2008 年台灣國際醫學資訊聯合研討會
Joint Conference on Medical Informatics in Taiwan
MIST 2008、NIST 2008、MISAT 2008、The 7th Asia-Pacific HL7 Conference

Journey to the Electronic Health Record: Enabling Seamless Care Delivery & Healthcare Transformation

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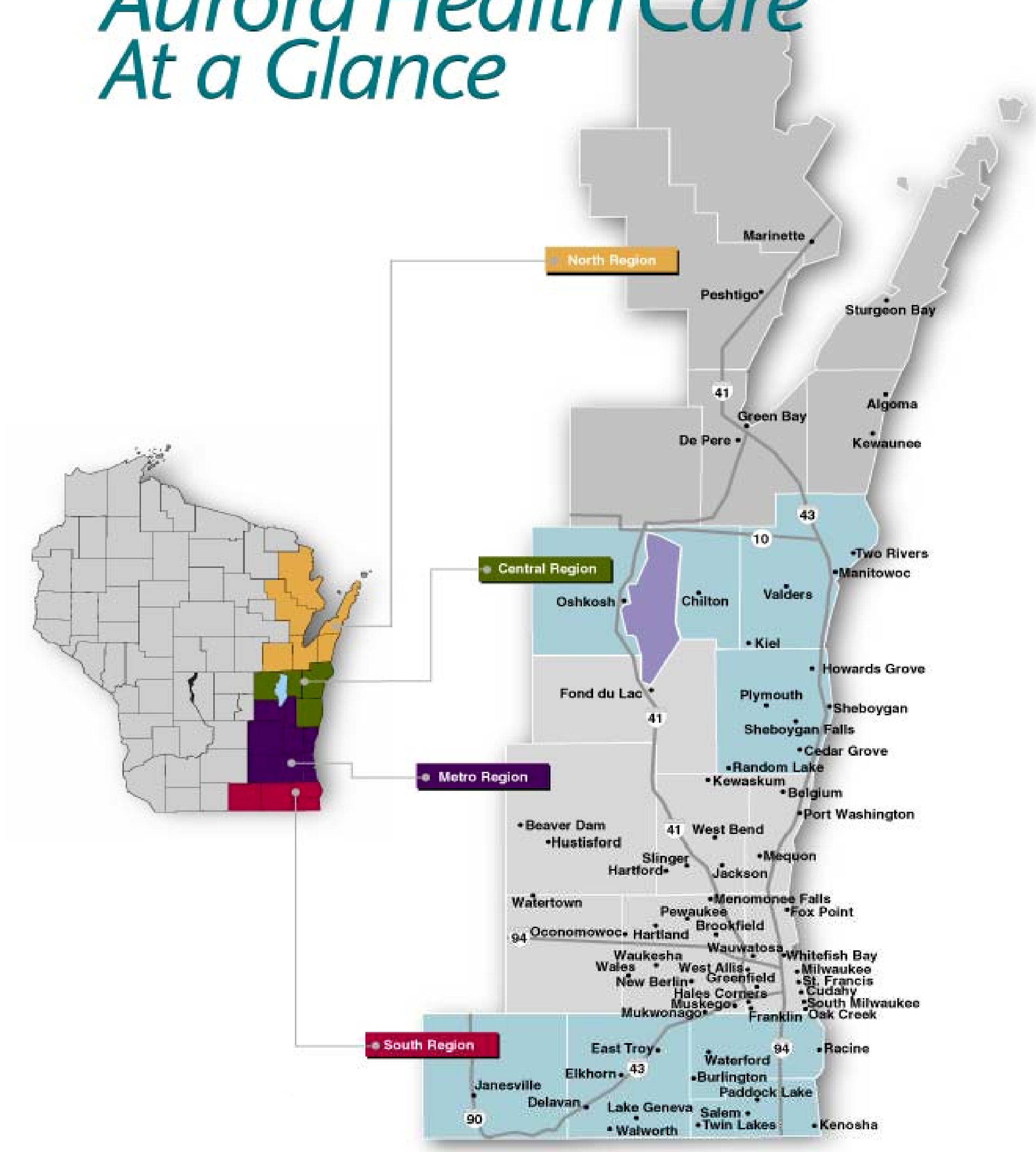
Aurora Health Care
Milwaukee, Wisconsin, USA

We will cover …

- A little bit about Aurora Health Care
- Aurora Health Care: An Electronic Health Record (EHR) Case Study
  - Use our experiences to exemplify key points about the EHR implementation process
  - Describe the benefits and challenges we've seen
  - Discuss where we've been; what we've learned
  - Elaborate on where we're going next and why
- Wrap-up
- Questions

Aurora Health Care At a Glance



- Integrated Delivery Network
- Private, non-profit, teaching
- 14 Hospitals (60-900 beds)
- 120 Clinics
- 130 Retail Pharmacies
- 18 QuickCare Clinics
- Home Health Services
- Hospice Services
- Laboratory Services

- 26,000 employees
- 3,700 physicians on staff
- 950 employed physicians

- $3.2 billion annual revenue
- 0.5 million IP days/year
- 1.1 million OP visits/year
- 250,000 ED visits/year
- 2.5 million clinic visits/year
- 284,000 Home visits/year
- 5.4 million prescriptions/year

Aurora Information Technology

- Average annual Capital budget – $32m USD
- Average annual Operating budget – $56m USD (about 3% of total)
  - 550 employees
  - 6 departments
- Electronic Health Record
  - $200m+ USD investment over 10 years (hardware, software, labor)
  - 17,000 user logins with 6,500 concurrent users during prime shifts
  - 19,000 connected devices, including 5,000 mobile devices
- One of the nation's "Most Wired" hospitals – 2004, 2005, 2006, 2007 and 2008

