



# **Northwest EHR Usability and Safety Institute (NExUS): Scientifically Improving EHR Functionality and Safety**

**November 14, 2013  
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# Background: Electronic Health Records

- Used by every member of health care institution
- Generates large amount of data/patient/d (>2500 in ICU)
- Accessing and integrating data essential for
  - Effective clinical decision making
  - Recognition of patient safety risks
  - Prevention of medical errors
- No standards for presentation of data or user interface design
  - EHR training is generic and basic
  - Allows for individual workarounds

# Measures of Successful EHR Use?

- Simple use (Can I find “A” and “B”?)
- Efficiency (How fast can I find A and B?)
- Pattern Recognition (Does A lead to B?)
- Recognition of Unexpected (You know A leads to B, but do you realize that A is really C?)
- For each, should it be
  - Context dependent or independent?
  - Data dense or data poor?

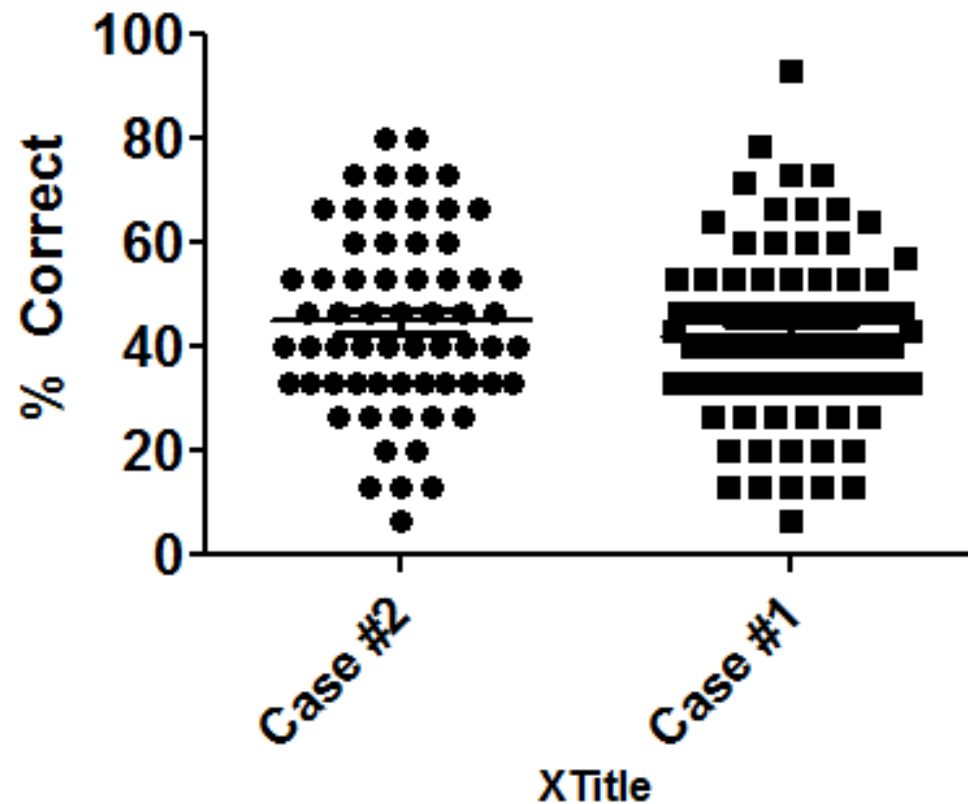
# Barriers to Safe and Effective EHR Use

- Little user interface design science focused on data mgmt
- Large amount of data per patient
  - Can you see the forest through the trees
- Need for standardization of patient care coupled with uniqueness of each individual/enivironment
- Training cases are simple, data poor, don't test cognitive processing
- Alert Fatigue (ICU pt 150-200 EHR alerts/day)
- Data fragmentation/over-customization
- Cognitive errors – knowing what's important

