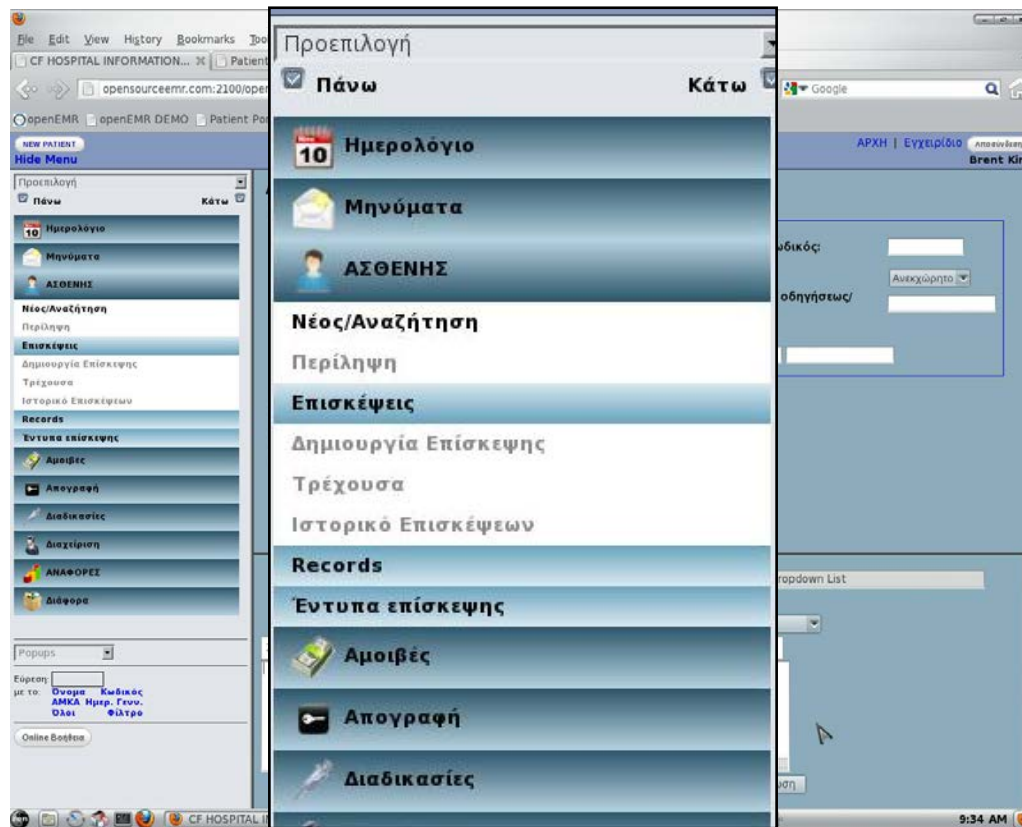


# Data Before It's Big: EHR as Visualization Platform

Dr. Peter Killoran

The first time I used an EHR  
(circa 2005)

You've got to be kidding me....



# Disclaimer

Screenshots used in this presentation were obtained using Google images without consideration of the vendor.

***Images are shown out of their original context and without consideration for their intended purpose.***

The goal is to illustrate challenges faced by clinicians when interpreting individual patient data rather than critique a particular product.

An Intern's Challenge (circa 2008)  
Did the Lasix make him pee?

Information needs

**Medications Administration Record (MAR)**

Martinez, Olivia - 0070024051 Opened by Zimmers, Katlyn

Task Edit View Patient Chart Links Options Help

Patient List PAL Staff Assignment New Sticky Note View Sticky Notes Medication Administration Adhoc Calculator Charges Charge Entry Exit PM Conversation Message Sender Depart Patient Education

PHLaunch Explorer

Martinez, Olivia x

Martinez, Olivia DOB:03/12/40 Age:71 years Sex:Female MRN:0070024051 Attending:Richards, Mario  
Allergies: penicillins Wt: Inpatient FIN: 40000016439 [Admit Dt: 05/18/2011 7:30] Loc: Adult II Medical, School of Health Prof

Menu

- Diagnoses & Proble...
- Allergies + Add
- Results Review
- Notes + Add
- Form List
- Direct Chart / I&O
- Orders + Add
- MAR
- MAR Summary
- Medication Profile
- Tasks / Interventions
- Histories
- Immunization Schedu...
- Growth Chart
- Reference
- Demographics

MAR

22 May 2011 21:05 CDT - 24 May 2011 21:05 CDT (Clinical Range)

Show All Rate Change Documen...

