



# Examples of the EHR

What is Biomedical and Health Informatics? - <http://informatics.health/>  
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Oregon Health & Science University



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## Examples of the EHR

- Using the Veterans Health Information Systems and Technology Architecture (VistA)
- Why VistA?
  - State-of-the-art EHR that has transformed healthcare in the Veteran's Health Administration (VHA) (Perlin, 2006; Byrne, 2010)
  - Not that pretty, but has all of the modern features of the EHR, e.g., clinical decision support (CDS), computerized provider order entry (CPOE), etc.
  - Distributed under open-source model, unlike most other vendors who do not even allow screen shots to be shown outside their customers' institutions
- Fascinating story (Allen, 2017), but VistA now being phased out in favor of Cerner EHR adopted by Department of Defense
  - <https://www.ehrm.va.gov/>

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## Some details about VistA

- Server written in M (formerly called MUMPS), accessed via command-line interface
  - Runs in commercial Intersystems Cache (on many platforms) or open-source GT.M (Linux only)
- Client (called CPRS) written in Delphi and provides graphical user interface
  - Only runs on Windows (just about all versions)

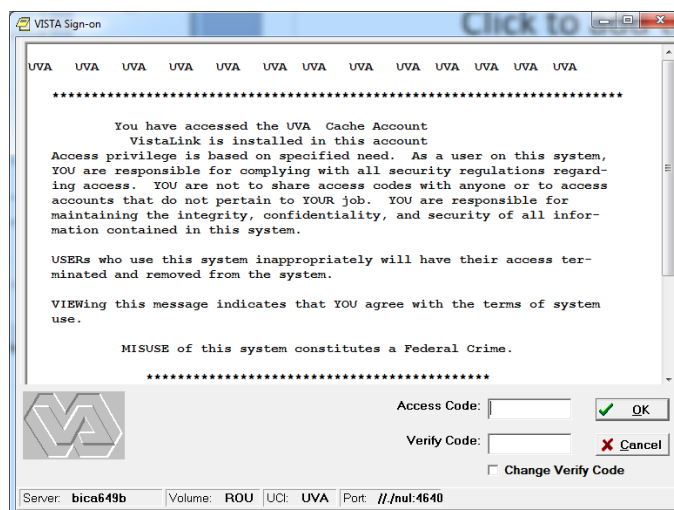
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## Logging on to CPRS, the front end to VistA



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## Choosing a patient

**Patient Selection**

☐ No Default  
☐ Providers  
☐ Team/Personal  
☐ Specialties  
☐ Clinics  
☐ Wards  
☒ All

Patients (All Patients)

Seven, Inpatient

Eight, Inpatient  
 Eight, Outpatient  
 Eight, Patient  
 Eighteen, Inpatient  
 Eighteen, Outpatient  
 Eighteen, Patient  
 Eighty, Inpatient  
 Eighty, Outpatient

Save Patient List Settings

OK  
Cancel

Notifications

Info	Patient	Location	Urgency	Alert Date/Time	Message
	ONE, PATIE (O0001)	GM	Moderate	09/07/2010@08:13	New order(s) placed.
	EIGHTY, OU (E0680)		Moderate	08/30/2010@10:07	Discontinued Consult WHC
	EIGHTY, OU (E0680)		Moderate	08/30/2010@10:07	New consult PSYCH (Today)
	SEVEN, INP (S0807)	3E NO...	Moderate	08/30/2010@07:44	Abnormal labs - [TSH, T-3 RU]

Process Info Process All Process Forward Show Comments Remove

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## Cover sheet – overview

Vista CPRS in use by: Doctor,One (BROKER SERVER)

SEVEN, INPATIENT 3E S 3E-100-4 Primary Care Team Unassigned  
 666-00-0807 Mar 09, 1945 (65) Provider: DOCTOR, ONE Attending: Doctor, Two

Flag VistaWeb Remote Data Postings A

Active Problems

- Depression
- Tachycardia
- Hypertrophy (BENIGN) OF PROSTATE WITHOUT URINARY OBSTRUCTION
- Phlebitis And Thrombophlebitis Of Femoral Vein (DEEP)
- Graves' Disease

Allergies / Adverse Reactions

- Pet Hair
- Keflex

Postings

Allergies

Active Medications

No Active Medications Found

Clinical Reminders

- Depression Screening Due 07.08
- PC Nutritional Screening DUE NOW
- Influenza Vaccine DUE NOW
- Pneumococcal vaccine (Pneumovax) DUE NOW