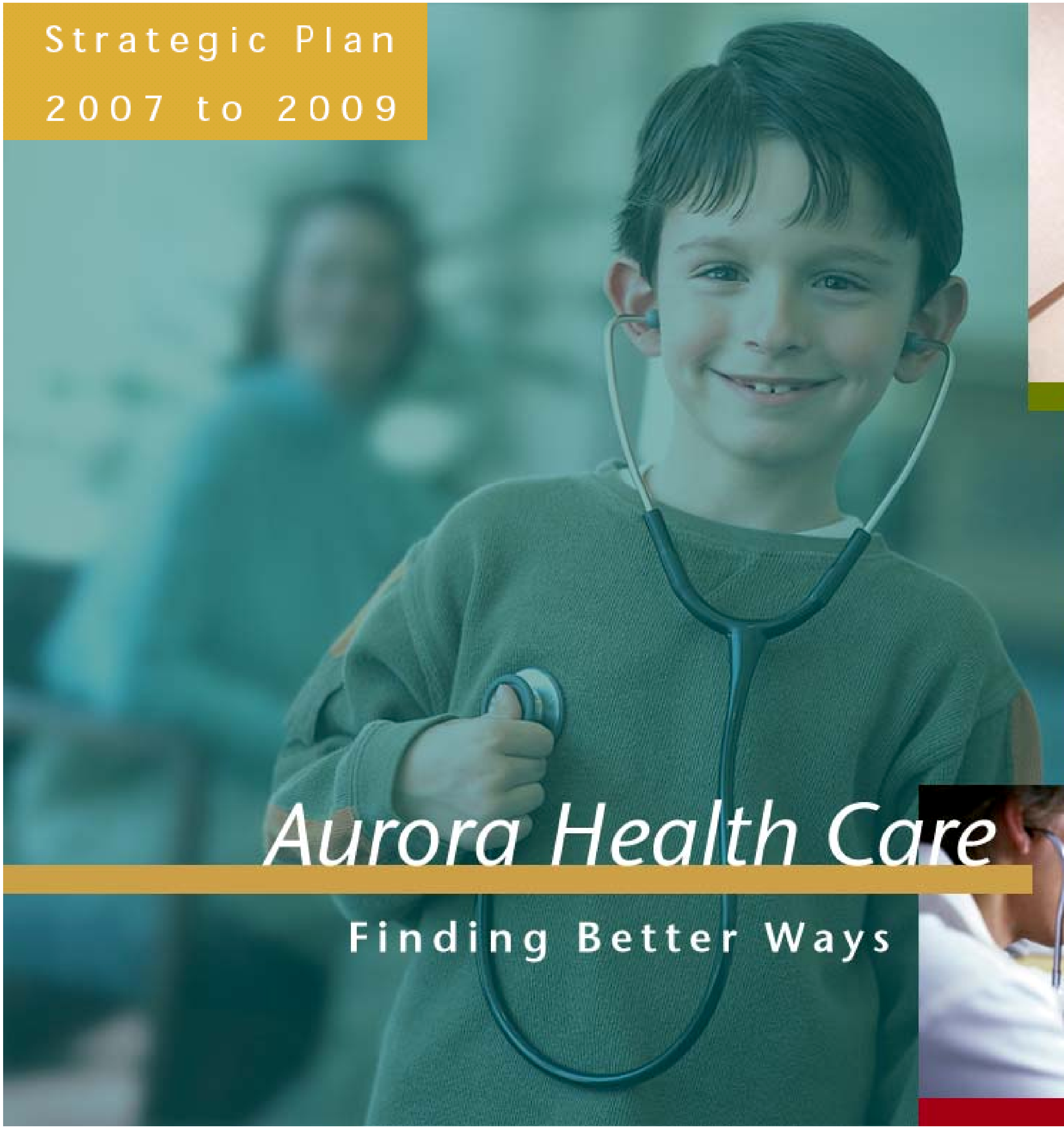
The EHR is a Journey …

Not a Destination

The EHR is a Means to an End …

Not an End Unto Itself

Strategic Plan
2007 to 2009



Aurora Health Care

Finding Better Ways

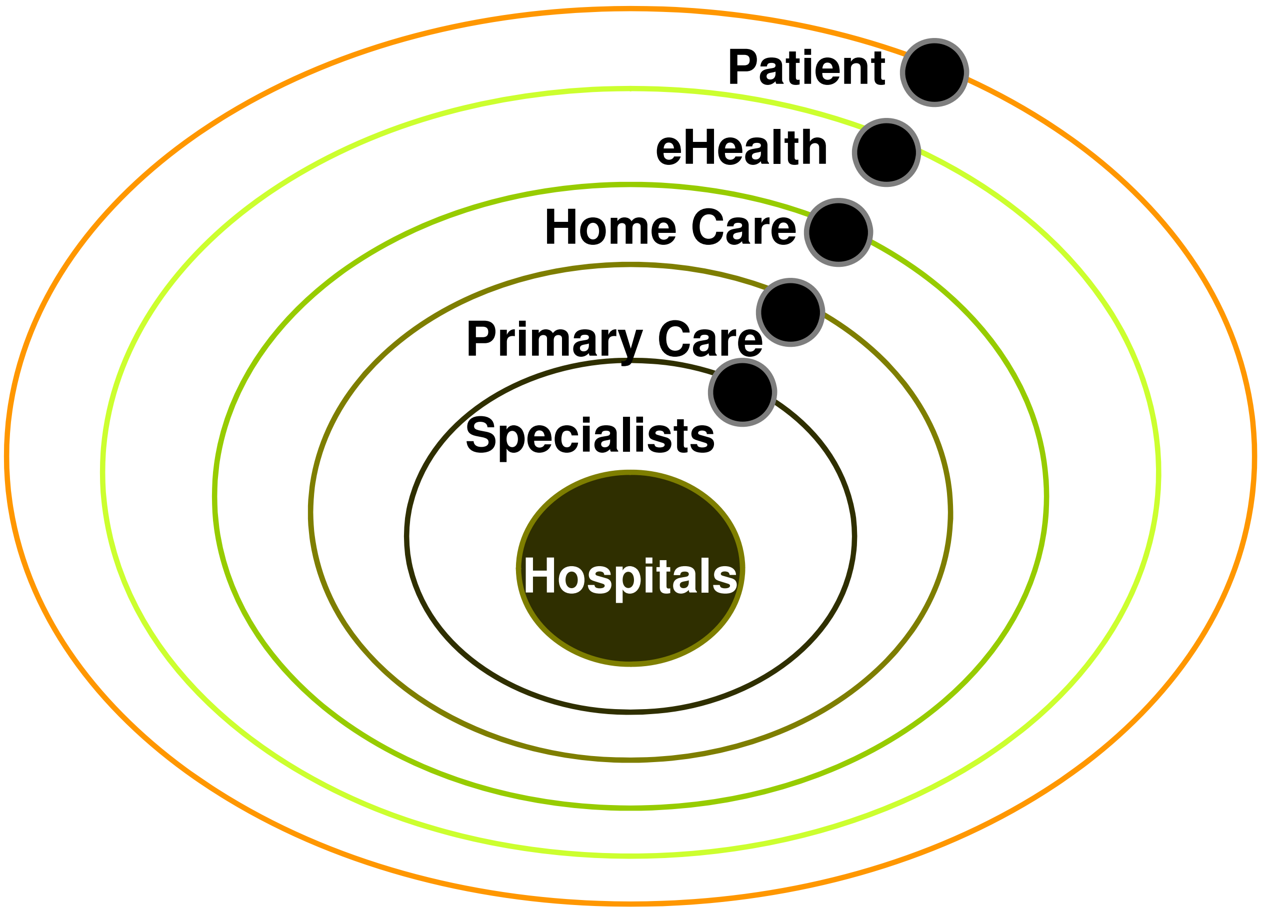
Aurora’s Vision

Aurora Health Care was created around a single idea:
There is a better way to provide health care.

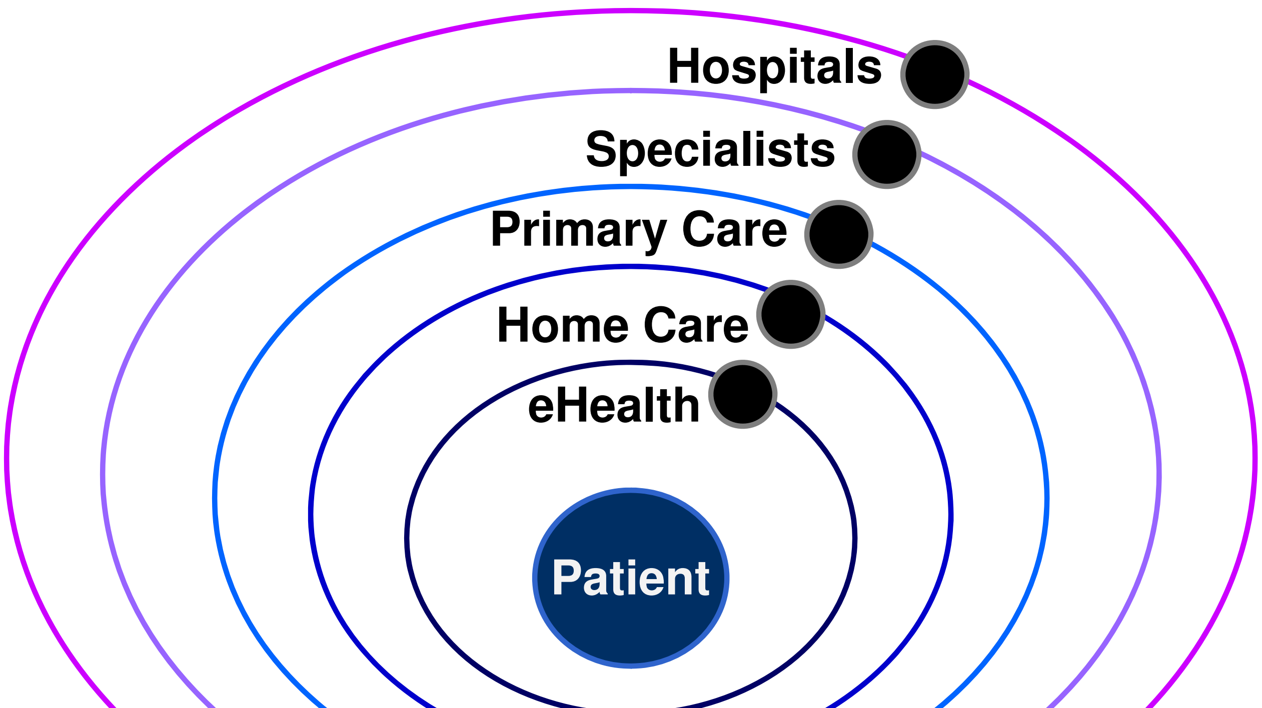
We will be satisfied only when Aurora gives people better access, better service, and better results than they can get anywhere else.

Working together, the people of Aurora will find a better way.

OLD WAY: Hospital as Center of the Universe



NEW WAY:
Patient as Center of the Universe



Murphy, J. "The Center of the Universe: A Closer Look at a Patient-Centric Care Model". Nursing Informatics Commentary, Journal of Healthcare Information Management, 6-7 (Spring 2008).

The ONC-Coordinated Federal Health Information Technology Strategic Plan: 2008 - 2012

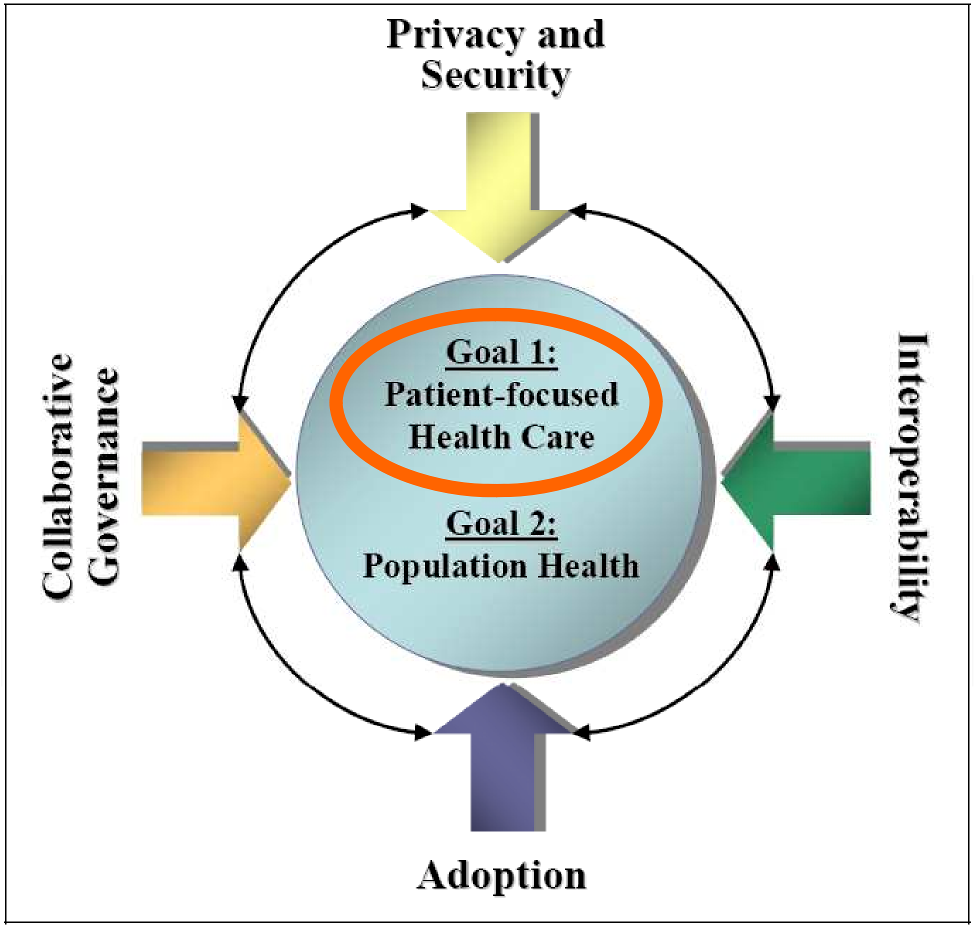
Improving the health, safety and well-being of America

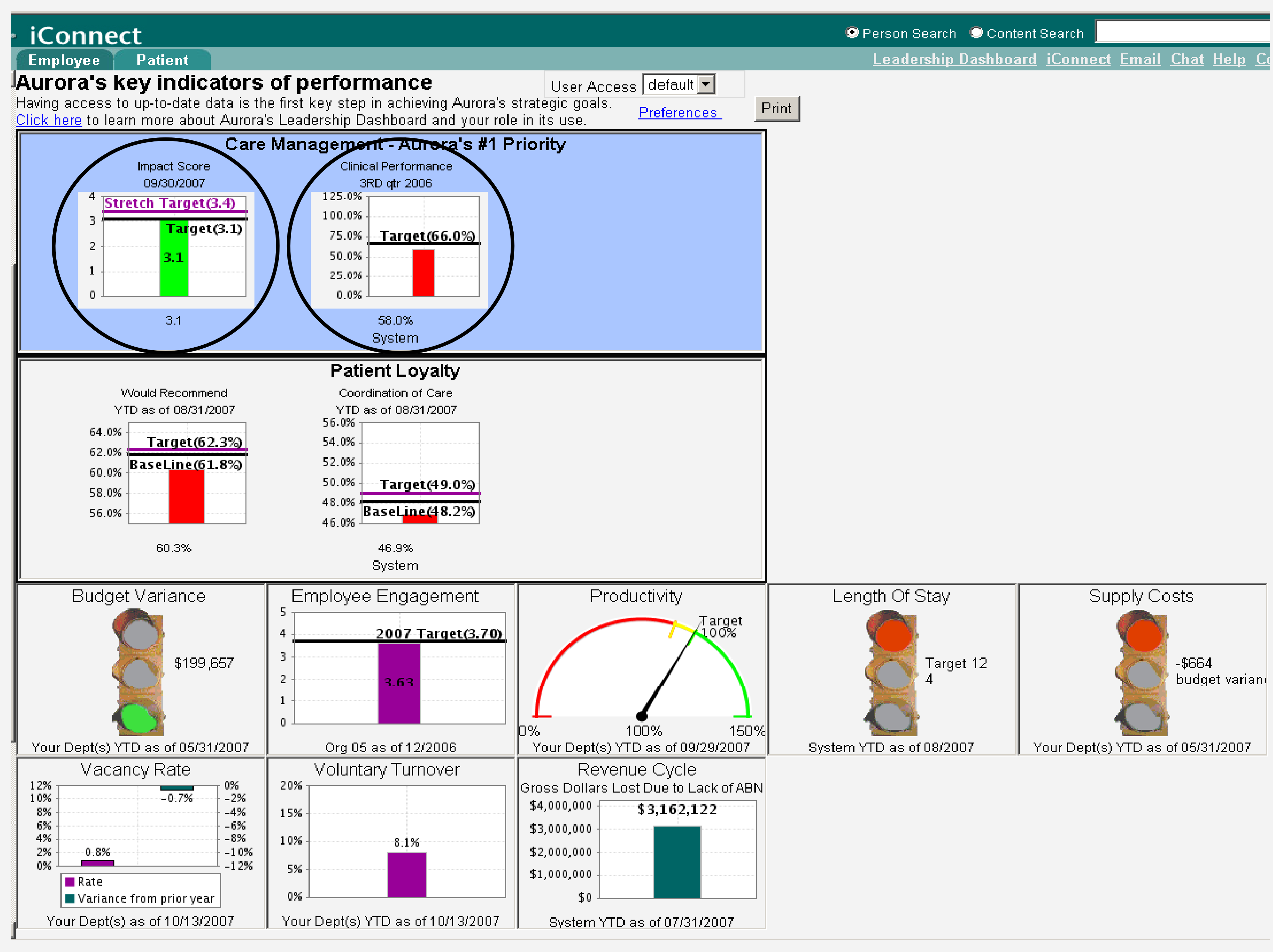
http://www.hhs.gov/healthit/resources/HITStrategicPlanSummary.pdf

The Plan has two goals, Patient-focused Health Care and Population Health.