Time View

- Scheduled
- Unscheduled
- PRN
- Continuous Infusions
- Future
- Discontinued Scheduled
- Discontinued Unscheduled
- Discontinued PRN
- Discontinued Continuous Infusions

Medications

Medication	05/23/11 21:05 CDT
PRN acetaminophen 650 mg, PR, q4hr, PRN for fever 1 day(s). Start date 05/18/11 9:00:00 CDT, Stop date 05/19/11 8:59:00 CDT, may also give orally for temp > 101 F	PRN 650 mg Not given within 5 days
acetaminophen Temperature Oral	
Pain Intensity	
Medication Administration Follow Up	
PRN morphine 2 mg, IV Push, q4hr, PRN for pain 1 day(s). Start date 05/18/11 9:00:00 CDT, Stop date 05/19/11 8:59:00 CDT	PRN 2 mg Not given within 5 days
morphine	
Numeric Pain Scale	
Pain Thermometer Scale	
Present Pain Inventory Scale	
Verbal Descriptor Pain Scale	
Medication Administration Follow Up	
PRN ondansetron (Zofran) 4 mg, IV Push, q4hr, PRN for nausea/vomiting day(s). Start date 05/18/11 9:00:00 CDT, Stop date 05/19/11 8:59:00 CDT	PRN 4 mg Not given
ondansetron	
Continuous Infusions	
Dextrose 5% with 0.45% NaCl 1000 mL Total volume (mL): 1000, Infuse at: 125 mL/hr, day(s). Start date 05/18/11 9:00:00 CDT, Stop date 05/19/11 8:59:00 CDT, Routine, Infuse over: 8 hr	
Administration Information	
Dextrose 5% with 0.45% NaCl	

Order Info...  
Event/Task Summary  
Reference Manual...  
Med Request...  
Additional Dose...  
Create Admin Note...  
Alert History...

Therapeutic Class View

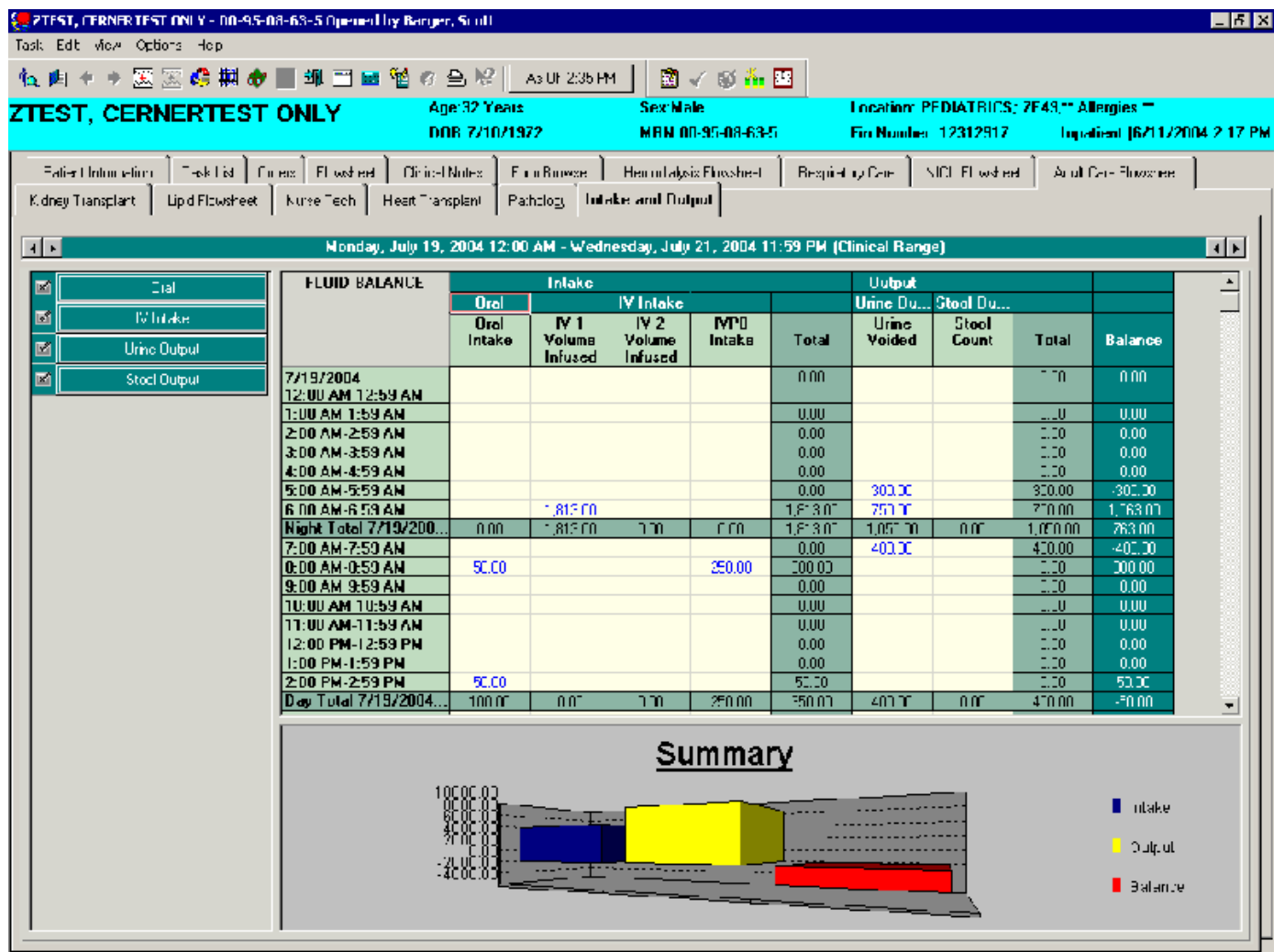
# An Intern's Challenge (circa 2008)