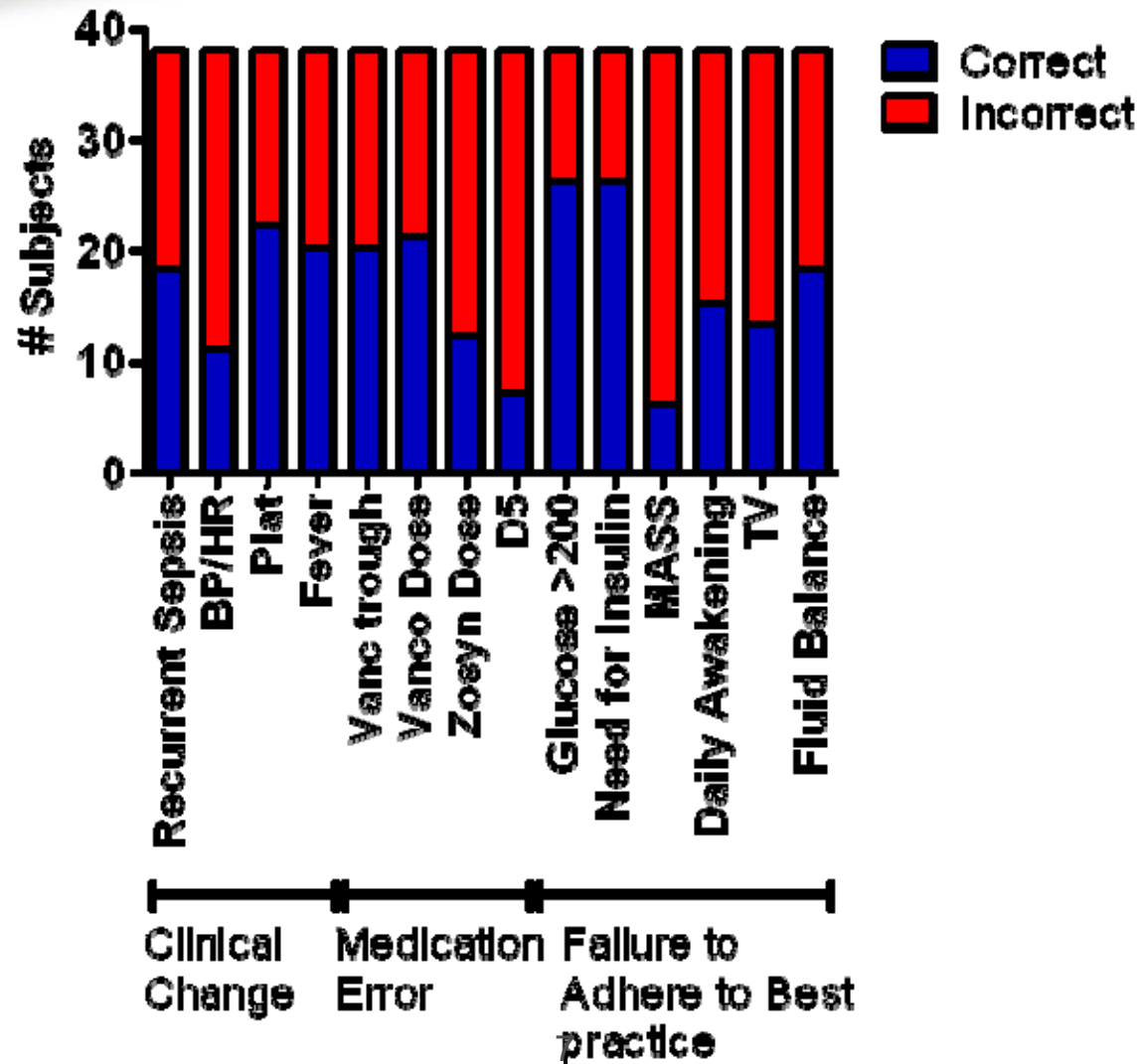
# Methods

- Trainees
  - Given written hx, relevant clinical info
  - Given 10 min to gather data in ICU to recapitulate environment (lights, noise, etc)
  - Then present case as if giving daily plan and sign-out for weekend
- Graded on # of items recognized within the case
- Immediate “debriefed” on appropriate case finding, EHR best practices, etc.
- Subjects could be tested again > 1 wk later with different case

# Results: Trainees fail to recognize patient safety issues

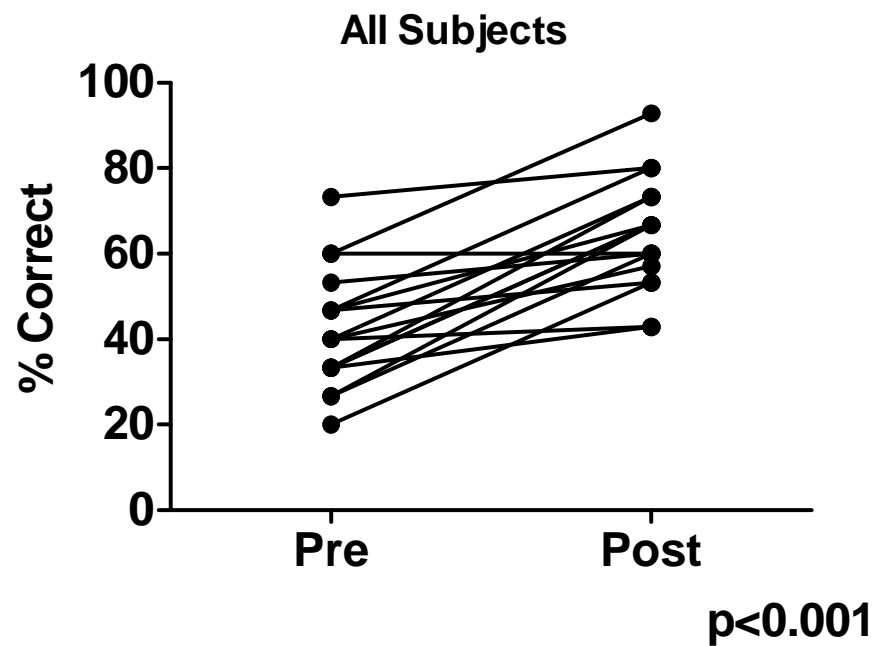


# Results: Little consistency on error recognition



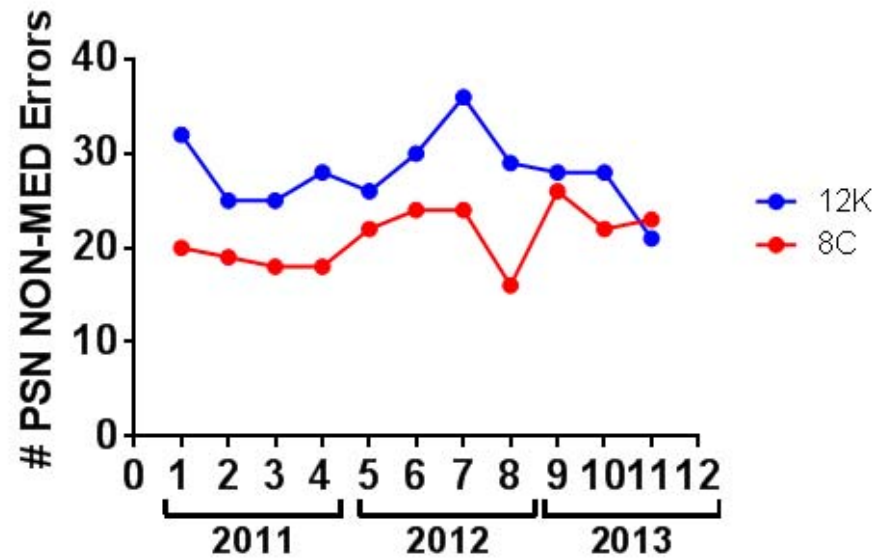
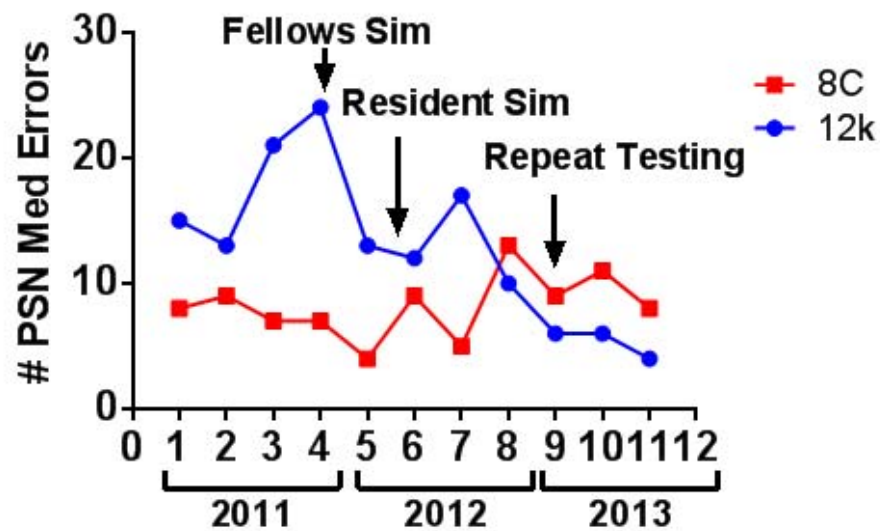
# Repeat Testing: Participation improves EHR use