Each goal has four objectives and the themes of ***privacy and security, interoperability, adoption, and collaborative governance.***

(Published June 3, 2008)





iConnect
Person Search
Content Search
Employee
Patient
Leadership Dashboard
iConnect
Email
Chat
Help
Aurora's key indicators of performance
User Access
default
Having access to up-to-date data is the first key step in achieving Aurora's strategic goals.
Click here to learn more about Aurora's Leadership Dashboard and your role in its use.
Preferences
Print
Care Management - Aurora's #1 Priority
Impact Score
09/30/2007
Stretch Target(3.4)
Target(3.1)
3.1
Clinical Performance
3RD qtr 2006
Target(66.0%)
58.0%
System
Patient Loyalty
Would Recommend
YTD as of 08/31/2007
Target(62.3%)
BaseLine(61.8%)
60.3%
Coordination of Care
YTD as of 08/31/2007
Target(49.0%)
BaseLine(48.2%)
46.9%
System
Budget Variance
$199,657
Your Dept(s) YTD as of 05/31/2007
Employee Engagement
2007 Target(3.70)
3.63
Org 05 as of 12/2006
Productivity
Target
100%
0%
100%
150%
Your Dept(s) YTD as of 09/29/2007
Length Of Stay
Target 12
4
System YTD as of 08/2007
Supply Costs
-$664
budget varian
Your Dept(s) YTD as of 05/31/2007
Vacancy Rate
-0.7%
0.8%
Rate
Variance from prior year
Your Dept(s) as of 10/13/2007
Voluntary Turnover
8.1%
Your Dept(s) YTD as of 10/13/2007
Revenue Cycle
Gross Dollars Lost Due to Lack of ABN
$3,162,122
System YTD as of 07/31/2007

Clinical Performance Measures

(Premier)

	AMI	CABG	PNEUMONIA (CAP)	CHF	HIP-KNEE	PREG	NECK	LUMBAR	STROKE
ASLMC	1	2	1	1	2	N/A	3	2	1
ASLSS	1	N/A	1	1 ↑	3 ↑	N/A	N/A	N/A	2 ↑
ASMC	1	3 ↓	1	1 *	1	1	N/A	N/A	3
WAMH	1	N/A	1	1 ↑	2	2	3 ↓	3 ↑	1
AMCWC	N/A	N/A	2	3 ↓	1	1	N/A	N/A	2
MHB	+ 1	N/A	1	+ 1	2	1	N/A	N/A	1 ↑
AMC-KEN	2 ↓	N/A	1	1	1	+ 1	N/A	N/A	1 ↑
ALMC	3 ↓	N/A	+ 1	1	4	1 *	N/A	N/A	3
ABMC	1 ↑	1	1	+ 1	1	2	2	2 ↑	1 ↑
AMCMC	1 ↑	N/A	2 ↓	1	1	1 ↑	N/A	N/A	2 ↑
ASMMC	1	N/A	1	+ 1	+ 1 *	+ 1	N/A	1	1
AMCO	1	N/A	1	1	2	1 ↑	N/A	N/A	2 ↓

** Peer group best performer*

+ Premier Award for Quality Winners

Quartile Performance

1 = Top Performer

4 = Bottom Performer

87% in Upper Median

66% in Top Quartile

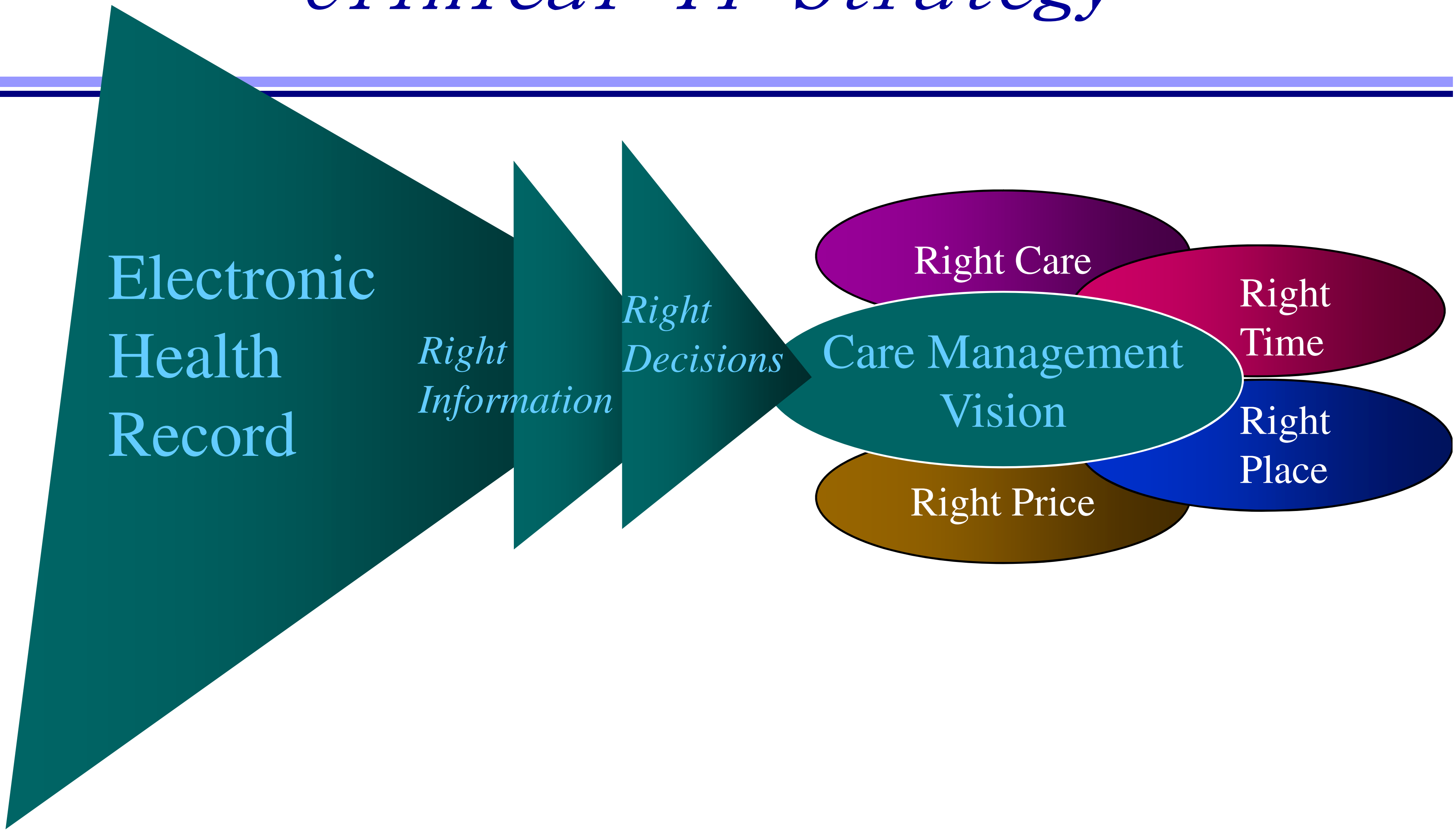
Based on 2nd Q 2006 - 1st Q 2007 Data

Arrows indicate movement from prior quarter

Aurora Health Care®

Updated 09//11/2007

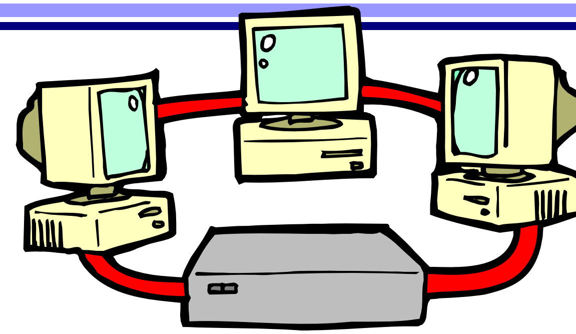
Clinical IT Strategy



Key Strategic Technologies

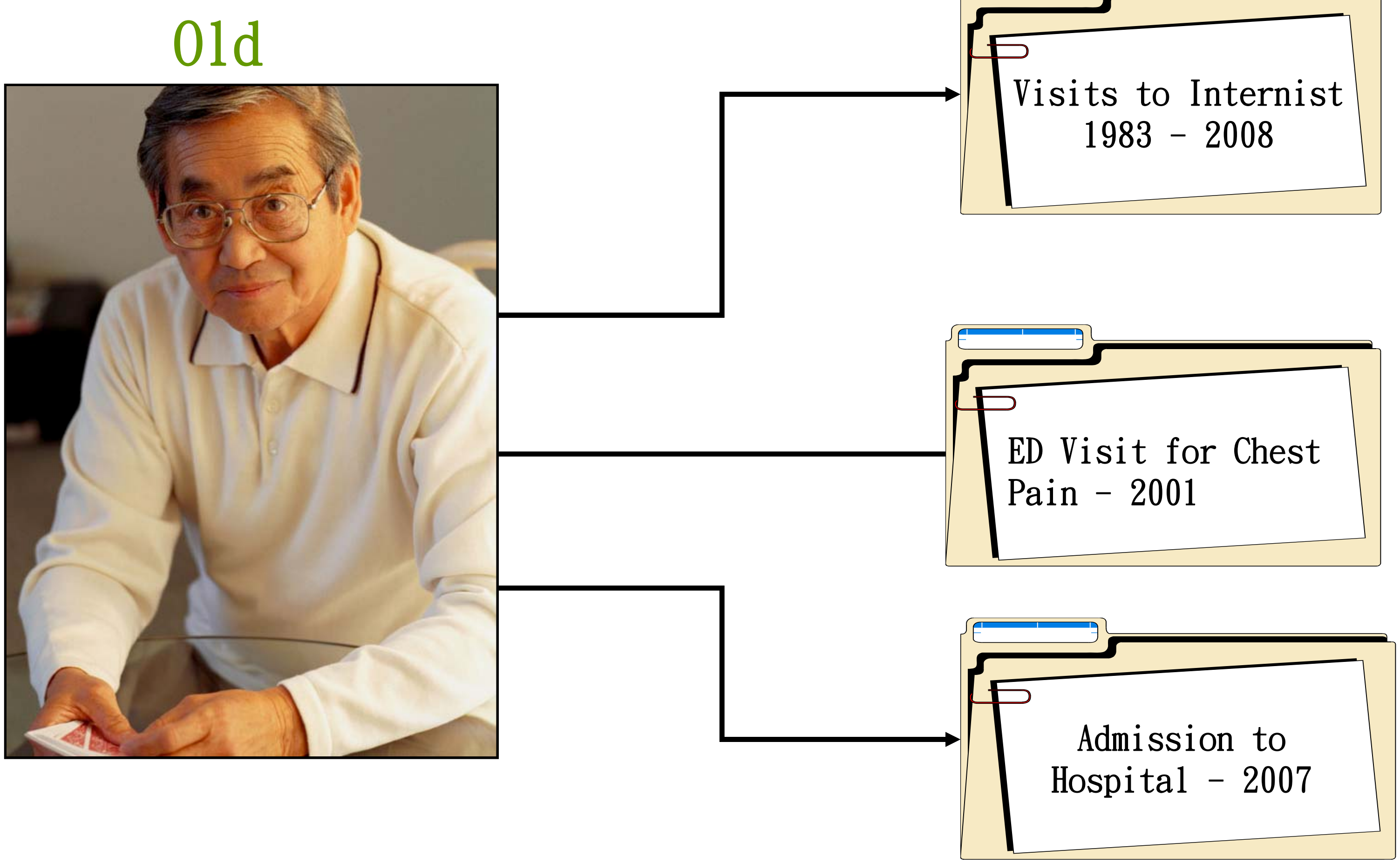
- Electronic Health Record (EHR)
  - Clinical information integrated into a single, across-the-continuum patient record
  - Best practices incorporated to support care management
  - Personal Health Record included
- Mobile Technology
  - Access to the EHR with mobile/wireless devices
- Digital Imaging
  - Cardiology, Radiology, Mammography
- Web Technology
  - Patient, physician, workforce integration
  - eHealth/Personal Health Record