## Did the Lasix make him pee?

Information needs

Medications Administration Record (MAR)

**Input and Output Flow sheet**





# An Intern's Challenge (circa 2008)

## Did the Lasix make him pee?

Information needs

Medications Administration Record (MAR)

Input and Output Flow sheet

**Vital Signs**

Intergy EHR by Sage: Madison Medical Center P. A. - David Ford
Supervising Provider: Depak E. Shah

IEHR
Patient
Tools
Setup
Medscape
Reports
Help

Provider Desktop
Patient Chart
Orders/Charges
Encounter Note

Aaron, Alice B.
03/11/1936 67yo F
ALGY

Summary
Cardiology Summary
Patient Info
Health
Immunizations
Tasks
Problems
Meds
Allergies
Vitals
Documents
Lab R

View : Last 10 results
Expand Blood Pressure
Graph

Vital Name	04/08/03 04:10pm	03/21/03 09:32am	02/06/03 09:03am	01/29/03 11:17am	11/25/02 10:49am	11/13/02 11:34am	03/21/02 09:30am	02/21/02 09:30am
<input type="checkbox"/> All Items								
<input type="checkbox"/> Systolic BP-Sitting (mmHg)	160	150	130	170	140	130	132	136
<input type="checkbox"/> Diastolic BP-Sitting (mmHg)	88	88	80	90	80	80	76	78
<input type="checkbox"/> Pulse Rate (bpm)	80	64	64	76	72	78	76	82
<input type="checkbox"/> Respiration Rate (per min)	38	30	24	36	32	24	24	20
<input type="checkbox"/> Temp-Oral (F)	102.5	98.8		98.3	98.7	98.8	98.2	97.8
<input type="checkbox"/> Temp-Tympanic (F)			98.6					
<input type="checkbox"/> Height (in)	65	65	65	65	65	65	65	65
<input type="checkbox"/> Weight (lbs)	175	174	170	172	170	170	170	172
<input type="checkbox"/> Body Mass Index	29.1	29.0	28.3	28.6	28.3	28.3	28.3	28.6
<input type="checkbox"/> Body Surface Area	1.87	1.86	1.85	1.86	1.85	1.85	1.85	1.86
<input type="checkbox"/> Vitals Notes	Patient's te...							

New
Edit

# An Intern's Challenge (circa 2008)

## Did the Lasix make him pee?

Information needs

Medications Administration Record (MAR)

Input and Output Flow sheet

Vital Signs

**Laboratory Results**

Flowsheet:	HIV FLOWSHEET	Level:	HIV FLOWSHEET	Table Group List			
04 March 2008 12:39 - 05 March 2010 12:39 (Clinical Range)							
Navigator	HIV FLOWSHEET		2/25/2009 14 41	2/25/2009 14 40	5/23/2008 10 24	3/25/2008 9 38	3/25/2008 9 36
<input checked="" type="checkbox"/> HEMATOLOGY - HIV VIEW	<input checked="" type="checkbox"/> Alkaline Phosphatase			64	66		71
<input checked="" type="checkbox"/> CHEMISTRY - HIV VIEW	<input checked="" type="checkbox"/> Amylase				101 H		
<input checked="" type="checkbox"/> MICRO-VIROLOGY - HIV VIEW	<input checked="" type="checkbox"/> Lipase				43		
<input checked="" type="checkbox"/> FLOW CYTOMETRY - HIV VIEW	<input checked="" type="checkbox"/> AST (SGOT)		20		34		35
	<input checked="" type="checkbox"/> ALT (SGPT)		27		40		50 H
	<input checked="" type="checkbox"/> Bilirubin, Total		0.2		0.3		0.3
	MICRO-VIROLOGY - HIV VIEW						
	<input checked="" type="checkbox"/> Hepatitis C Virus Genotyping						2* (m)
	Hepatitis C Virus Genotyping Interpretation						TEST PERFORMANCE
	HIV RNA Ultrasensitive		HIV 1 RNA N/A FOR LABCOF			HIV 1 RNA N/A FOR LABCOF	
	HIV RNA Ultrasensitive Interpretation						
	FLOW CYTOMETRY - HIV VIEW						
	<input checked="" type="checkbox"/> % Cd4+ T Lymph			21 L			23 L
	<input checked="" type="checkbox"/> Abs Cd4+ T Lymph			427 L			389 L
	<input checked="" type="checkbox"/> % Cd8+ T Lymph			54 H			56 H
	<input checked="" type="checkbox"/> Abs Cd8+ T Lymph			1,097 H			946 H
	<input checked="" type="checkbox"/> Cd4/Cd8 Ratio			0.389 L			0.411 L