**A.**



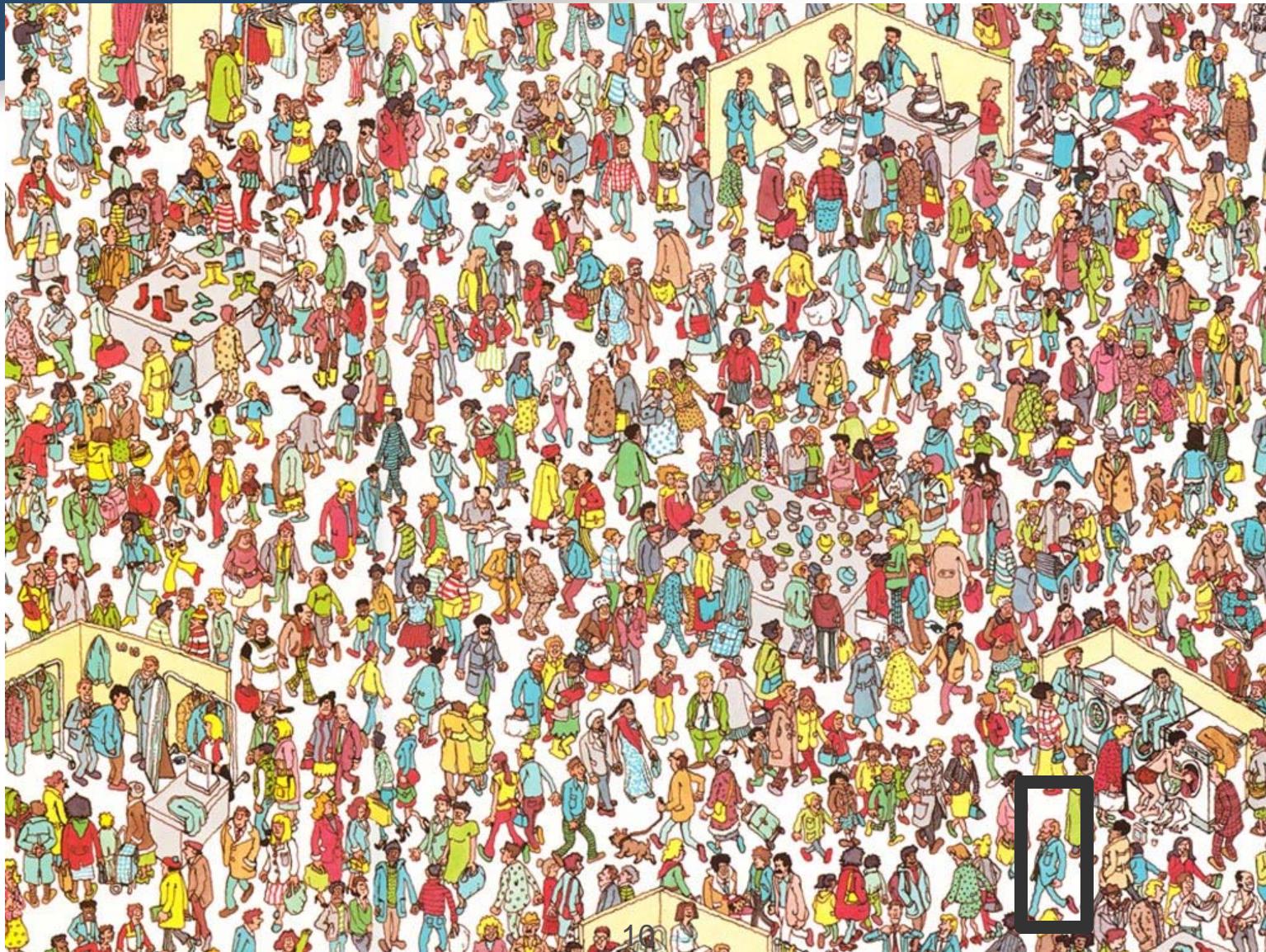


# Results: Impact on outcomes?





# Why are we so poor?



# Next Steps: Building User Interface Science

- Talk aloud studies
  - Biases cognitive processing
- Screen Tracking
  - What screens and how often? What did you look at?
- Eye-Tracking
  - Where you look and in what order
    - Used in menu and website design





**Kardashian, Kandy V** MRN: 06381492 Sex: Female [1] Allergies: Iso: (None) Wt: 105 kg Alerts  
DOB: 1/6/1942 Age: 71 y.o. Not on File Bed: 12KI / pool / NONE Code: Full Code Ins: BLUE CROSS OF OR

ICU Accordion

Vitals Order Review MAR Labs Culture Results Vital Signs Glucose Recent Results ICU Accordion

Report: ICU Accordion

- Snapshot
- Patient Summary
- Chart Review
- Results Review
- Growth Chart
- Demographics
- Problem List
- History
- PCP/Care Teams
- MAR
- Allergies
- Synopsis
- Intake/Output
- Doc Flowsheets
- Notes
- Orders Manager
- Admission
- Transfer
- Rounding
- Surgical Orders
- Discharge
- Day Procedure

ICU Accordion [ 02/06/13 1401 - 02/07/13 1800 ] in 2hr interval													
Today													
Yesterday 1401 - Today 1800													
24 hrs 12 hrs 8 hrs 6 hrs 4 hrs 2 hrs 1 hr 15 min 1 min													
Date: 02/06 0001 - 02/07 0000													
2 hrs: 1401 1601 1801 2001 2201 0001 0201 0401 0601 0801 1001 1201 1401 1601													
General Comments													
General Comments													
IV fluids given													
Vitals													
Temperature	37.8 (100)*	38.1 (100.6)*	38.4 (101.1)*	38 (100.4)*	37.8 (100)*	37.9 (100.2)*	38.1 (100.6)*	37.9 (100.2)*	38 (100.4)*				
Pulse	96*	107*	101*	93*	93*	105*	114*	121*	118*				
Resp	24*	24*	24*	24*	24*	24*	24*	24*	28!				
BP	106/62*	97/70*	96/61*	95/61*	102/64*	93/67*	91/61*	92/55!	90/50*				
BP Mean	76*	79*	73*	72*	77*	76*	71*	67*	63*				
Vent Settings													
Vent Mode	Vol A/C			Vol A/C			Vol A/C						
VT Set	440			440			440						
FI02	80			65			65						
Vent Readings													
PEEP	20			18			18						
Cycle Parameters													
PBW				49.7									
Plat Press	30			34			36						
Oxygenation													
FI02	80			65			65						
O2 Sat	89*	91*	93*	92*	93*	90*	95*	91*	90!				
I/O Totals													
Total In	304	304	354	304	304	354	304	304					
Cumulative In	2932	3236	3590	3894	4198	354	658	962	962	962	962	962	962
Total Out	118	138	124	91	111	102	115	118					
Cumulative Out	951	1089	1213	1304	1415	102	217	335	335	335	335	335	335
I/O Net	186	166	230	213	193	252	189	186					
I/O Cumulative Net	1981	2147	2377	2590	2783	252	441	627	627	627	627	627	627
Urine Output													
Urine Output	118 mL*	138 mL*	124 mL*	91 mL*	111 mL*	102 mL*	115 mL*	118 mL*					
Common Labs													
WBC		25.6					26.1						
Hgb		10.6					10.3						
Hct		31.8					31.2						
Plt		194					162						
Na		138					139						
K		4.3					4.6						
Cl		106					105						
CO2		21					20						
BUN		26					24						
Cr		1.11					1.09						
Glucose		299					314						