Electronic Health Record

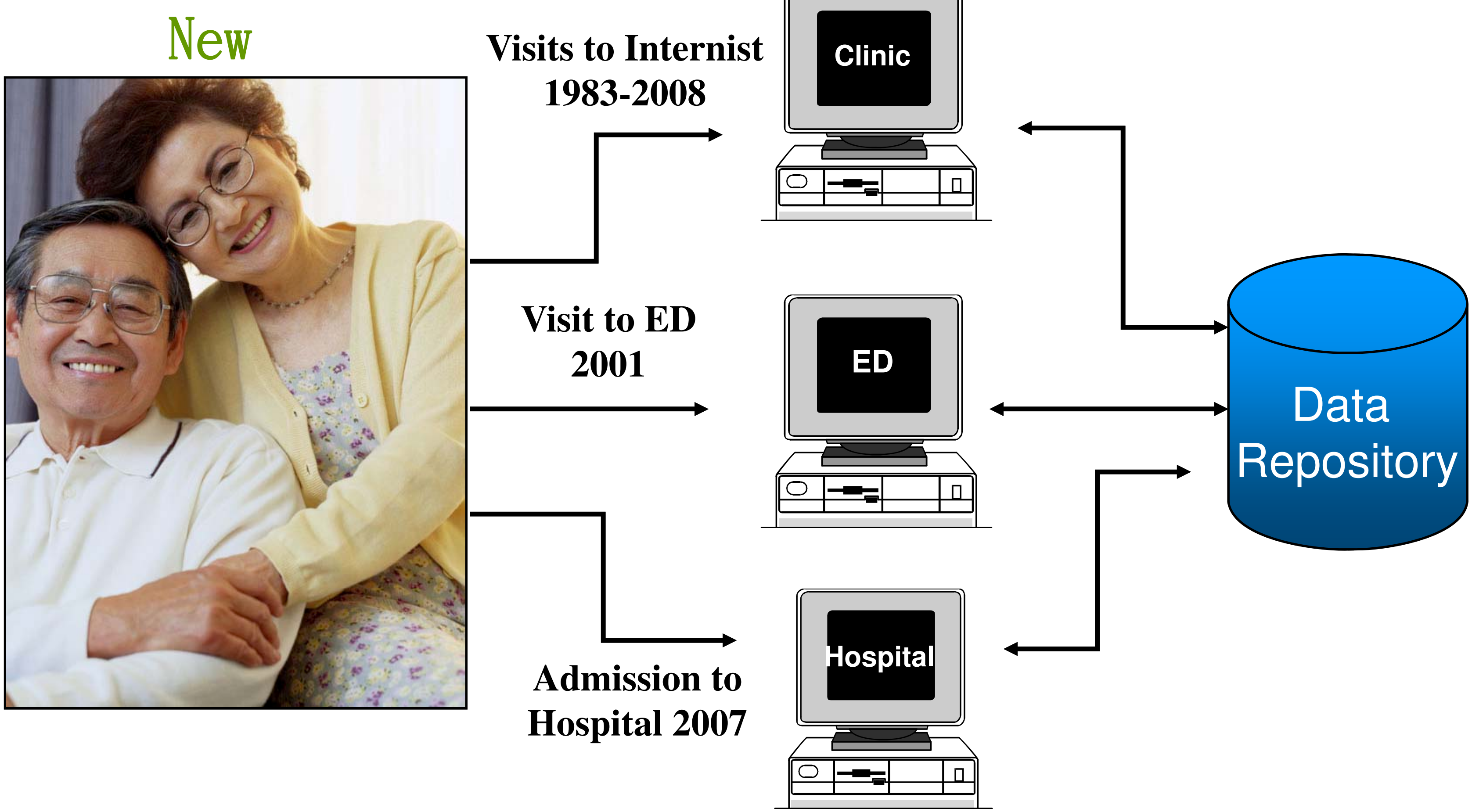


- *Patient-focused* electronic record
  - Enterprise Master Patient Index
  - Anytime, anywhere access
- Integrated Architecture for Core Systems
  - Allows different applications to interact with common patient data
- "Best of Breed" software for select systems
  - Interfaces from "feeder" systems
  - Examples: Lab, Dictation, Transcription, Coding, Billing

Flow of Information



Flow of Information



EHR Repository as of Aug 2008

Patients	3.6 m
Documents	30 m
Laboratory Results	290 m
Pharmacy Orders	7 m




Medication Profile

Summary Sheet - [[redacted]

File View Go Problem Chart Help

As Of 1:18 PM

Name: [redacted] DOB: 1/5/1895 Age: 105 Years Sex: Female Chart Number: 1076202 (Enc Chartnum)

Allergy Profile

Substance	Reaction Status	Severity	Onset Date	Created By
NO KNOWN DRUG ALLERGIES	Active		10/7/1996	Contributor_syst...

Medication Profile

Medication View

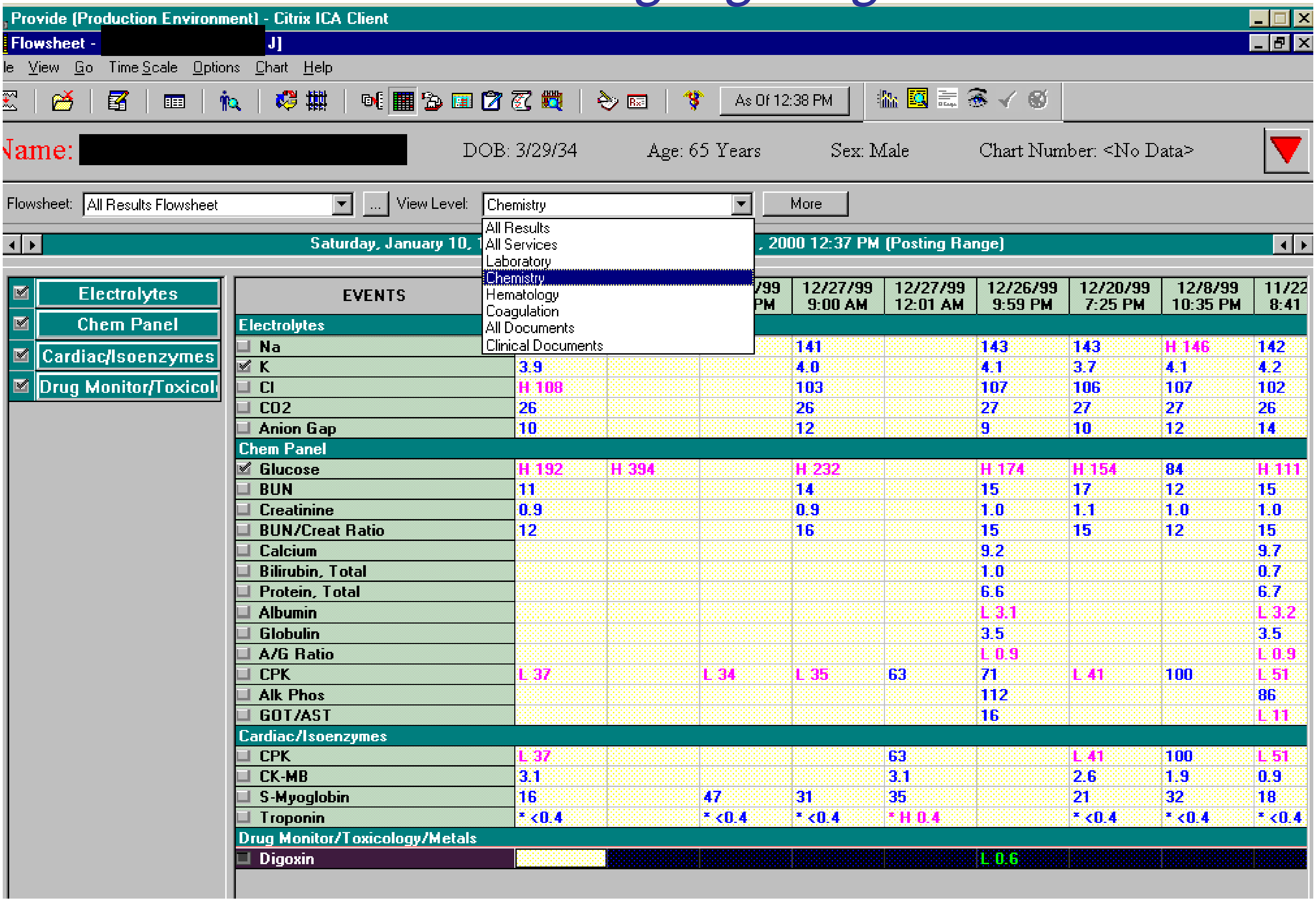
See Rx View

Name	SIG				C..	Provider	Date	Status
Current Medications								
aspirin (ASPIRIN TAB 81MG)	**-- 1 active prescription**							
Rx aspirin (ASPIRIN TAB 81MG)		01	qd	##0	NO Refills	Pfotenhauer, Joseph	03/17/1998 ...	Active
levothyroxine (Synthroid)	**-- 1 active prescription**							
Rx levothyroxine (Synthroid)	0.05mg	1 tab(s)	qd	#30	0 Refills	Pfotenhauer, Joseph	06/01/1999 ...	Active
ranitidine (ZANTAC TAB 150MG)	**-- 1 active prescription**							
Rx ranitidine (ZANTAC TAB 150MG)		01	bid	#000	00 Refills	Pfotenhauer, Joseph	10/07/1996 ...	Discontinued
Rx ranitidine (ZANTAC TAB 75MG)		01	bid	##0	NO Refills	Pfotenhauer, Joseph	03/02/1998 ...	Active
Past Medications								
Rx **acetaminophen-propoxyphene (Darvocet N)**	650 mg-...		q4-6h prn	#0	0 Refills	Pfotenhauer, Joseph	12/14/1999 ...	Discontinued
Rx **amlodipine (Norvasc)**	2.5mg	1 tab(s)	qd	#0	0 Refills	Pfotenhauer, Joseph	12/06/1999 ...	Discontinued
Rx **cephalexin (Keflex)**	250mg	1 tab(s)	qid	#40	0 Refills	Zablotney, David	01/14/1999 ...	Discontinued
furosemide (FUROSEMIDE TAB 20MG)	**-- 3 past prescriptions**							
Rx furosemide (FUROSEMIDE TAB 20MG)		01	qd	##60	1 Y Refills	Pfotenhauer, Joseph	03/02/1998 ...	Discontinued
Rx furosemide (FUROSEMIDE TAB 20MG)		01	qd	#050	06 Refills	Pfotenhauer, Joseph	08/14/1997 ...	Discontinued
Rx furosemide (FUROSEMIDE TAB 20MG)		01	qd	#000	00 Refills	Pfotenhauer, Joseph	10/07/1996 ...	Discontinued
Rx **hydrochlorothiazide-losartan (Hyzaar)**	12.5 mg-...	1 tab(s)	qd	#30	PRN Re...	Pfotenhauer, Joseph	06/01/1999 ...	Discontinued
Rx **Misc Medication (MISCELLANEOUS DRUG)**		01	qd	##60	PRN Re...	Pfotenhauer, Joseph	05/26/1998 ...	Discontinued
Rx **nitroglycerin (NITRO-DUR PATCH .2MG)**		01	qd	##0	NO Refills	Pfotenhauer, Joseph	03/17/1998 ...	Discontinued
Rx **potassium chloride (POTASSIUM TAB 20MEQ)**		01	qd	##60	1 Y Refills	Pfotenhauer, Joseph	03/02/1998 ...	Discontinued
Rx **trimetrexate (Neutrexin)**	25mg	30	tid			Zablotney, David	01/14/1999 ...	Discontinued