# An Intern's Challenge (circa 2008)

## Did the Lasix make him pee?

Aug 619-

Lasix — 1000

WP  $71-79 = 400$

UP  $79-71 = 1200$

Run in 1000

---

— 200

vs 160/90  $\rightarrow$  130/70

$\leftarrow \oplus$  3.8 — 3.4

$\rightarrow$  Subcut 20 mEq

**CONTEXT IS CRITICAL**

# My EHR needs (today)

## Patient Evaluation

What's the current state?

Is treatment effective?


What's the next step?

Visual display should amplify (and not impair)  
cognition

# A Critical Care EHR (circa) 2006




Some things could have been better...



**CHRISTINE TEST**

31 year(s), Gender:F, Kg:55.0, Cm:172.7, BSA:1.65, 6 day(s) LOS

Medication allergies:  
Other allergies: ALMONDS; LATEX, NATURAL RUBBER  
Precautions:



Flowsheets

Real Time Variables

**Lab Results**

Medications

All Medications

All Fluids

Combined Med/Fluid Flowsheet

ICU Flowsheet

Nursing Assessments/Cares

Nursing Diagnosis/Education

Admission/Discharge

Cardiac Assist Devices

Labs/Interventions

Labs/Interventions II

Preventive Cares

Pain/Sedation

Hemodynamics

Pulmonary

Demographics

Resolution:  
1 hour

☒ Show only rows with data  
☒ Show subheadings

**Lab Results**

ICU (SICU)  
7/14/2006


06	07	08	09	10	11	12	13	14	15	16	17
<b>ARTERIAL BLOOD GASES</b>											
PH, ARTERIAL				7.36	7.31 L		7.55 H*	7.35			
PCO2, ARTERIAL				45	45		40 *	35			
PARTIAL PRESSURE O2, ARTE..				89	87		95 H*	88			
BASE EXCESS, ARTERIAL				2	0		1 *	2			
BICARBONATE, CALCULATED				33 H			39 H*				
TOTAL CO2, ARTERIAL				34 H	20 L		39 H*	24			
TEMPERATURE, ARTERIAL				36.5	37.3		38.0 *	37.2			
FRACTIONAL INSPIRED O2, ART				NOT S..	NOT S..		NOT S..	NOT S..			
PULSE OXIMETRY, ART				NOT S..	NOT S..		NOT S..	NOT S..			
END TIDAL CO2, ART				NOT S..	NOT S..		NOT S..	NOT S..			
BICARBONATE, ARTERIAL					20 L			24			
<b>VENOUS BLOOD GASES</b>											
<b>FINGERSTICK BLOOD GASES</b>											
<b>CRITICAL CARE/NICU LAB TESTS</b>											
SODIUM, WHOLE BLOOD				144			145				
TRANSPORT SODIUM, WHOLE ...					145						
POTASSIUM, WHOLE BLOOD				4.5							
TRANSPORT POTASSIUM, WB					5.4 H						
POTASSIUM, OTHER				2.5 *							
GLUCOSE, WHOLE BLOOD							400 R				
TRANSPORT GLUCOSE, WHOL..					350 R						
HEMOGLOBIN, CCL								10.4 L			
HEMATOCRIT, CALCULATED								29 L			
LACTIC ACID, WHOLE BLOOD							5.7 H*	4.5 H*			
BILIRUBIN TOTAL, WHOLE BLO..				0.9							
METHEMOGLOBIN								4.5 C*			
<b>HEMOGRAM (CBC) AND BLOO..</b>											
WHITE BLOOD CELL COUNT								17.0 R			
RED BLOOD CELL COUNT								3.13 L			
HEMOGLOBIN								9.5 R			

When were the blood gases done?

What are the ventilator settings?

Start

2 Pics Car...



5:17 PM

**DATA + CONTEXT = ACTION**

# CRAIG TEST

41 year(s), Gender:M, Kg:100.0, Cm:180.0, BSA:2.20, 4 day(s) LOS

Medication allergies: Aspirin; Cephalosporins; Codeine; Erythromycin; Morphine; Penicillin  
Other allergies:  
Precautions:



## Flowsheets

### Real Time Variables

### Lab Results

### Medications

### All Medications

### All Fluids

### Combined Flowsheet

### ICU Flowsheet

### Nursing Assessments/Cares

### Nursing Diagnosis/Education

### Admission/Discharge

### Cardiac Assist Devices

### Preventive Cares

### Pain/Sedation

### Hemodynamics

### Pulmonary

### Demographics

Resolution:

1 hour

☒ Show only rows with data

☒ Show subheadings

## Real Time Variables

ICU (SICU)