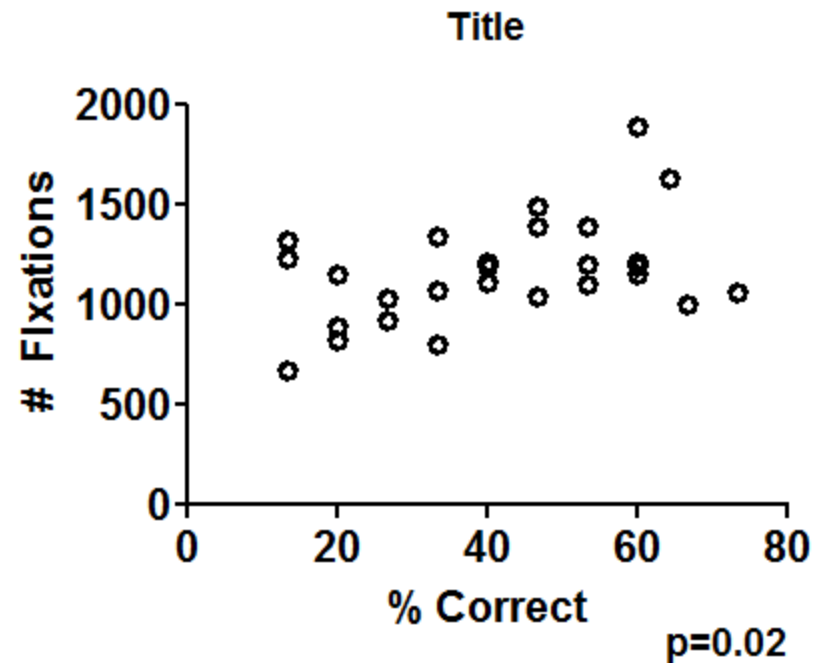
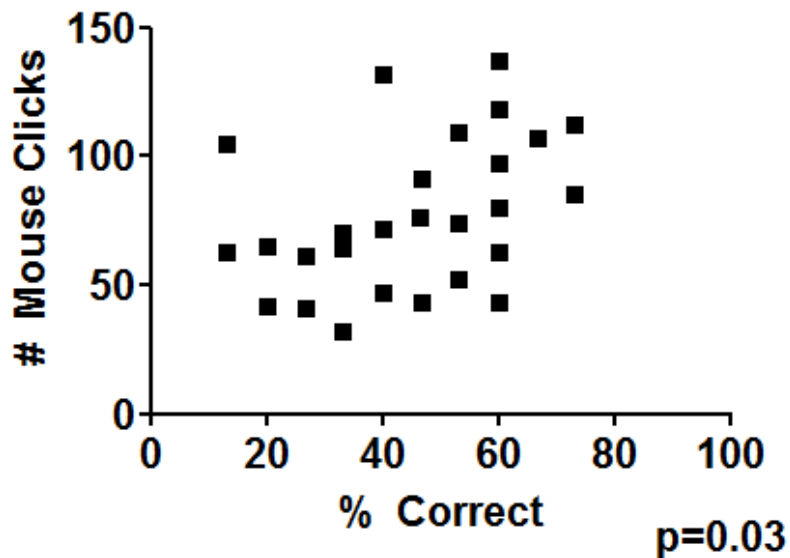
# Data Analysis

- We get simple screen logs, counts of mouse clicks, keystrokes etc...
- Videos scored manually for screen visited, and items viewed
  - Composite score for total # times items within case are viewed
- 100% agreement between 3 observers for data seen outside of notes (80% within notes)
- All videos scored by 1 member of study team blinded to performance on simulation