Problem List

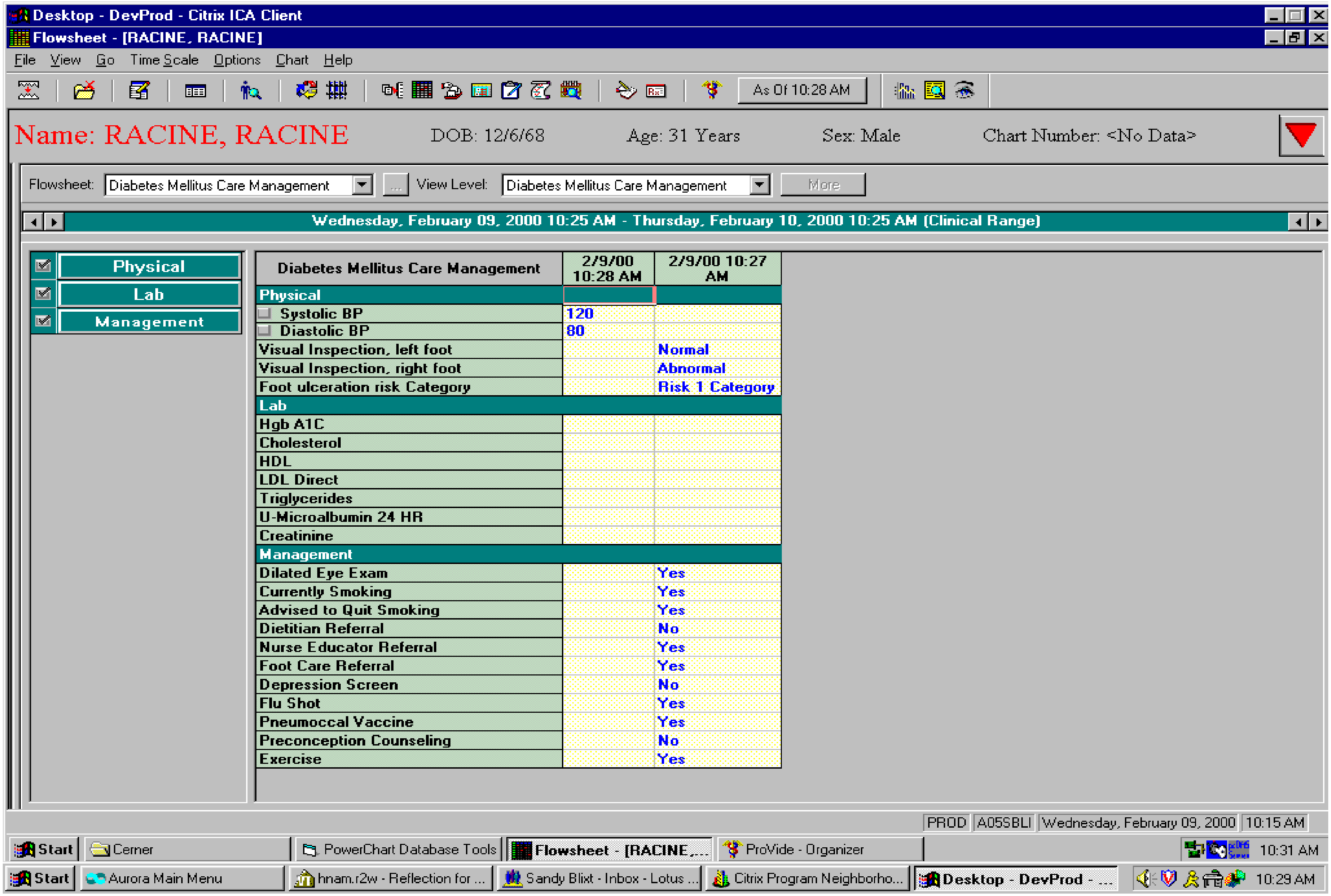
Name of Problem	Life Cycle Status	Co...	Onset Date	Responsible Provider	Recorded By
UNSPECIFIED ESSENTIAL HYPERTENSION	Active		5/7/1998		Contributor_system, HNA01M

Abnormal value highlighting



EVENTS			/99 PM	12/27/99 9:00 AM	12/27/99 12:01 AM	12/26/99 9:59 PM	12/20/99 7:25 PM	12/8/99 10:35 PM	11/22 8:41
Electrolytes									
Na				141		143	143	H 146	142
K	3.9			4.0		4.1	3.7	4.1	4.2
Cl	H 108			103		107	106	107	102
CO2	26			26		27	27	27	26
Anion Gap	10			12		9	10	12	14
Chem Panel									
Glucose	H 192	H 394		H 232		H 174	H 154	84	H 111
BUN	11			14		15	17	12	15
Creatinine	0.9			0.9		1.0	1.1	1.0	1.0
BUN/Creat Ratio	12			16		15	15	12	15
Calcium						9.2			9.7
Bilirubin, Total						1.0			0.7
Protein, Total						6.6			6.7
Albumin						L 3.1			L 3.2
Globulin						3.5			3.5
A/G Ratio						L 0.9			L 0.9
CPK	L 37		L 34	L 35	63	71	L 41	100	L 51
Alk Phos						112			86
GOT/AST						16			L 11
Cardiac/Isoenzymes									
CPK	L 37				63		L 41	100	L 51
CK-MB	3.1				3.1		2.6	1.9	0.9
S-Myoglobin	16		47	31	35		21	32	18
Troponin	* <0.4		* <0.4	* <0.4	* H 0.4		* <0.4	* <0.4	* <0.4
Drug Monitor/Toxicology/Metals									
Digoxin						L 0.6			

Specialty Event Sets


Desktop - DevProd - Citrix ICA Client
Flowsheet - [RACINE, RACINE]
File View Go Time Scale Options Chart Help
As Of 10:28 AM

Name: RACINE, RACINE DOB: 12/6/68 Age: 31 Years Sex: Male Chart Number: <No Data>

Flowsheet: Diabetes Mellitus Care Management ... View Level: Diabetes Mellitus Care Management More

Wednesday, February 09, 2000 10:25 AM - Thursday, February 10, 2000 10:25 AM (Clinical Range)