7/2/2006

01	02	03	04	05	06	07	08	09	10	11	12

## All Real-Time Variables

Real-Time Variables	01	02	03	04	05	06	07	08	09	10	11	12
Monitor Respiratory Rate per min.	9	12	14	14	15	10	11	8	12	16	23	23
Airway Respiratory Rate	18	13	14	14	22	16	11	17	13	18	0	
SpO2	99	100	100	100	100	99	99	100	99	82	100	100
ETCO2	33	29	28	27	28	30	30	36	36	17	31	
Heart Rate	74	77	74	76	57	77	66	68	76	94	67	61
Pulse Rate Pulse Oximeter	73	75	71	72	60	76	64	58	73	64	69	62
Systolic Arterial Pressure	134	134	150	123	133	105	140	145	144	145	147	154
Diastolic Arterial Pressure	60	58	69	58	59	46	65	71	66	83	67	65
Mean Arterial Pressure	83	81	93	79	81	65	89	94	94	108	93	90
***NON-INVASIVE MONITORING..	----	----	----	----	----	----	----	----	----	----	----	----
***MECHANICAL VENTILATION***	----	----	----	----	----	----	----	----	----	----	----	----
Mode	PSIMV	PSIMV	PSIMV	PSIMV	PSIMV	PSIMV	PSIMV	PS	PS	PS	PS	
Respiratory Rate Set SIMV	9	9	9	9	9	9	9	9				
Respiratory Rate Actual	9	15	14	14	11	9	12	3	6	15	31	
Tidal Volume Inspiratory	706	417	772	1012	798	778	1082	576	503	219	1637	
Tidal Volume Expiratory	849	479	866	828	885	851	765	622	518	905	0	
Minute Volume Exhaled	8.4	11.0	11.9	11.8	11.6	7.9	8.7	0.2	5.8	9.8	9.0	
Inspiratory Time Set	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Pressure Control Total	20	20	20	20	20	20	20	20				
PIP Measured	19	20	20	20	19	20	20	14	14	10	9	
Mean Airway Pressure	6	7	7	11	6	6	16	8	8	7	8	
Pressure Support	15	15	15	15	15	15	15	9	9	6	6	
PEEP	5	5	5	5	5	5	5	5	5	5	5	
FiO2-Vent	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
FiO2 For Apache	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
Rise Time %	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	
Peak Flow	dem	dem	dem	dem	dem	dem	dem	dem	dem	dem	dem	dem
Compliance Dynamic	45	24	49	63	51	49	69	58	50	35	369	
****AL ADMS***												

Vital Signs

Ventilator Settings

View/Chart

Start

11:18 AM

**WHAT'S THE PATTERN?**

# CRAIG TEST

41 year(s), Gender: M, Kg: 100.0, Cm: 180.0, BSA: 2.20, 4 day(s) LOS

Medication allergies: Aspirin; Cephalosporins; Codeine; Erythromycin; Morphine; Penicillin  
Other allergies:  
Precautions:



## Flowsheets

### Real Time Variables

### Lab Results

### Medications

### All Medications

### All Fluids

### Combined

### ICU Flowsheet

### Nursing

### Assessments/Cares

### Nursing

### Diagnosis/Education

### Admission/Discharge

### Cardiac Assist Devices

### Preventive Cares

### Pain/Sedation

### Hemodynamics

### Pulmonary

### Demographics

Resolution:

1 hour

☒ Show only rows with data

☒ Show subheadings

## Real Time Variables

ICU (SICU)

7/2/2006

01	02	03	04	05	06	07	08	09	10	11	12

## All Real-Time Variables

Real-Time Variables	01	02	03	04	05	06	07	08	09	10	11	12
Monitor Respiratory Rate per min.	9	12	14	14	15	10	11	8	12	16	23	23
Airway Respiratory Rate	18	13	14	14	22	16	11	17	13	18	0	
SpO2	99	100	100	100	100	99	99	100	99	82	100	100
ETCO2	33	29	28	27	28	30	30	36	36	17	31	
Heart Rate	74	77	74	76	57	77	66	68	76	94	67	61
Pulse Rate Pulse Oximeter	73	75	71	72	60	76	64	58	73	64	69	62
Systolic Arterial Pressure	134	134	150	123	133	105	140	145	144	145	147	154
Diastolic Arterial Pressure	60	58	69	58	59	46	65	71	66	83	67	65
Mean Arterial Pressure	83	81	93	79	81	65	89	94	94	108	93	90
***NON-INVASIVE MONITORING..	----	----	----	----	----	----	----	----	----	----	----	----
***MECHANICAL VENTILATION***	----	----	----	----	----	----	----	----	----	----	----	----
Mode	PSIMV	PSIMV	PSIMV	PSIMV	PSIMV	PSIMV	PSIMV	PS	PS	PS	PS	
Respiratory Rate Set SIMV	9	9	9	9	9	9	9	9				
Respiratory Rate Actual	9	15	14	14	11	9	12	3	6	15	31	
Tidal Volume Inspiratory	706	417	772	1012	798	778	1082	576	503	219	1637	
Tidal Volume Expiratory	849	479	866	828	885	851	765	622	518	905	0	
Minute Volume Exhaled	8.4	11.0	11.9	11.8	11.6	7.9	8.7	0.2	5.8	9.8	9.0	
Inspiratory Time Set	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Pressure Control Total	20	20	20	20	20	20	20	20				
PIP Measured	19	20	20	20	19	20	20	14	14	10	9	
Mean Airway Pressure	6	7	7	11	6	6	16	8	8	7	8	
Pressure Support	15	15	15	15	15	15	15	9	9	6	6	
PEEP	5	5	5	5	5	5	5	5	5	5	5	
FiO2-Vent	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
FiO2 For Apache	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
Rise Time %	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	
Peak Flow	dem	dem	dem	dem	dem	dem	dem	dem	dem	dem	dem	dem
Compliance Dynamic	45	24	49	63	51	49	69	58	50	35	369	
***ALADMS***												

