alarms across instruments are not linked to patient data (so, WHAT is unusual?)
- Too many alarms
- New orders require monitoring!!
- BCMA does not alert nurses regarding symptoms/labs ADEs

Rapidly identify and classify events

- ***Sense-making*** requires flexible, customizable and easy to change views of patient data
  - Medications linked to problems, indicators for success, patient hx
  - Therapeutic goals
- Nurses work in ***teams*** and discuss
- Need ***integrated rules*** for crossing threshold for classifying event

CPRS Support for identifying and classifying events

- ***CPRS data stove-piped***
  - Medications, problems and orders and notes in separate places.
  - Teams not identified – have to go searching for who's who
- Too much information in narrative
- Providers think that others are reading their notes (very little of that)

Know how to respond and decide what to do

- Decisions may take time (symbolic)
- Knowledge (book-learning) has to be linked to actions
- Action thresholds require knowing goals of care and objectives
- Action ALSO requires knowing who else knows!!!
- Decision-support needs to include scientific knowledge with policies

CPRS Support for: Knowing how to respond

- No decision-support for calling the doctor or advancing to next stage (compare to diagnostic dec support)
- Information systems do not respond to large differences in nursing expertise
- Assumes that nurses do not diagnose
- Many decisions require integration of policy, institutional rules and knowledge about “who is taking care of patient.”

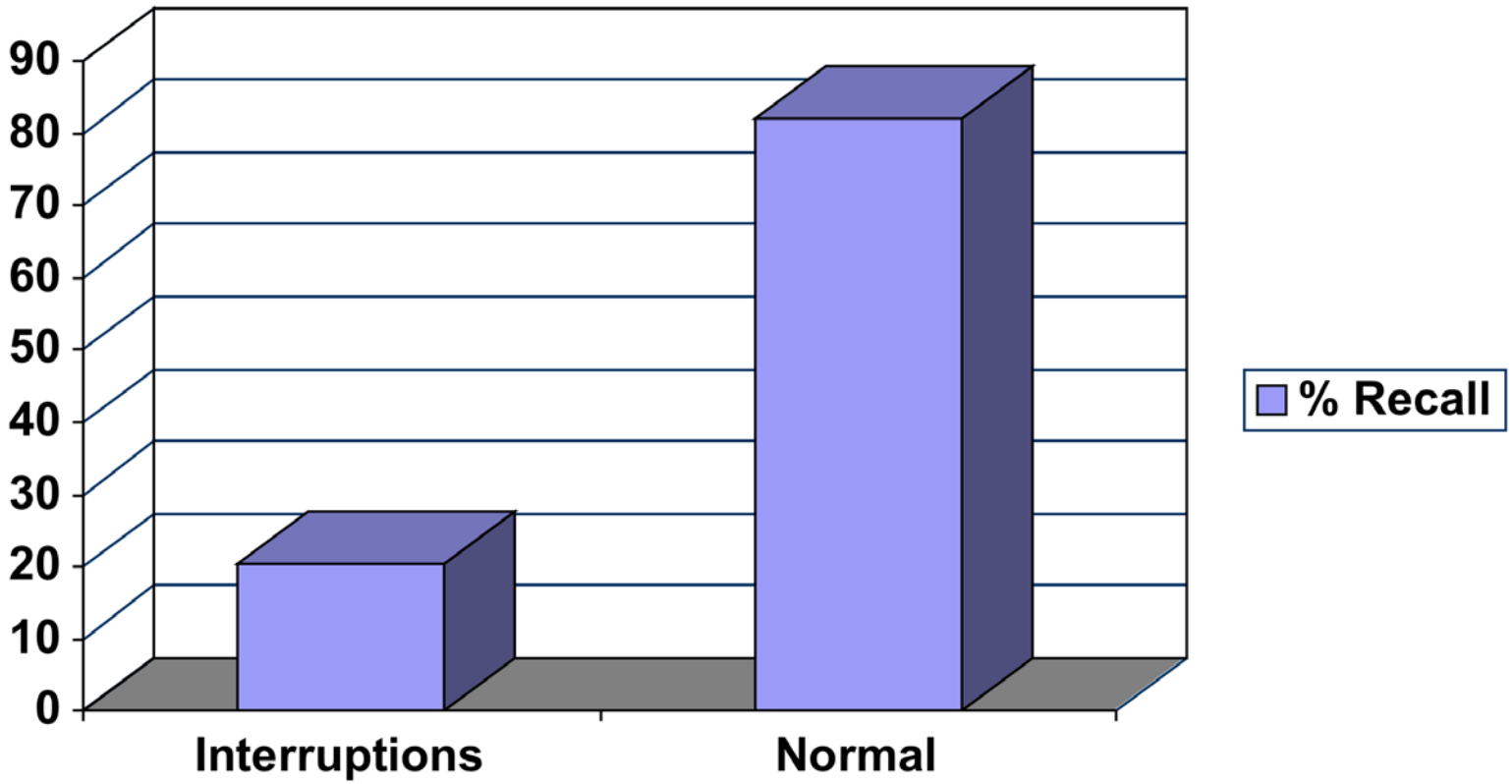
Social Coordination/ Team Work

- Support mental models of shared workloads and task assignments
- Should support negotiation of responsibilities
- Should track tasks/processes across time and individuals
- Imbed communication functions

CPRS Support for: Social Coordination/ Team Work

- Information about workloads and task assignments scattered or not present
- Negotiation of responsibilities either very structured (e.g. orders or verbal)
- Not tracking of tasks/processes across time and individuals (requires searching)
- No imbedded communication functions

Effects of Interruptions During Report for Patient Handoffs



Hypotheses Regarding Impact of Information-Systems on Nursing

- Interface not suitable for highly interruptive context and highly mobile workforce
- Searching for data takes cognitive resources:
  - Data display strategies that work well with sparse data fail when data is abundant
  - nurses need a different timeframe for display
- Structured information entry is interruptive and causes cognitive overload
- Communication is not the same as information transfer – nursing information is MORE isolated

Ash, J, Berg,M. Coiera, E. JAMIA 2004; 11:104-112

RECOMMENDATIONS
Task-Person-Technology Fit

- Decision support for easy tasks should not require attention (they will be seen as interruptions). ***Increase Control***
  - Order sets and protocols
  - Standing Orders
  - Administrative Control (e.g. formulary)
  - Documentation / Order Combinations
  - Embedded tracking of behavior

RECOMMENDATIONS Task-Person-Technology Fit

- Decision support for hard/complex tasks should **assist the human** in active problem-solving - not replace him/her.
  - Provide information early in the planning phase
  - Display information by tasks (e.g.problems)
  - Slow down the process in order to

The Socio-Technical Perspective

"Embracing a user-oriented perspective, socio-technical approaches emphasize that ***thorough insight*** into the work practices in which IT applications will be used should be the starting point for design and implementation." (p. 89-emphasis mine)

Berg, M (1999). Patient care information systems and health care work: a sociotechnical approach. Int. J of Med Inf. 55; 87-101

Questions?