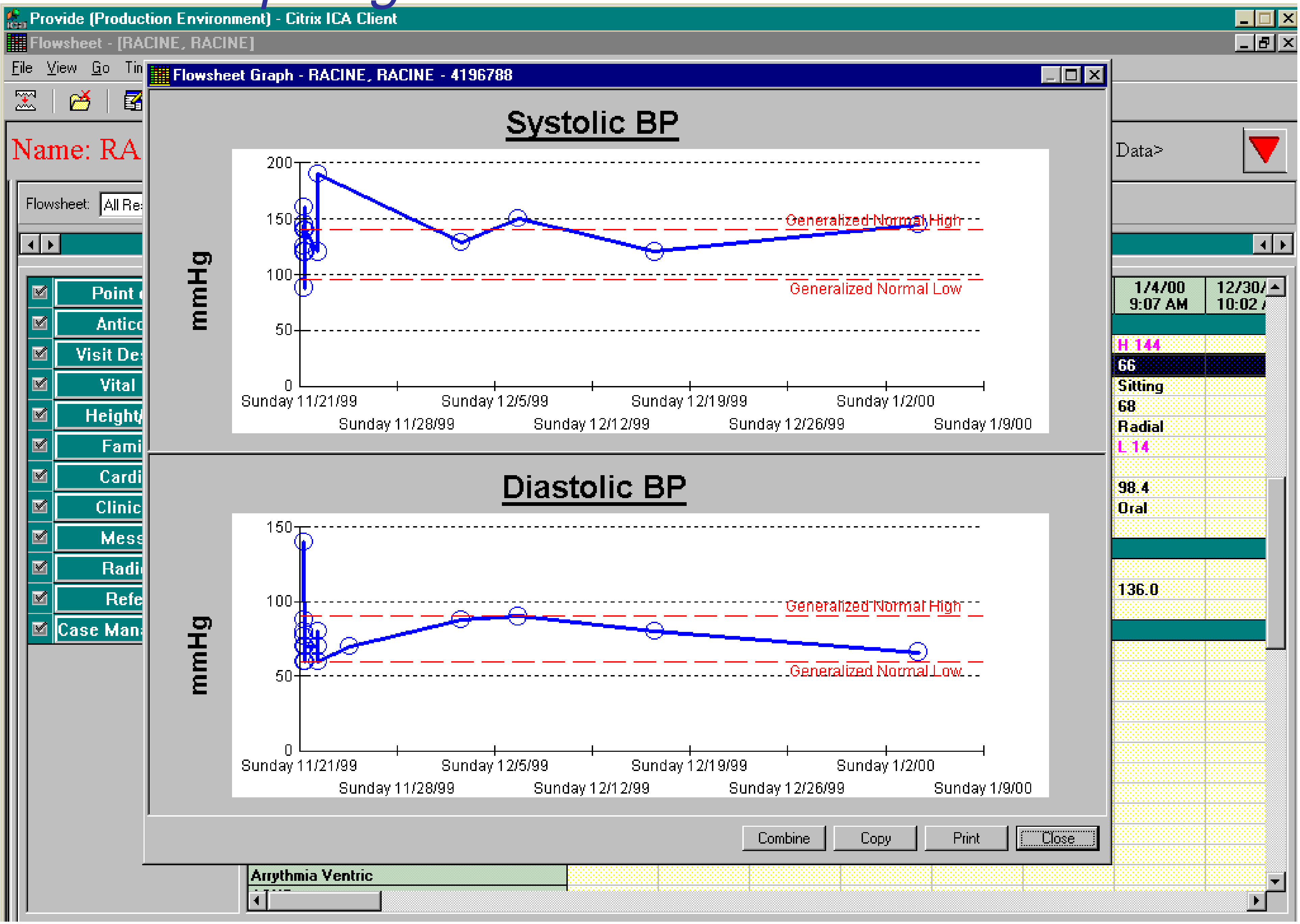
Physical
Lab
Management

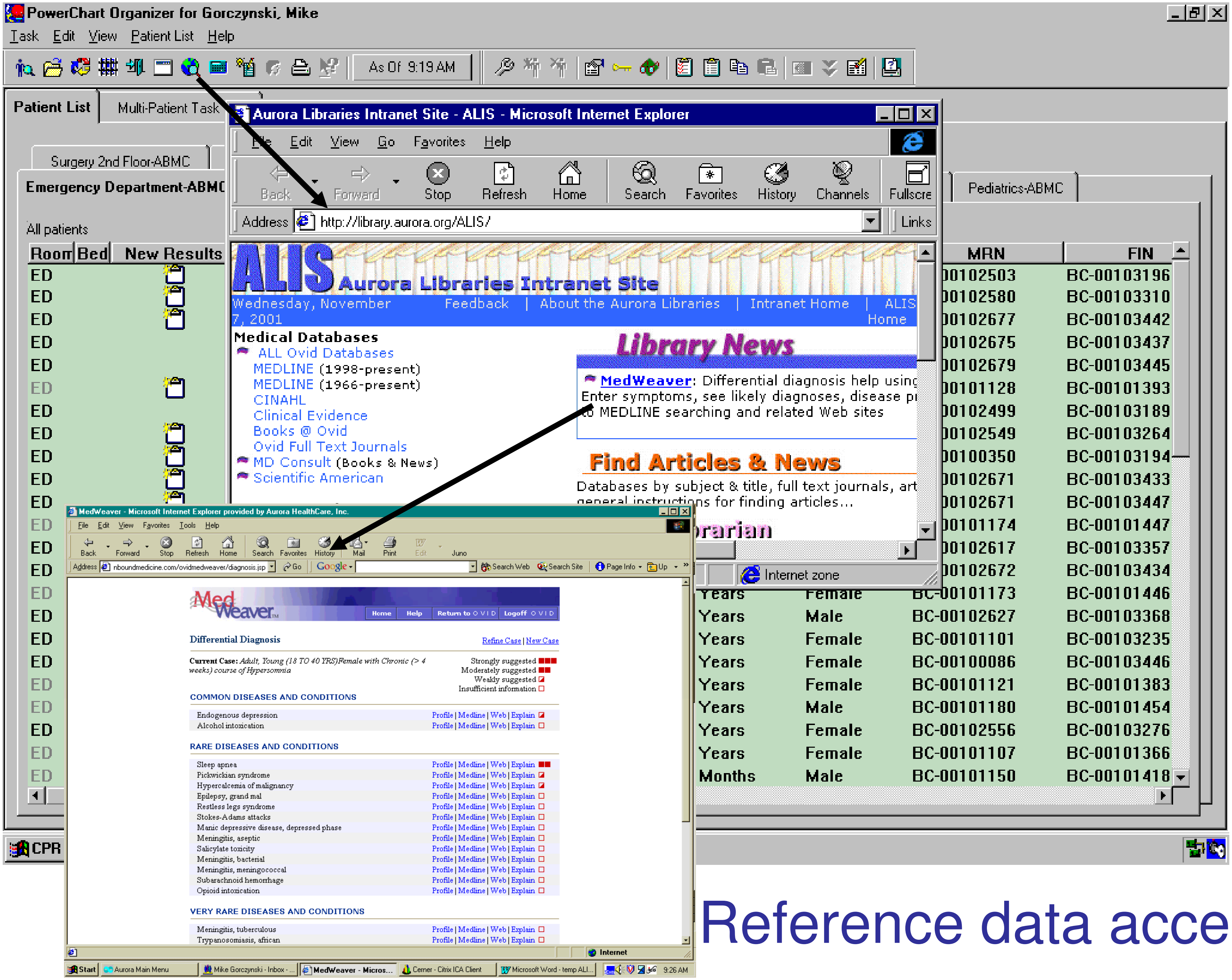
Diabetes Mellitus Care Management	2/9/00 10:28 AM	2/9/00 10:27 AM
Physical		
Systolic BP	120	
Diastolic BP	80	
Visual Inspection, left foot		Normal
Visual Inspection, right foot		Abnormal
Foot ulceration risk Category		Risk 1 Category
Lab		
Hgb A1C		
Cholesterol		
HDL		
LDL Direct		
Triglycerides		
U-Microalbumin 24 HR		
Creatinine		
Management		
Dilated Eye Exam		Yes
Currently Smoking		Yes
Advised to Quit Smoking		Yes
Dietitian Referral		No
Nurse Educator Referral		Yes
Foot Care Referral		Yes
Depression Screen		No
Flu Shot		Yes
Pneumoccal Vaccine		Yes
Preconception Counseling		No
Exercise		Yes

PROD A05SBLI Wednesday, February 09, 2000 10:15 AM

Start Cerner PowerChart Database Tools Flowsheet - [RACINE,... ProVide - Organizer 10:31 AM
Start Aurora Main Menu hnam.r2w - Reflection for ... Sandy Blixt - Inbox - Lotus ... Citrix Program Neighborho... Desktop - DevProd - ... 10:29 AM

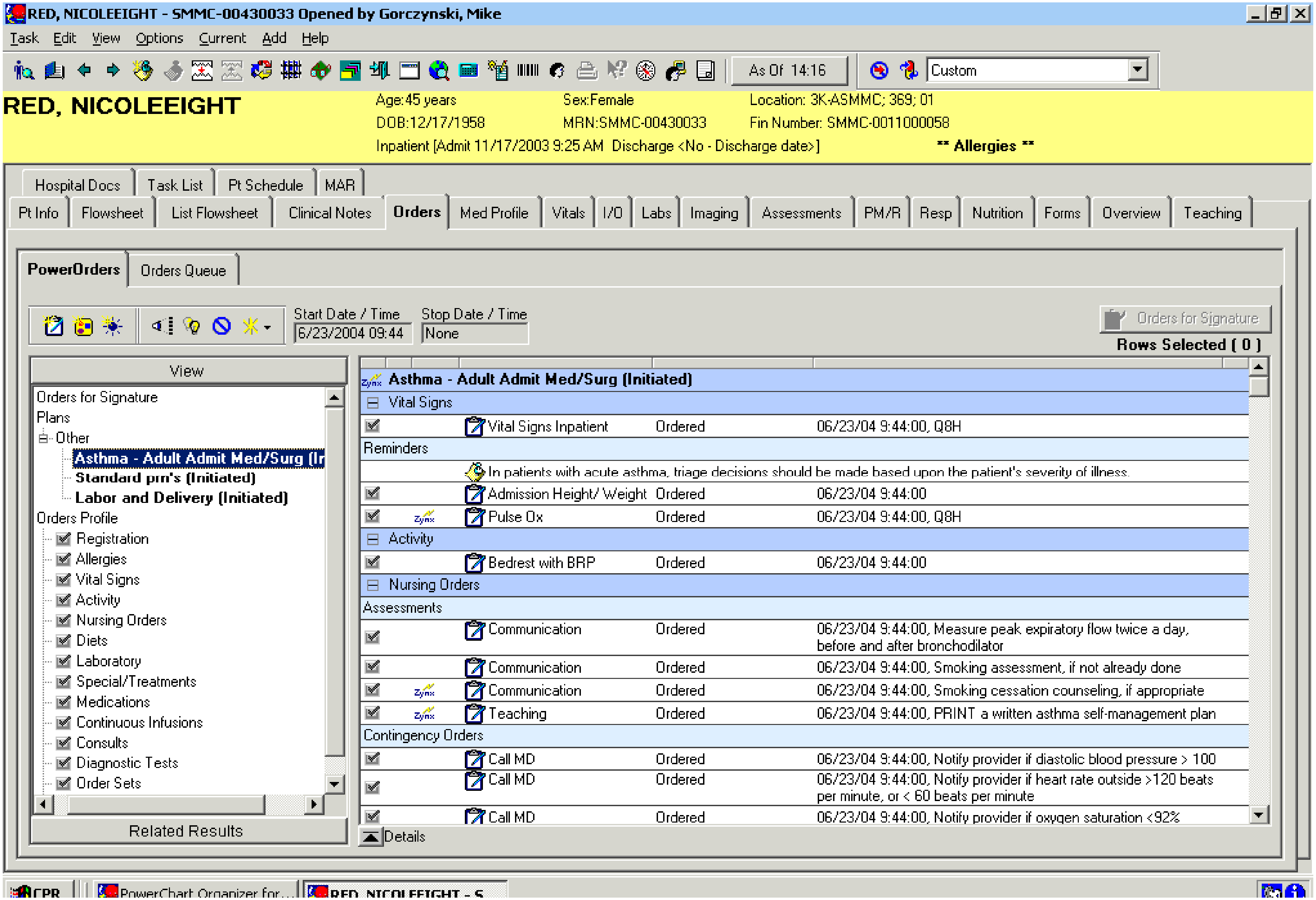
Graphing


Provide (Production Environment) - Citrix ICA Client
Flowsheet - [RACINE, RACINE]
Flowsheet Graph - RACINE, RACINE - 4196788
Systolic BP
mmHg
200
150
100
50
0
Generalized Normal High
Generalized Normal Low
Sunday 11/21/99
Sunday 11/28/99
Sunday 12/5/99
Sunday 12/12/99
Sunday 12/19/99
Sunday 12/26/99
Sunday 1/2/00
Sunday 1/9/00
Diastolic BP
mmHg
150
100
50
0
Generalized Normal High
Generalized Normal Low
Sunday 11/21/99
Sunday 11/28/99
Sunday 12/5/99
Sunday 12/12/99
Sunday 12/19/99
Sunday 12/26/99
Sunday 1/2/00
Sunday 1/9/00
Combine
Copy
Print
Close
Name: RA
Flowsheet:
Point
Antic
Visit De
Vital
Height
Fami
Cardi
Clinic
Mess
Radi
Refe
Case Man
Data>
1/4/00 9:07 AM
12/30/ 10:02
H 144
66
Sitting
68
Radial
L 14
98.4
Oral
136.0
Arrythmia Ventric



Reference data access

CPOE


RED, NICOLEEIGHT - SMMC-00430033 Opened by Gorczynski, Mike
Task Edit View Options Current Add Help
As Of 14:16
Custom
RED, NICOLEEIGHT
Age:45 years
Sex:Female
Location: 3K-ASMMC; 369; 01
DOB:12/17/1958
MRN:SMMC-00430033
Fin Number: SMMC-0011000058
Inpatient [Admit 11/17/2003 9:25 AM Discharge <No - Discharge date>]
** Allergies **
Hospital Docs
Task List
Pt Schedule
MAR
Pt Info
Flowsheet
List Flowsheet
Clinical Notes
Orders
Med Profile
Vitals
I/O
Labs
Imaging
Assessments
PM/R
Resp
Nutrition
Forms
Overview
Teaching
PowerOrders
Orders Queue
Start Date / Time
6/23/2004 09:44
Stop Date / Time
None
Orders for Signature
Rows Selected (0)
View
Orders for Signature
Plans
Other
Asthma - Adult Admit Med/Surg (In
Standard prn's (Initiated)
Labor and Delivery (Initiated)
Orders Profile
Registration
Allergies
Vital Signs
Activity
Nursing Orders
Diets
Laboratory
Special/Treatments
Medications
Continuous Infusions
Consults
Diagnostic Tests
Order Sets
Related Results
Asthma - Adult Admit Med/Surg (Initiated)
Vital Signs
Vital Signs Inpatient Ordered 06/23/04 9:44:00, Q8H
Reminders
In patients with acute asthma, triage decisions should be made based upon the patient's severity of illness.
Admission Height/ Weight Ordered 06/23/04 9:44:00
Pulse Ox Ordered 06/23/04 9:44:00, Q8H
Activity
Bedrest with BRP Ordered 06/23/04 9:44:00
Nursing Orders
Assessments
Communication Ordered 06/23/04 9:44:00, Measure peak expiratory flow twice a day, before and after bronchodilator
Communication Ordered 06/23/04 9:44:00, Smoking assessment, if not already done
Communication Ordered 06/23/04 9:44:00, Smoking cessation counseling, if appropriate
Teaching Ordered 06/23/04 9:44:00, PRINT a written asthma self-management plan
Contingency Orders
Call MD Ordered 06/23/04 9:44:00, Notify provider if diastolic blood pressure > 100
Call MD Ordered 06/23/04 9:44:00, Notify provider if heart rate outside >120 beats per minute, or < 60 beats per minute
Call MD Ordered 06/23/04 9:44:00, Notify provider if oxygen saturation <92%
Details
CPR
PowerChart Organizer for...
RED, NICOLEEIGHT - S