Vital Signs

Ventilator Settings

View/Chart

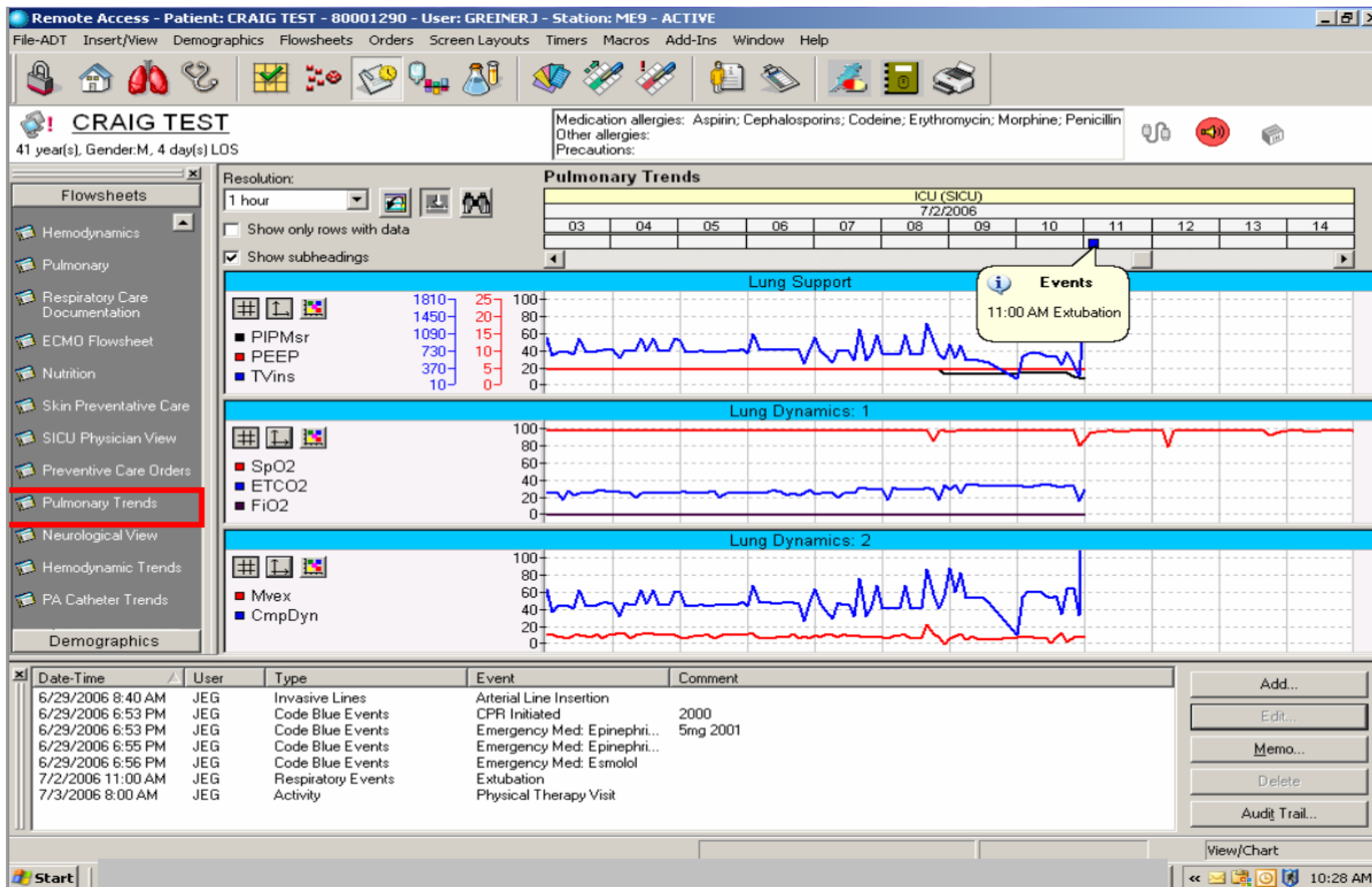


11:18 AM

# A Critical Care EHR (circa) 2006

What we should have learned...