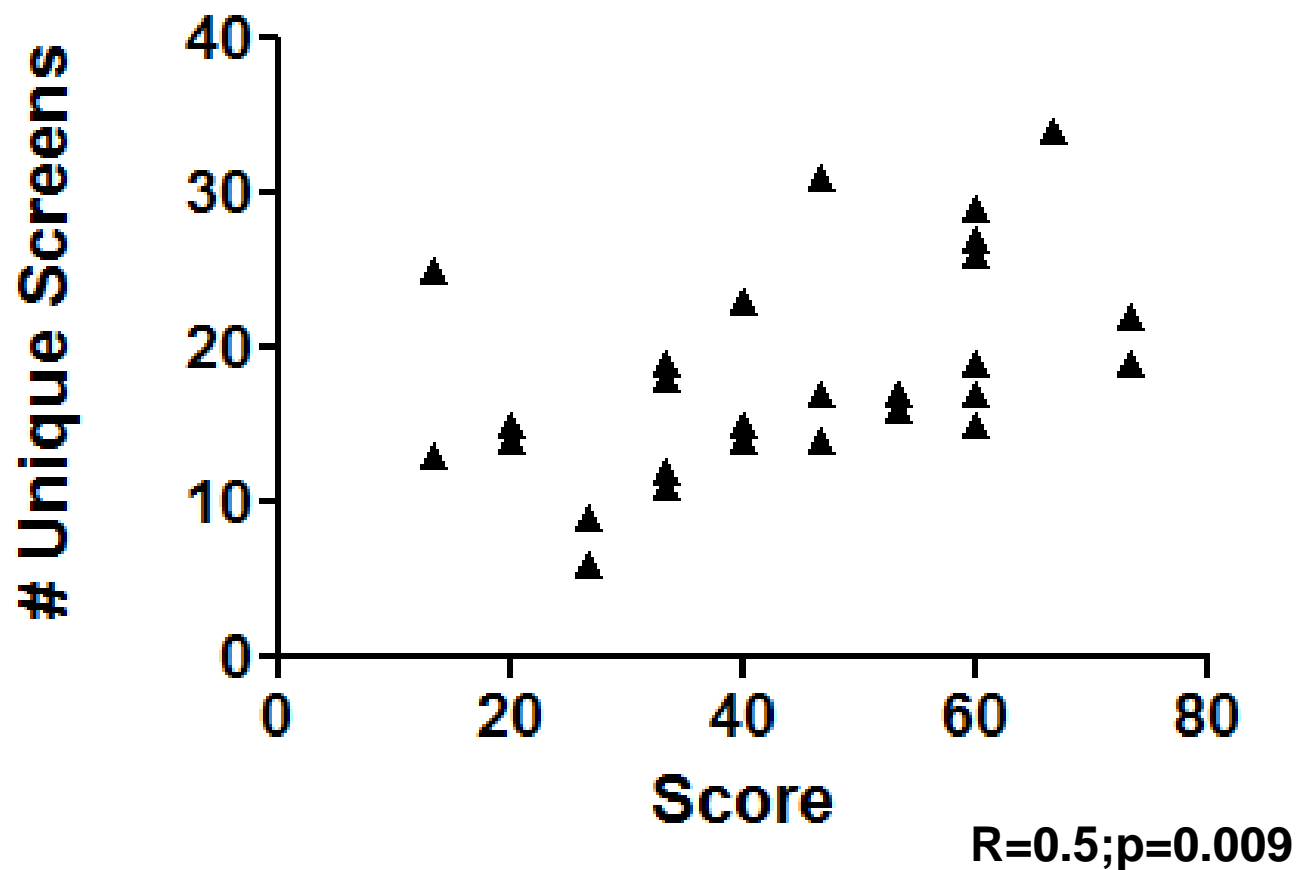
Participant  
t: 5

	Screens visited	pip/tazo dose glance	pip tazo intense	vanco dose glance	vanco intense	D5 IV viewed?	>24 hr creatinine viewed	WBC Trend Viewed	therapeuti c drug monitorin g viewed?	plasma glucose viewed?	fever longitudin ally <24 H	>24 H fever longitudin ally viewed	hemodyn amics longitudin ally <24 H	>24 hr Hemodyn amics viewed longitudin ally	Plat Press viewe?	Net I/O?	MASS score in Doc Flowsheet ?	Time Stamp
1	5																	:04
2	10																	:09
3	10																	
4	10																	
5	10																	
6	18																	:21
7	2										1		1					:26
8	6															1		1:36
9	22																	2:11
10	2																	2:13
11	17																	2:16
12	23		1			1												2:34
13	1							1		1								3:55
14	10																	4:54
15	10														1			
16	22																	5:29
17	9																	5:33
18	2							1							1			5:51
19	1																	6:25
20	10																	6:38