Decision Support in CPOE (1): Enterprise-wide Order Sets

Careset - Uncomplicated-Community Acquired Pneumonia-CPOE

	Component	Order Detail
	Nursing:	
☑		T;N, Intake and output Q8hrs while on IV's, Q8H
☑	Weigh	T;N, Daily wieghts while on IV's, qAM
☑		T;N, Encourage fluids 660-800cc/shift while awake
☑	Bathroom Privileges (BRP)	T;N, BRP and advance per clinical pathway
	Laboratory:	
☑	Carbon Dioxide (CO2)	Routine, T;N, Lab Collect, Venous
☐	Blood Culture	Routine, T;N, Lab Collect, Q5MIN 2 TIME/DOSE
☐	Respiratory Culture & Smear (Sputum Culture)	Routine, T;N, Nurse Collect, Sputum, Sputum, Do not delay antibiotic if unable to obtain
	If from Nursing home:	
☐	Urinalysis Screen (Urine Screen)	Routine, T;N, Nurse Collect
	Pulmonary Consults:	
☑	Oxygen Request	ASAP, T;N, Oxygen request ______ LPM/NC titrate to keep Sat>92%
	Consults:	
☐	Nutrition Consult/Instruction (Dietitian Consult)	T;N
☐	Social Services Consult	Today, T;N
☐	Physical Therapy*	Today, T;N, Physical Therapy Consult
	Medications:	