**MAKE IT VISUAL**





# **MARKETING MATERIAL**

## **2014**

Mike Gonzales Gender: M DOB: 01/04  
This page is not a complete source of visit information

# Did the Lasix make him pee?

## Inpatient Summary

Patient Information	
Room/Bed:	3-18/1
Admitting Diagnosis:	Congestive Heart Failure (428.0)
Admit Date:	06/20/2009
Primary Physician:	Angela Brown, MD
Emergency Contact:	Carol Gonzales
Emergency #:	(913) 123-4455
Code Status:	Full Code

Diagnosis (4) Active	
Acute Renal Failure (584.9)	
Congestive Cardiomyopathy (425.9)	
Congestive Heart Failure (428.0)	
Unstable Angina (411.1)	

Problems (8) Active	
Alcoholism (303.90)	
Diabetes (249)	
Esophageal Reflux (530.81)	
Esophageal Varices (456.1)	
Hepatic Artery Embolism (902.22)	
Hypertension (997.91)	
Peripheral Vascular Disease (443.9)	
Site-specific Disorder of Skin (709.9)	

Allergies (3) Active	
	Reaction
ACE Inhibitors	Lips Swelling
Peanuts	Rash
Dust	Sneezing

Medications (15) Active	
Scheduled (5)	

## Vital Signs

Vitals Last 10 days	
	Latest within Since 06/23 07:00 Previous 24 hours
	Min / Max Min / Max
Temp, degC	↑ 39 15 min ↑ 36.5/39 37/37.5
Systolic BP mm/Hg	120 15 min ↑ 120/190 120/120
Diastolic BP mm/Hg	80 15 min 80/115 90/115
RR br/min	18 15 min 18/20 14/20
HR bpm	78 15 min ↑ 60/78 72/76
O <sub>2</sub> Sat %	99 15 min ↓ 90/97
Glu (POC) mg/dL	-- Ordered 81/110

Measurements and Weights Last 14 days	
	Latest within Previous within Change
Weight kg	90 1h 91.4 2d +1.4
Height cm	180 2d 180 2d 0
BMI	24.4 2d 24.4 2d 0

Intake and Output 06/22/09 09:00 - Current	
	Since 06/23 07:00 Previous 24 hours
Total Fluid Intake mL	201.2 1.135
- IV mL	72.5 140
Total Urine Output mL	50 200.4
- Urine mL/kg/hr	0.28 0.625
Stools	0 2
Last Diet Order	2000 kcal 1... NPO

Diagnostics (7) Last 10 days	
	Latest Status Previous Status
EKG (1)	
EKG 12-lead	1 hr Completed 3 mg Completed

## Lab Results

Labs Last 10 days	
	Latest within Previous within
WBC x10(3)/mcl	6.5 15 min ↓ 4.0 16 h
Hemoglobin gm/dL	15 15 min 15 16 h
Hematocrit %	45 15 min 45 16 h
Platelets x10(3)/mcl	250 15 min 280 16 h
Sodium mEq/L	↑ 145 15 min 140 16 h
Potassium mEq/dL	4.0 15 min 3.9 16 h
CO <sub>2</sub> mm/Hg	38 15 min 37 16 h
Chloride mEq/L	100 15 min 99 16 h
Creatinine g/24hr	1.0 15 min 1.0 16 h
BUN mg/dL	↓ 6.0 15 min 8.0 16 h
Glucose mg/dL	↓ 60 15 min 80 16 h
Magnesium mg/dL	2.0 15 min 1.6 16 h
Phosphorus mg/dl	3.0 15 min 3.0 16 h
Calcium mg/dL	9.2 15 min 10.0 16 h
PT s	13.0 15 min 13 16 h
INR	1.0 15 min 1.0 16 h
PTT s	22 15 min 24 16 h
Troponin ng/mL	-- Ordered 0.3 5 h
CK-MB ng/mL	-- Ordered 2 5 h
CK	-- Ordered 2 5 h

Microbiology (3)	
Source/Site	Collected within Normality Status
Blood, Left Arm	2 d Growth Final
Blood, Right Arm	1 h -- Pending
Urine	1 h -- Pending