Recent Lab Results

No Orders Found

Vitals

T	98.6 F	Aug 20, 2010 11:30	(37.0 C)	
P	68	Aug 20, 2010 11:30		
R	24	Aug 20, 2010 11:30		
BP	194/88	Aug 20, 2010 11:30		
HT	70 in	Aug 20, 2010 11:30	(177.8 cm)	
WT	199 lb	Aug 20, 2010 11:30	(90.3 kg)	
PN	0	Aug 20, 2010 11:30		
PDX	98	Aug 20, 2010 11:30		
BMI	28.61	Aug 20, 2010 11:30		

Appointments/Visits/Admissions

Aug 03, 10 09:00	Endocrine	Inpatient Appointment	
Jul 23, 10 08:00	Inpatient Stay	3e North	
Jul 15, 10 13:00	General Medicine	Action Required	
Jul 01, 10 14:00	General Medicine	Action Required	
Jun 20, 10 13:00	General Medicine	Action Required	
Jun 10, 10 10:00	General Medicine	Action Required	
May 24, 10 13:00	Inpatient Stay	3e North	
May 20, 10 08:00	General Medicine	Action Required	
May 18, 10 08:00	General Medicine	Action Required	
May 10, 10 15:00	General Medicine	Action Required	

Cover Sheet | Problems | Meds | Orders | Notes | Consults | Surgery | DIC Summ | Labs | Reports

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## Drilling down to details of a problem

\* Phlebitis And Thrombophlebitis Of Femoral Vein (DEEP)

Phlebitis and thrombophlebitis of femoral vein (deep) (451.11)

Onset: 8/10  
Status: ACTIVE/ACUTE  
SC Cond: NO  
Exposure: None

Provider: DOCTOR, ONE  
Clinic:

Recorded: 8/22/10, by DOCTOR, ONE  
Entered: 8/22/10, by DOCTOR, ONE  
Updated: 8/22/10

----- Audit History -----  
8/22/10: DATE OF ONSET changed by DOCTOR, ONE from to 8/10  
8/22/10: SERVICE changed by DOCTOR, ONE from UNSPECIFIED to MEDICINE

Print Close

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## Details of an allergy

Keflex

Causative agent: KEFLEX  
Nature of Reaction: Allergy

Signs/symptoms: HIVES

Drug Classes: CEPHALOSPORIN 1ST GENERATION

Originator: DOCTOR, ONE (PHYSICIAN)  
Originated: Aug 22, 2010@15:11  
Obs dates/severity: AUG 22, 2010

Verified: No  
Observed/Historical: Observed

Add New Entered in Error Print Close

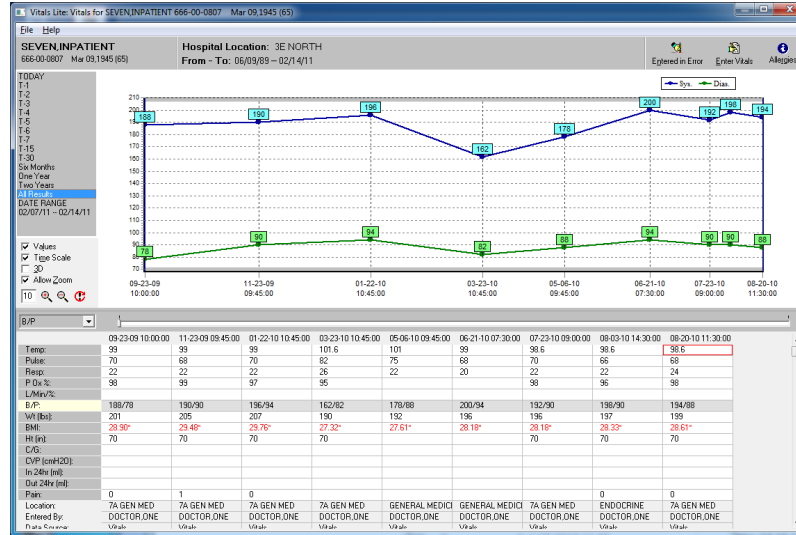
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# Viewing vital signs over time



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# More details on problems

Vista CPRS in use by: Doctor,One (BROKERSERVER)

File

Edit

View

Action

Tools

Help

SEVEN,INPATIENT

666-00-0807    Mar 09,1945 (65)