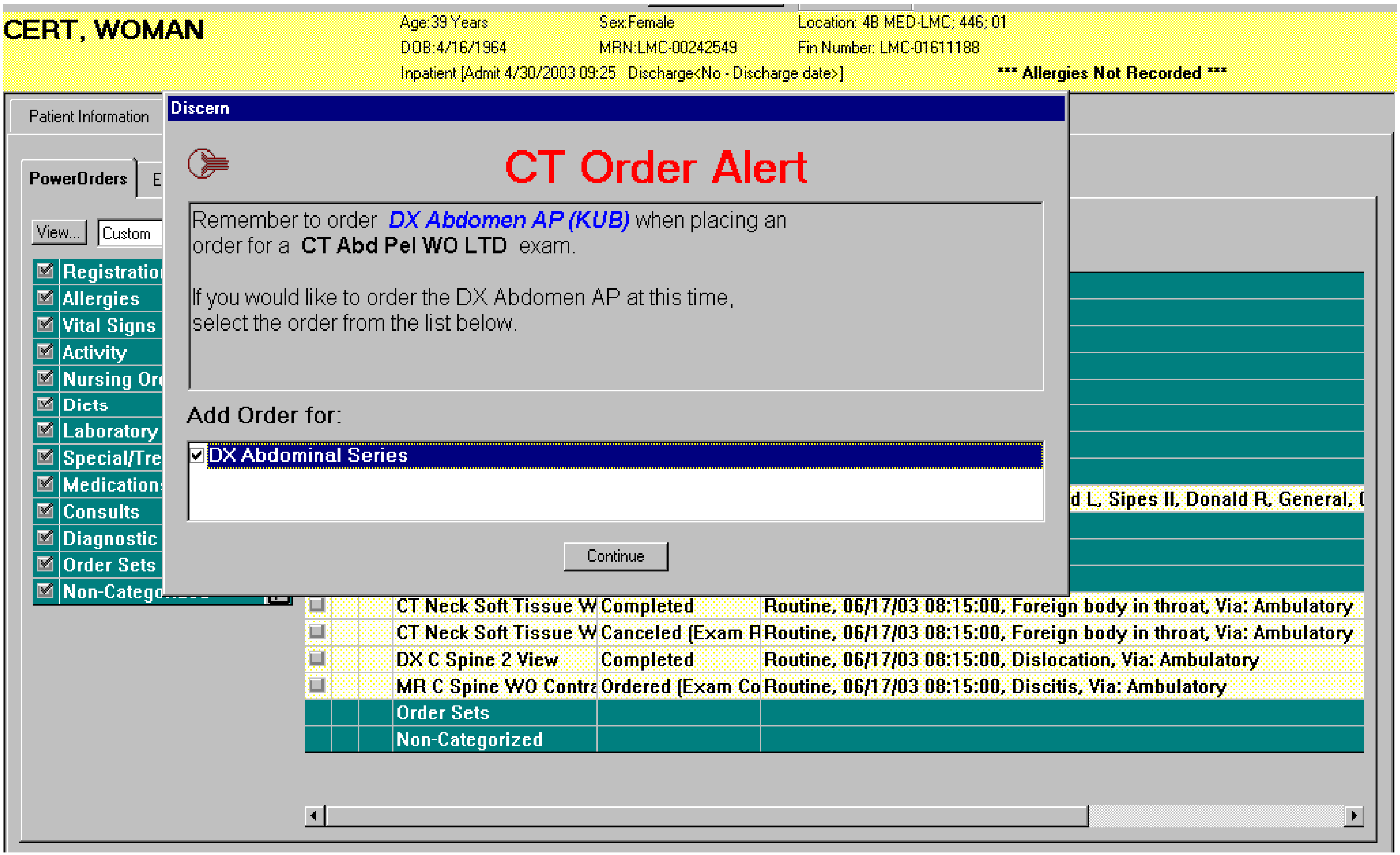
Order Details

Detail Values

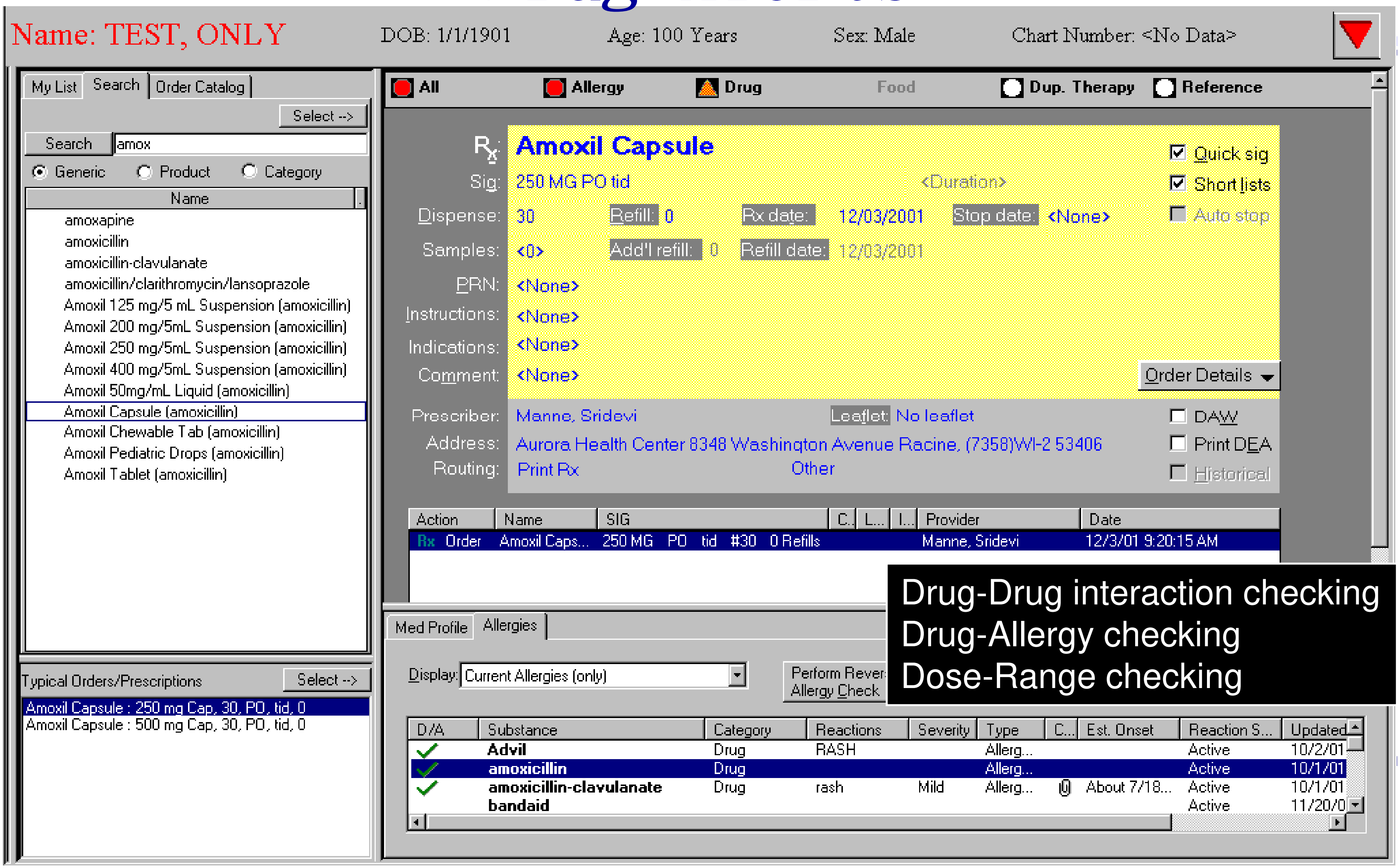
Order Comments

Details

Decision Support in CPOE (2): Discern Alerts

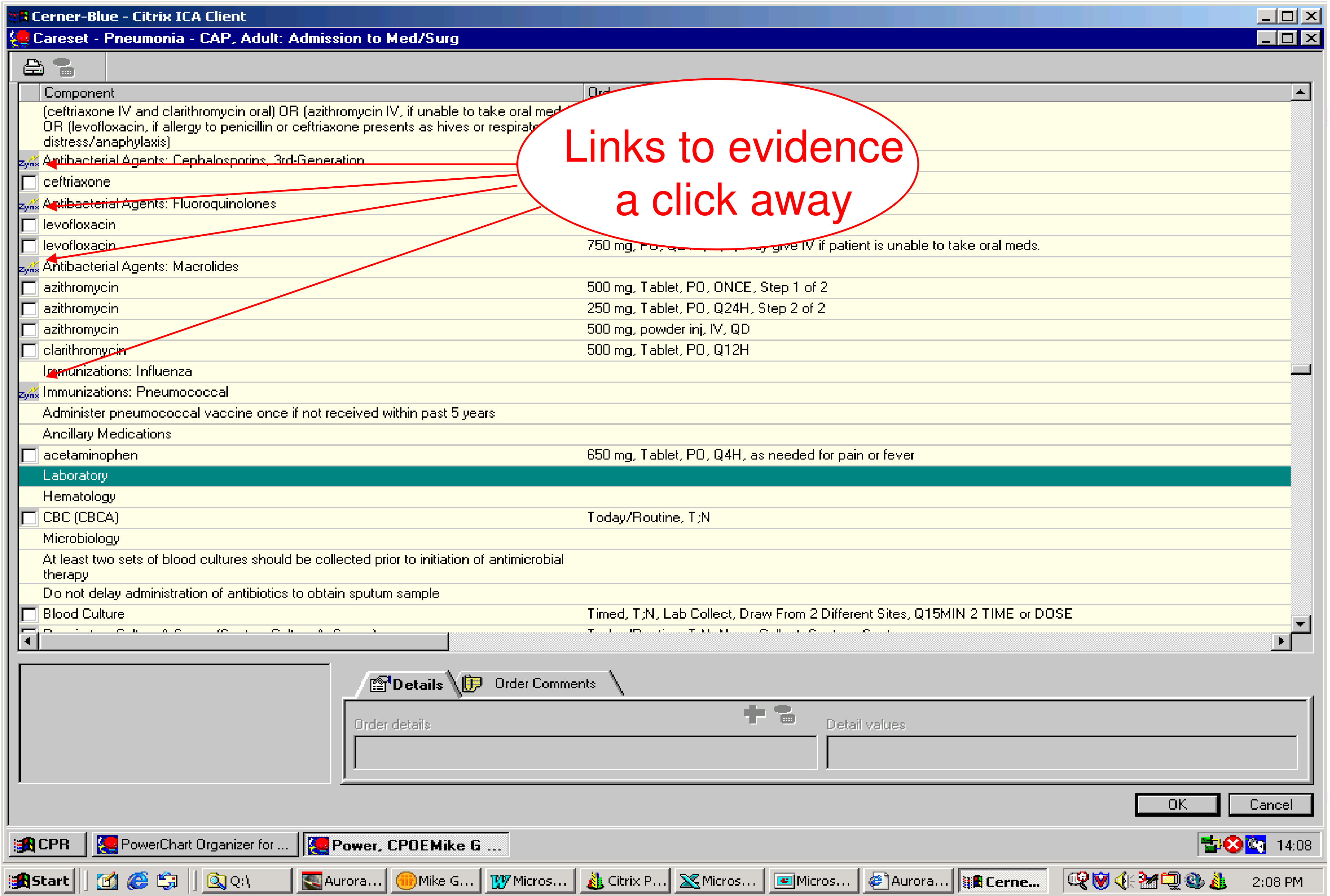


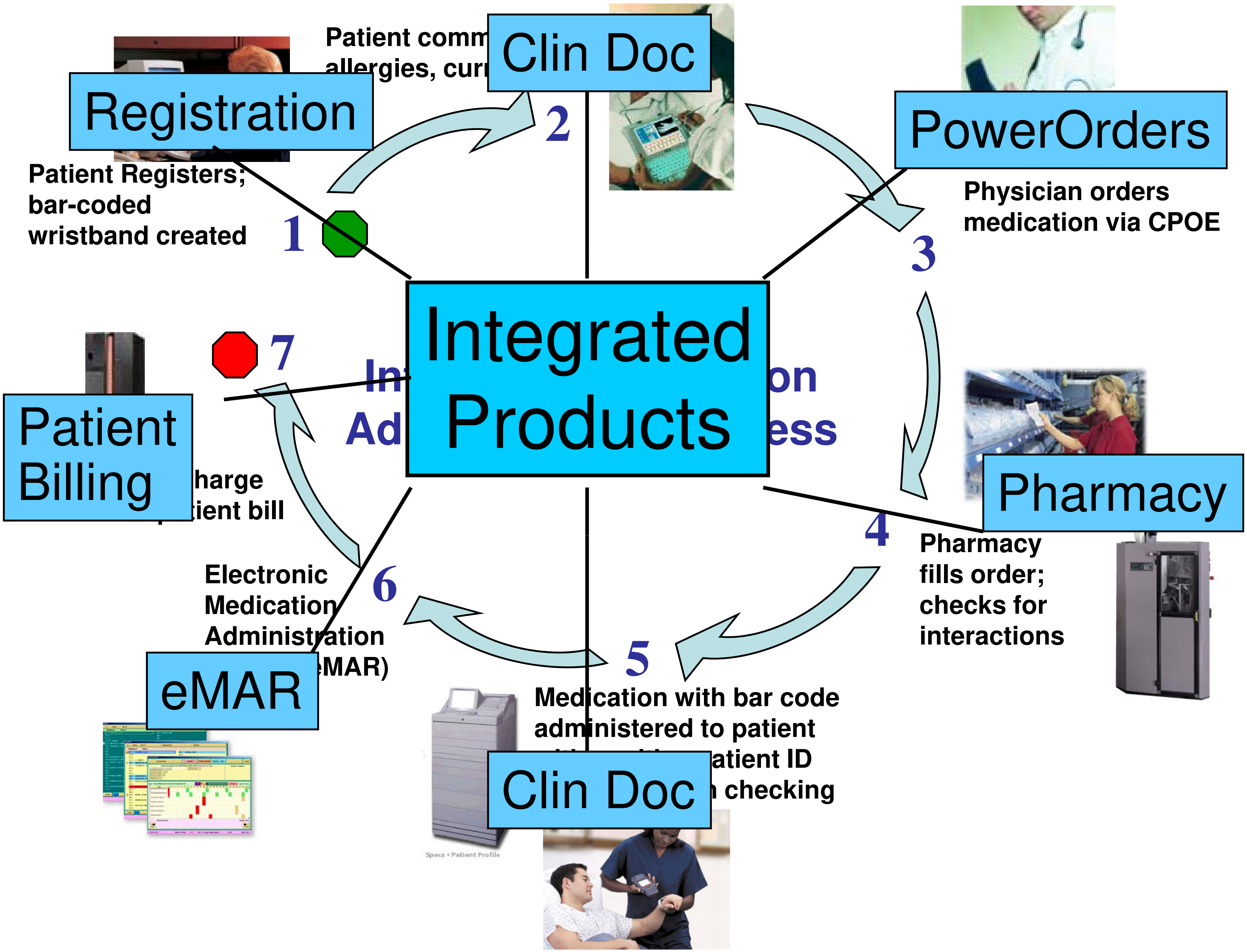
Decision Support in CPOE (3): Drug Alerts



Drug-Drug interaction checking
Drug-Allergy checking
Dose-Range checking

Links to Evidence on internet from patient chart





Registration
Patient Registers; bar-coded wristband created
1
Clin Doc
2
PowerOrders
Physician orders medication via CPOE
3
Integrated Products
Pharmacy
4
Pharmacy fills order; checks for interactions
5
Medication with bar code administered to patient
Clin Doc
6
Electronic Medication Administration
eMAR
7
Patient Billing
Specs • Patient Profile

Key Successes

- Decision Support – Evidence-Based Medicine (easy to do the right thing)
- Inbox, Result Review, Electronic signature
- Timeliness of result availability
- Completeness of record - longitudinal, cross site
- Medication Profile
- Remote access to data (75% of physicians have access from home or office)
- Access to data without chart pull - for returning phone calls or prescription refills
- Ease of concurrent reminders and retrospective reporting for drug recalls or care management data retrieval

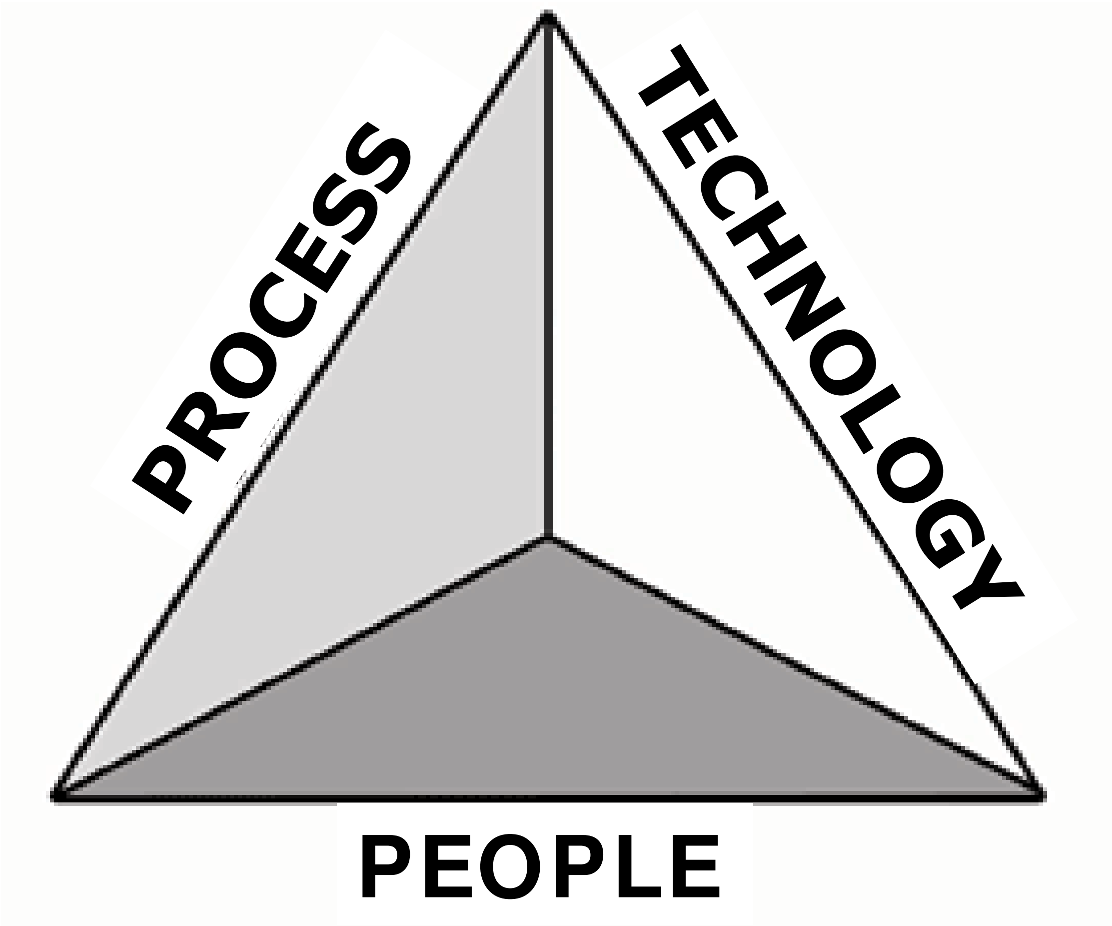
Key Challenges

- Care Team Workflow Redesign and how computer is used at POC (mobile computing devices)
- Training and Support
- Availability of System - aka, NO DOWNTIME (back-up data access strategy)
- Response Time

  Response Time

  Response Time
- Support … maintaining the gains ...

The "Triple Constraint" to Manage in IT Implementations with Clinicians



Electronic Health Record Adoption

EMR Adoption Model℠

Stage	Cumulative Capabilities	2007 Final	Q2 2008
Stage 7	Medical record fully electronic; HCO able to contribute CCD as byproduct of EMR; Data warehousing in use	0.0%	0.0%
Stage 6	Physician documentation (structured templates), full CDSS (variance & compliance), full R-PACS	0.8%	0.9%
Stage 5	Closed loop medication administration	1.4%	1.0%
Stage 4	CPOE, CDSS (clinical protocols)	2.2%	1.8%
Stage 3	Clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology	25.1%	32.0%
Stage 2	Clinical Data Repository, Controlled Medical Vocabulary, Clinical Decision Support, may have Document Imaging	37.2%	33.9%
Stage 1	Ancillaries – Lab, Rad, Pharmacy – All Installed	14.0%	12.6%
Stage 0	All Three Ancillaries Not Installed	19.3%	17.7%

Data from HIMSS Analytics™ Database N = 5073/5071 ©2008 HIMSS Analytics

Ubiquitous Computerization in Healthcare?

"That it will ever come into general use, notwithstanding its value, is extremely doubtful because its beneficial application requires much time and gives a good bit of trouble, both to the patient and to the practitioner because its hue and character are foreign and opposed to all our habits and associations."

- The London Times, 1834

Commenting on the "stethoscope"

Thank You,
Judy

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