# Results: More through correlated with better performance

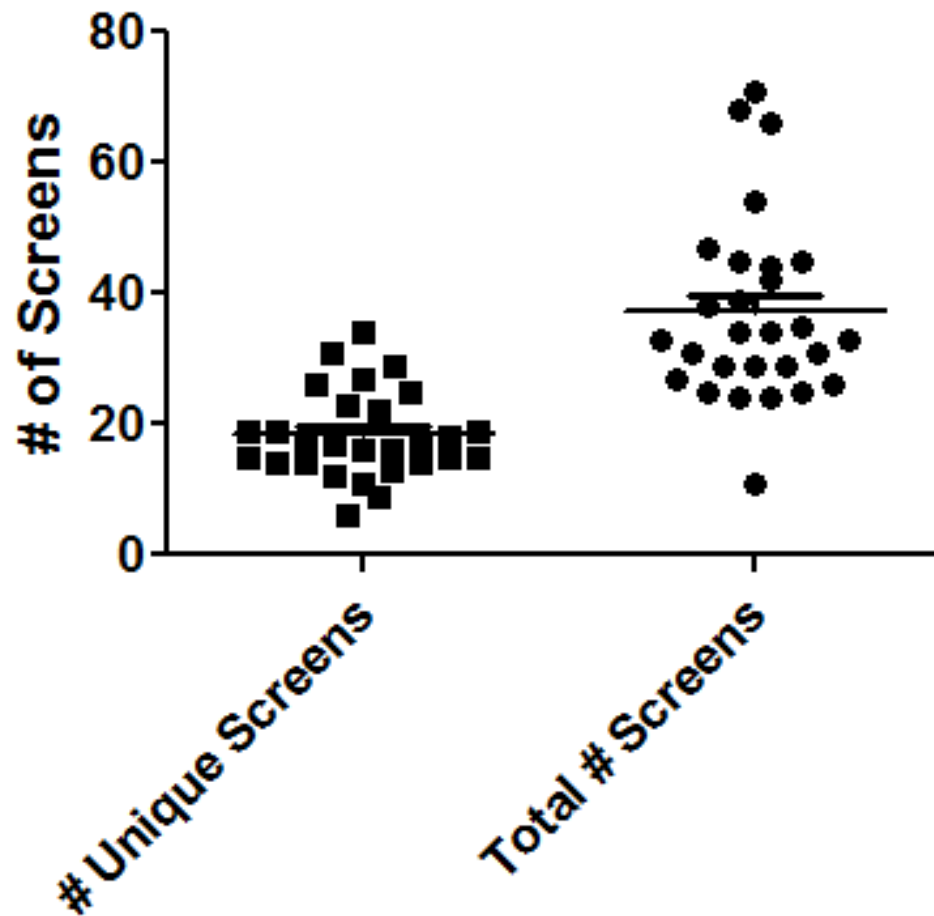


## Results: More through correlated with better performance



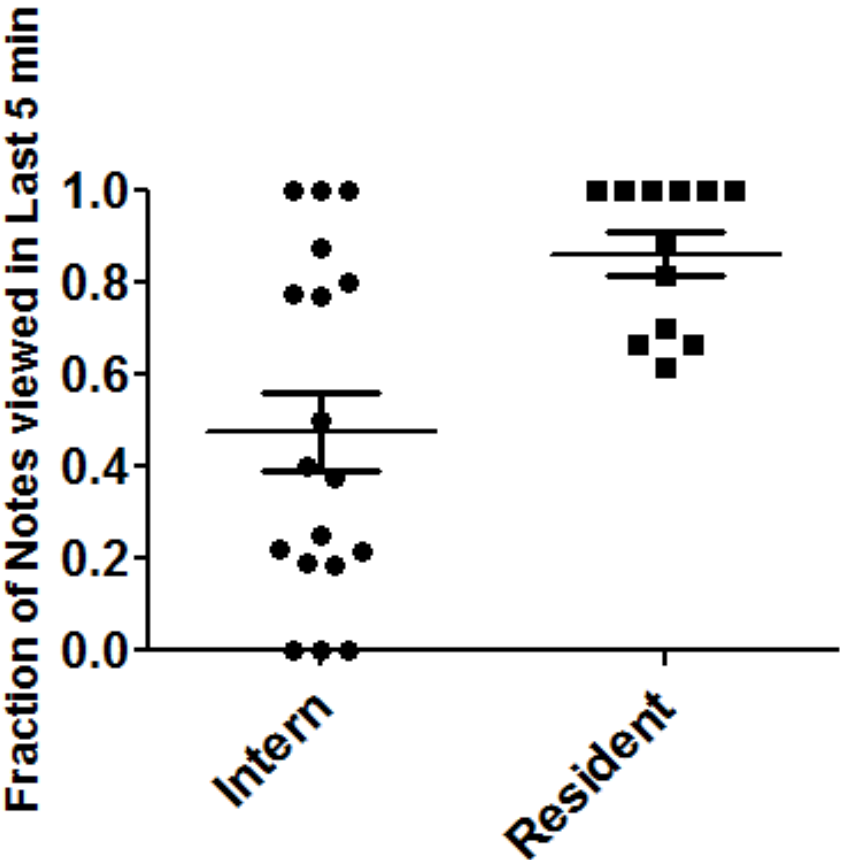


# Results: Data fragmentation

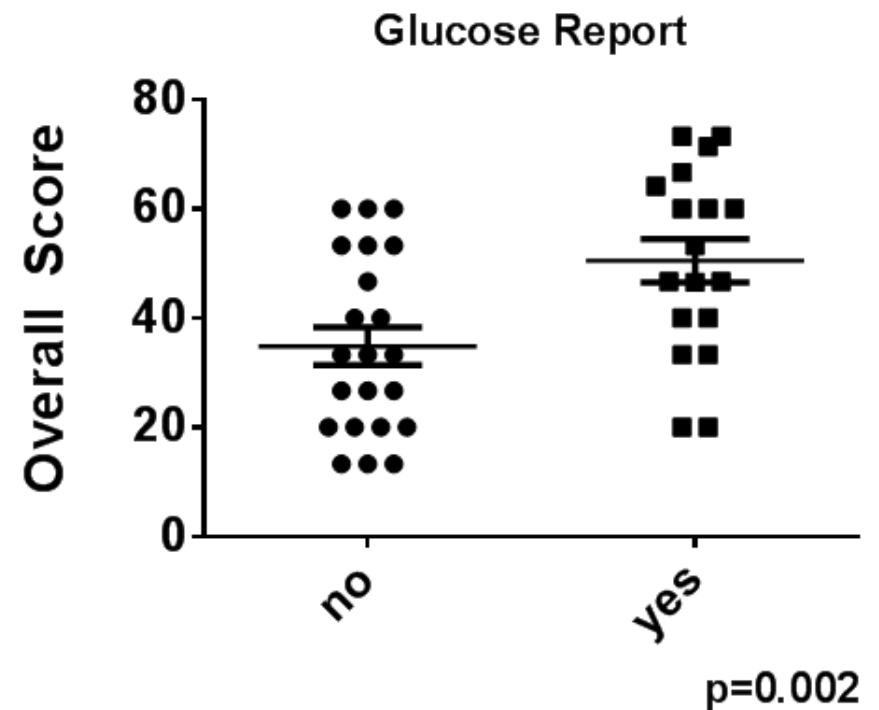
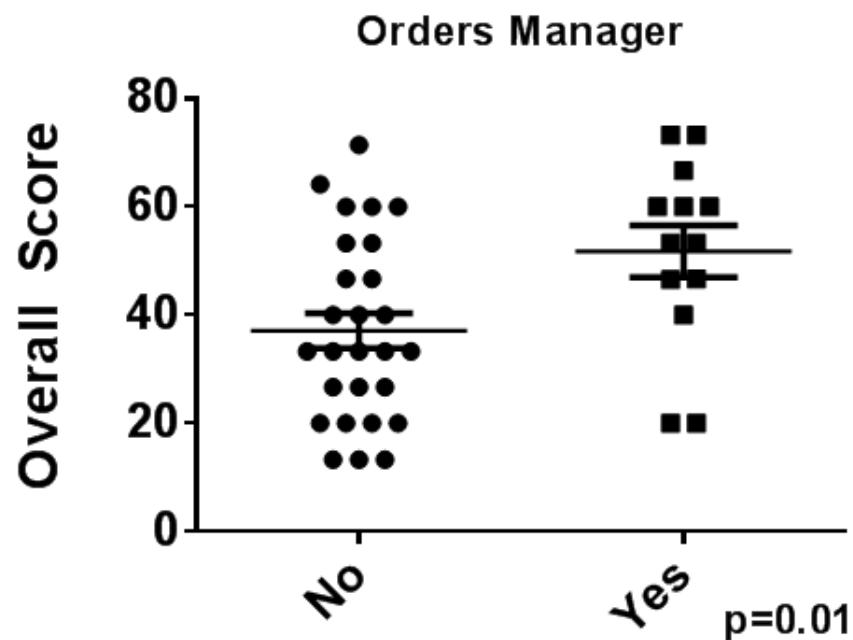