Pathology Last 5 results	
	Verified Date
Surgical Pathology Report	04/23/09

# Did the Lasix make him pee?

Time of Administration

Time UOP measured before administration

Elapsed time

Time UOP measured after administration

Volume of UOP before administration

Difference in volume

Volume of UOP after administration

Blood Pressure before administration

Difference in systolic blood pressure

Blood Pressure after administration

Difference in diastolic blood pressure

Heart rate before administration

Heart rate after administration

Difference in heart rate

Potassium before administration

Potassium after administration

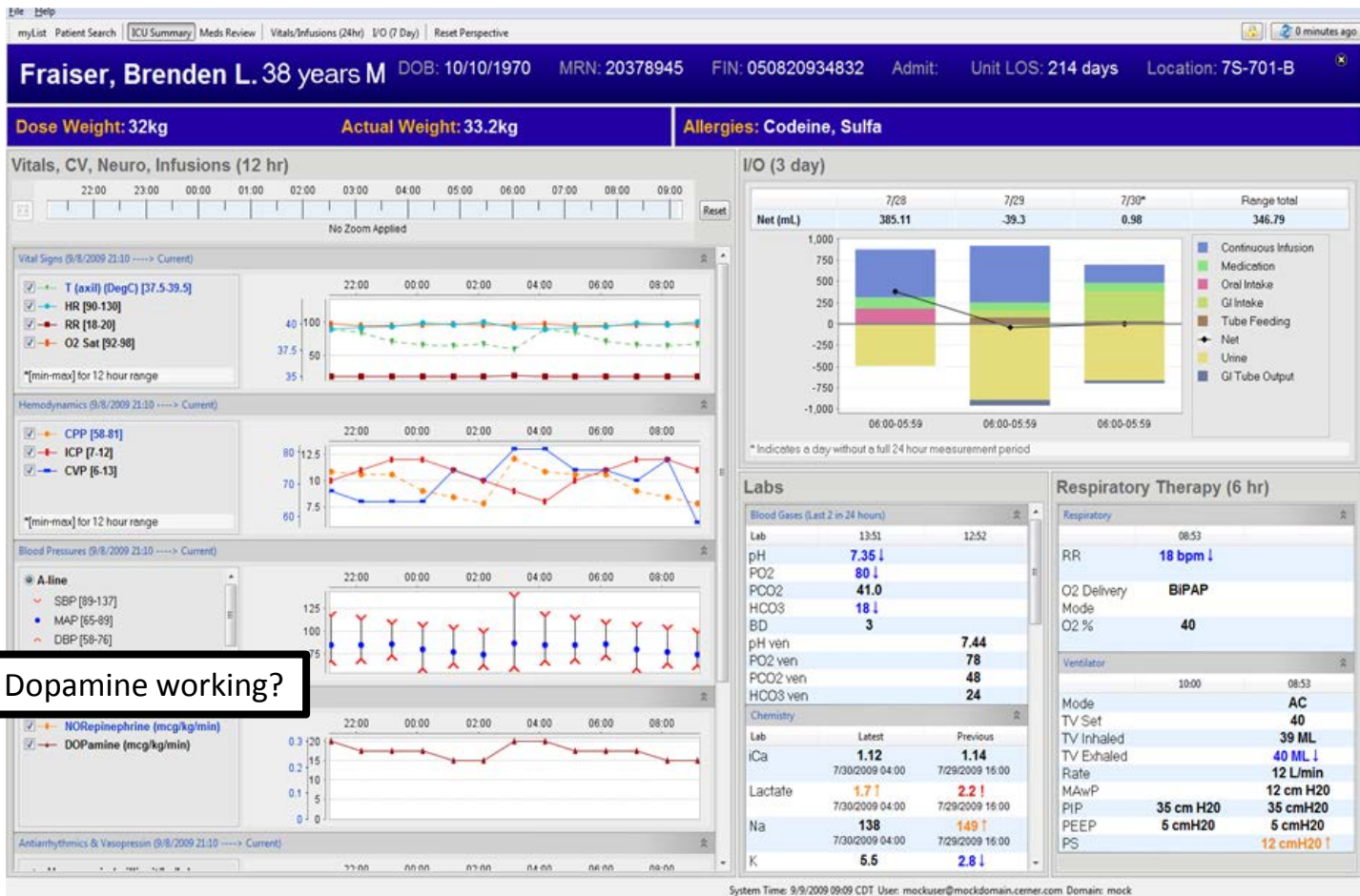
Difference in serum potassium

17

17 > 7 chunks (+/- 2)\*

\*Miller, G.A. 1956. The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review* 63(2): 81-87.

**MAKE IT VISUAL**



Is the Dopamine working?

**MAKE (THE CONTEXT) VISUAL**

# How to move forward?

**More research**

**What really works in clinical environments?**



**MAKE IT VISUAL**

# How to move forward?

More research

What really works in clinical environments?

**More Innovation**

**Open platforms to incorporate new designs**

**MAKE IT OPEN**

# How to move forward?

More research

What really works in clinical environments?

More Innovation

Open platforms to incorporate new designs

**More Flexible**

**Modular platforms for different environments**

**MAKE IT MODULAR**

**MAKE IT VISUAL**

**MAKE IT OPEN**

**MAKE IT MODULAR**