38 Users with 105 Individual Screens<sup>17</sup>

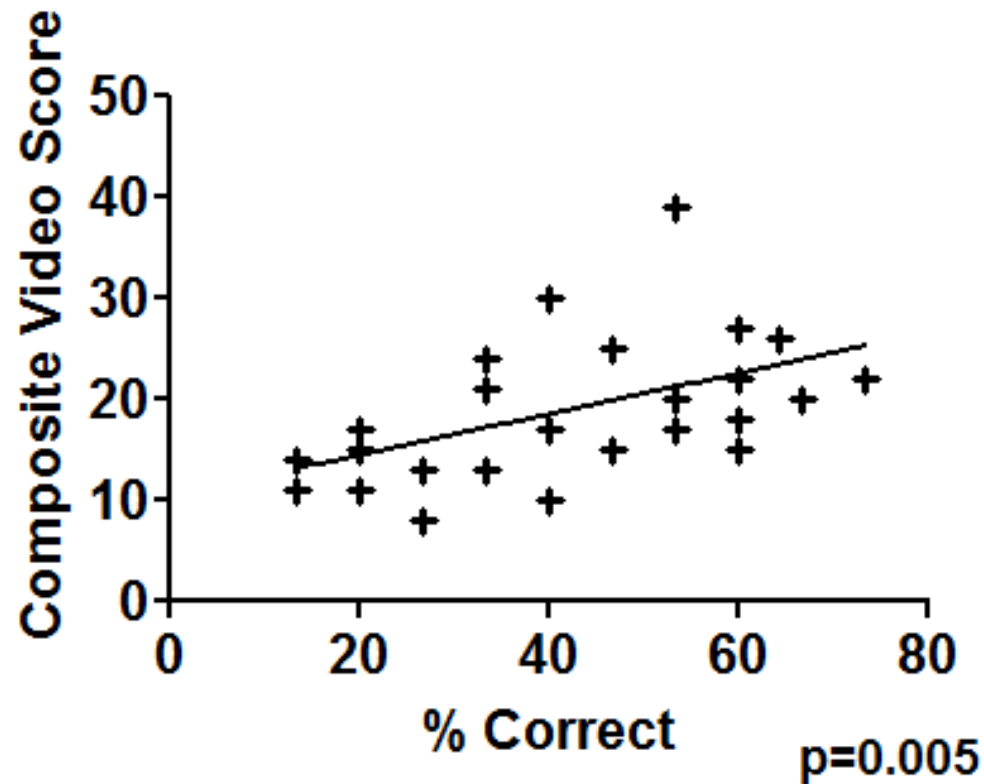
## Results: Chart note review



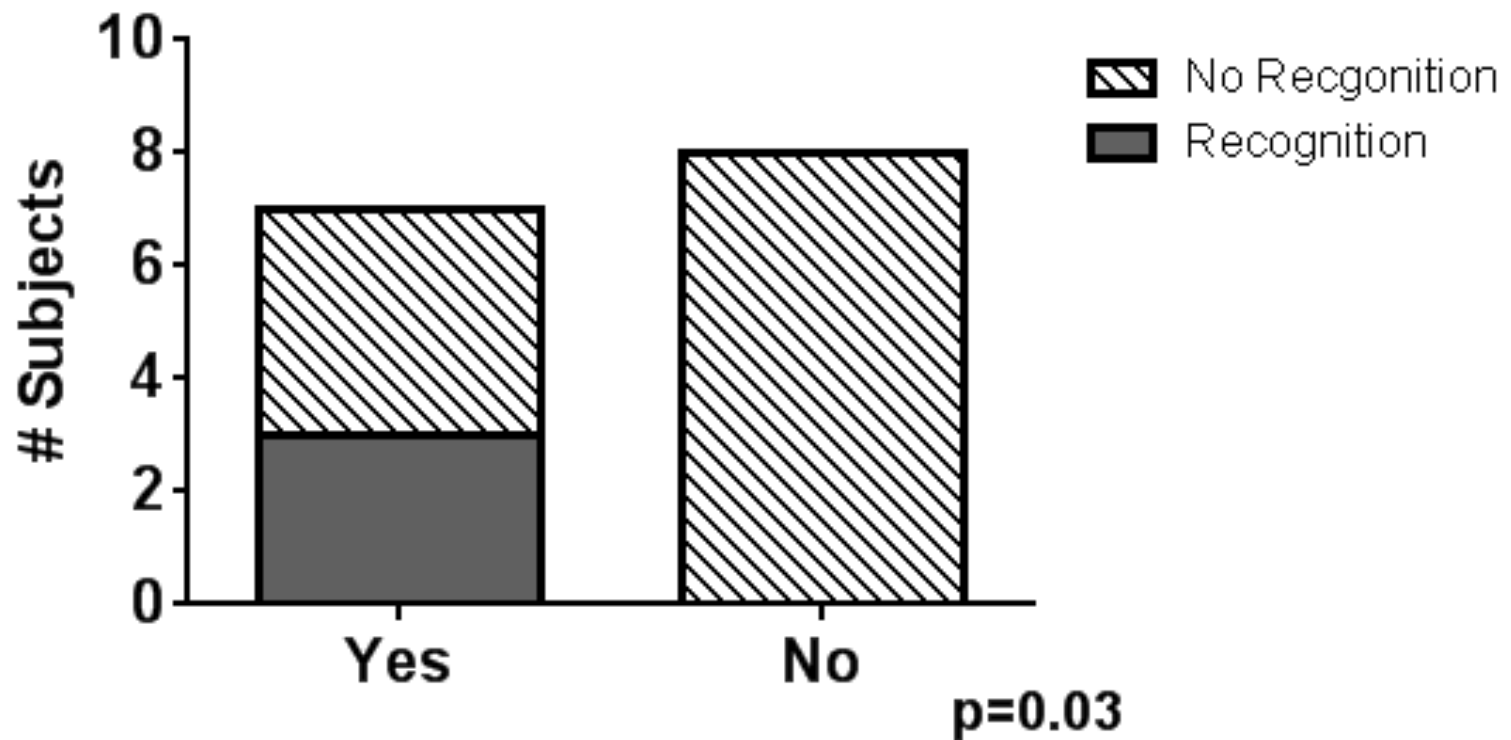
# Results: Identification of high yield screens



# Results: Eye-tracker score correlates with performance in simulation



# How One Views Data Affects Cognition



# Limitations

- Note not created
- Independent of normal rounds structure
- No evidence of implementation of plan
- Unclear what impact if any, interprofessional team would have on error recognition

# Best Practice for ICU Rounds

- Interprofessional Rounds, including RN and RT
- Multiple studies document improved cost, improved morbidity and patient satisfaction with interprofessional rounds
- Multiple barriers, including information retrieval and EHR
  - Both increase time and decrease communication
- Little data in controlled settings to determine whether improved error recognition by the group
  - Swiss chess or Cheese cloth

# Impact of IP Rounds in ICU (Oleary 2010)

**Table 4. Effect of SDR on Adverse Events, by Category**

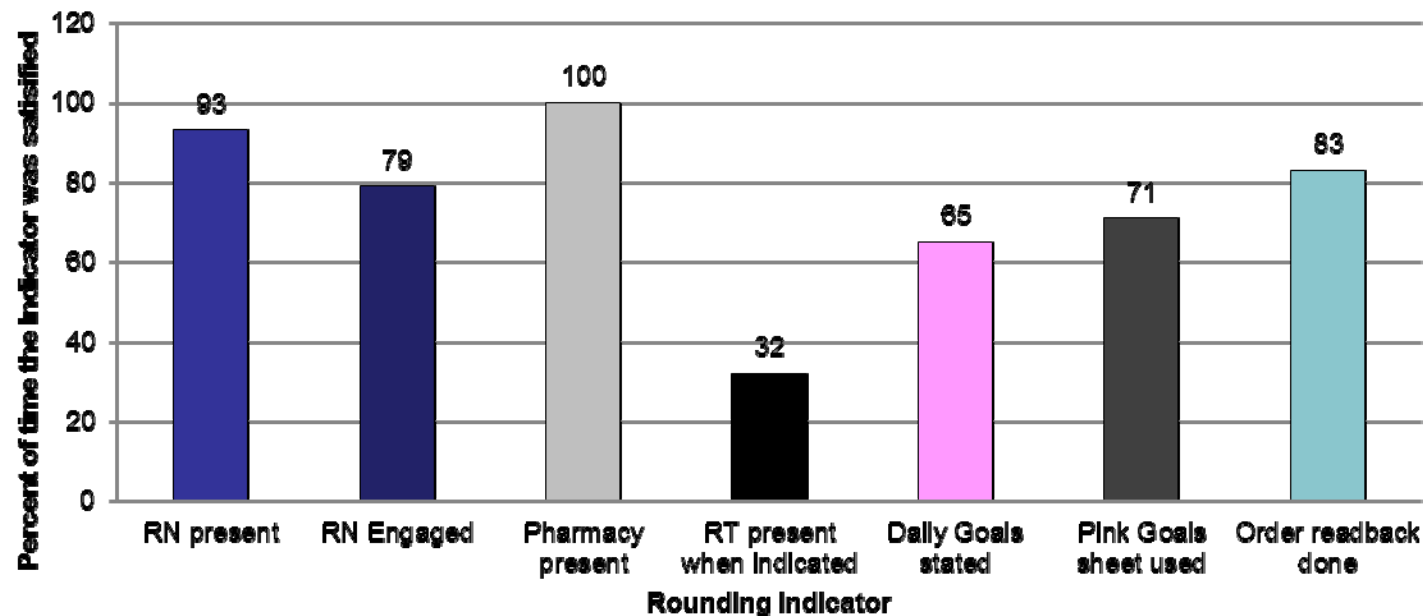
Category of Adverse Events	Control Unit, No. (n=63)	Intervention Unit, No.	
		Pre-SDR (n=69)	Post-SDR (n=35)
Adverse drug event <sup>a</sup>	33	31	14
Adverse event not drug related	30	38	21
Manifestation of poor glycemic control	9	15	4
Hospital-acquired infection	5	2	3
Operative/procedural injury	2	5	2
Pressure ulcer	5	2	1
Delirium	1	2	3
Fall	1	3	2
Venous thromboembolism	2	1	0
Acute renal failure	0	1	0
Other	5	7	6



# OHSU IP Rounds

- RN and pharmacist engaged

**Satisfactory Completion of Rounding Indicators**



# RN and MD are Different

- RNs like EHRs more often than MDs
- EHR has more dramatic affects on efficiency for MDs (Poissant)
- Only 46% of handoff items overlap in data transmitted during handoff (Collins)
- RNs unaware of abnormal vitals in 43% of ward patients (Fuhrman 2012)
- 25% of goals stated in rounds are not present in EHR (collins 2009)

# Simulation Improves Teamwork in ICU (Frengley CCM 2011)

Table 1. Scores for teamwork and components of teamwork in the two groups in airway and cardiac assessment simulations

Item	Simulation Type	Intervention Group	Preintervention Score	Postintervention Score	Difference	Confidence Interval Difference	<i>p</i>
Overall teamwork behavior	Airway	Cardiac	4.284	5.299	1.015	0.572–1.458	<.001
		Airway	4.088	5.216	1.129	0.619–1.638	<.001
	Cardiac	Cardiac	4.100	5.000	0.900	0.531–1.268	<.001
		Airway	3.950	4.700	0.751	0.319–1.182	.002
Leadership and team coordination	Airway	Cardiac	4.913	5.603	0.690	0.284–1.097	.002
		Airway	4.635	5.643	1.008	0.586–1.430	<.001
	Cardiac	Cardiac	4.747	5.444	0.697	0.397–0.997	<.001
		Airway	4.474	5.159	0.685	0.378–0.992	<.001
Verbalizing situational information	Airway	Cardiac	4.101	4.820	0.720	0.429–1.010	<.001
		Airway	4.086	4.860	0.774	0.441–1.107	<.001
	Cardiac	Cardiac	4.257	4.884	0.427	0.085–0.769	.017
		Airway	4.097	4.615	0.517	0.191–0.844	.004
Mutual performance monitoring	Airway	Cardiac	3.031	3.150	0.120	–0.286–0.525	.545
		Airway	3.200	3.192	–0.007	–0.491–0.476	.974
	Cardiac	Cardiac	3.273	3.062	–0.211	–0.543–0.122	.200
		Airway	3.205	3.349	0.144	–0.322–0.610	.526

# Measures of Teamwork



**STORC**  
OB Safety  
Initiative

## Clinical Teamwork Scale

### Overall

1. How would you rate teamwork during this delivery/emergency?

Not Relevant

☐

Unacceptable

0

Poor

1 2 3

Average

4 5 6

Good

7 8 9

Perfect

10

### Communication

2. Overall Communication Rating:

Not Relevant

☐

Unacceptable

0

Poor

1 2 3

Average

4 5 6

Good

7 8 9

Perfect

10

3. Orient new members (SBAR)

☐

0

1 2 3

4 5 6

7 8 9

10

4. Transparent thinking

☐

0

1 2 3

4 5 6

7 8 9

10

5. Directed communication

☐

0

1 2 3

4 5 6

7 8 9

10

6. Closed loop communication

☐

0

1 2 3

4 5 6

7 8 9

10

### Situational Awareness

7. Overall Situational Awareness Rating:

Not Relevant

☐

Unacceptable

0

Poor

1 2 3

Average

4 5 6

Good

7 8 9

Perfect

10

8. Resource allocation

☐

0

1 2 3

4 5 6

7 8 9

10

9. Target fixation

Yes

☐

No

☐

### Decision Making

10. Overall Decision Making Rating:

Not Relevant

☐

Unacceptable

0

Poor

1 2 3

Average

4 5 6

Good

7 8 9

Perfect

10

11. Prioritize

☐

0

1 2 3

4 5 6

7 8 9

10

### Role Responsibility (Leader/Helper)

12. Overall Role Responsibility (Leader/Helper) Rating:

Not Relevant

☐

Unacceptable

0

Poor

1 2 3

Average

4 5 6

Good

7 8 9

Perfect

10

13. Role clarity

☐

0

1 2 3

4 5 6

7 8 9

10

14. Perform as a leader/helper

☐

0

1 2 3

4 5 6

7 8 9

10

### Other

15. Patient friendly

Not Relevant

☐

Unacceptable

0

Poor

1 2 3

Average

4 5 6

Good

7 8 9

Perfect

10

# Interim Summary

- EHR are main portal for information retrieval
- ICU is especially susceptible to EHR related errors
- Physicians have significant blindspots in recognition of EHR related errors
- Interprofessional rounds are Best practice in ICU
- Each member of IP team accesses data differently and has different workflow

# Aim #1-Understand EHR Usability and Performance among IP Staff

- Daytime MICU RNs will undergo EHR simulation with same case as used for housestaff
- Usability tracked with screen and eye tracker
- Simulation will be performed by RN champion (Alycia Solis-Rivera)
- Same principal for all hospital pharmacists and pharmacy interns

# Endpoints

- # safety issues recognized within case
  - Data will be compared within and between professions
- Determine if eye tracker composite score is predictive of safety issue recognition among other professions
- Establish (if possible) patterns of screen utilization associated with extremes in performance
- To compare FHR workflow between

## Aim #2-Creation of Interprofessional ICU Rounds Simulation

- New simulation case created in EHR with similar characteristics as prior
- Pharm, MD (Resident) and RN given signout and review case
- Team will “round” using MICU rounding script
- Additional resident to put in orders on WOW
- Fellow to serve as role of attending



# Endpoints

- # of action items recognized by each member of the IP team and for team as a whole
  - Verbalized plan and what is implemented in EPIC
- Measures of teamwork using IP teamwork scale (adopted from STORC study)
  - Currently used for SCITT

## AIM #3-Determine Clinical Impact of Simulation Training

- ICU rounds to be audited for MICU and CCU for assessment of teamwork using STORC scale throughout study period
  - CCU to serve as control unit (may need to change with ICU realignment)
- PSN safety net reports

# Acknowledgements

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