3E S 3E-100-4

Provider: DOCTOR,ONE

Primary Care Team Unassigned

Attending: Doctor,Two

Flag

VistaWeb

Remote Data

Postings

A

View options

Active

Inactive

Both active and inactive

Removed

Active Problems (5 of 5)

St. | Description

Onset | Last U. | Provider | Service

A | Depression

2009 | Sep 02 2 | Doctor,One

A \* | Tachycardia

Patient presents with tachycardia and Graves ophthalmopathy

Aug 02 2 | Aug 29 2 | Doctor,One | Medical

A | Graves' Disease

Patient requires dietary counseling to reduce iodine intake.

2005 | Aug 24 2 | Doctor,One | Medicine

A \* | Phlebitis and thrombophlebitis of femoral vein (deep)

Aug 201 | Aug 22 2 | Doctor,One | Medicine

A | Hypertrophy (Benign) of Prostate without Urinary obstruction

2009 | Aug 22 2 | Doctor,One | Medicine

New problem

Cover Sheet | Problems | Meds | Orders | Notes | Consults | Surgery | D/C Summ | Labs | Reports

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## List of active orders

Vista CPRS in use by: Doctor,One (BROKERSERVER)

SEVEN,INPATIENT 3E S 3E-100-4 Primary Care Team Unassigned  
666-00-0807 Mar 09,1945 (65) Provider: DOCTOR,ONE Attending: Doctor,Two

View Orders Active Orders (includes Pending & Recent Activity) - ALL SERVICES

Service	Order	Start / Stop	Provider	Nurse	Clerk	Chart
Diet	REGULAR Diet	Start: 08/23/10	Clinical Coordinator,O			
Lab	TSH BLOOD SERUM SP LB #17674	Start: 06/10/10 11:00	Doctor,O			
	T-3 RU BLOOD SERUM SP LB #17674	Start: 06/10/10 11:00	Doctor,O			
	T-4 BLOOD SERUM SP LB #17674	Start: 06/10/10 11:00	Doctor,O			
	FREE T-4 BLOOD SERUM SP LB #17674	Start: 06/10/10 11:00	Doctor,O			
	TSH BLOOD SERUM SP LB #17672	Start: 05/24/10 11:00	Doctor,O			
	T-3 RU BLOOD SERUM SP LB #17672	Start: 05/24/10 11:00	Doctor,O			
	T-4 BLOOD SERUM SP LB #17672	Start: 05/24/10 11:00	Doctor,O			
	FREE T-4 BLOOD SERUM SP LB #17672	Start: 05/24/10 11:00	Doctor,O			
	TSH BLOOD SERUM SP LB #17670	Start: 08/03/10 11:00	Doctor,O			
	T-3 RU BLOOD SERUM SP LB #17670	Start: 08/03/10 11:00	Doctor,O			
	T4, FREE & TOTAL BLOOD SERUM SP LB #17670	Start: 08/03/10 11:00	Doctor,O			

Cover Sheet | Problems | Meds | Orders | Notes | Consults | Surgery | DIC Summ | Labs | Reports

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## Viewing the patient's notes

Vista CPRS in use by: Doctor,One (BROKERSERVER)

SEVEN,INPATIENT 3E S 3E-100-4 Primary Care Team Unassigned  
666-00-0807 Mar 09,1945 (65) Provider: DOCTOR,ONE Attending: Doctor,Two

Last 100 Signed Notes

- Aug 23,10 SCI GENERAL NOTE: 3E NORTH, ONE DOCTOR
- Aug 22,10 Adverse React/Allergy: 7A GEN MED, ONE DOCTOR
- Aug 03,10 OPHTHALMOLOGIST CONSULT NOTE: GENERAL MEDICINE, ONE DOCTOR

Adm: 07/23/10 SCI GENERAL NOTE, 3E NORTH, ONE DOCTOR (Aug 23,10@20:17)

LOCAL TITLE: SCI GENERAL NOTE  
DATE OF NOTE: AUG 23, 2010@20:17 ENTRY DATE: AUG 23, 2010@20:19  
AUTHOR: DOCTOR,ONE EXP COSIGNER:  
URGENCY: STATUS: COMPLETED

REASON FOR VISIT/CHIEF COMPLAINT:  
Evaluation and management of chronic problem(s)

Weight gain

INTERVAL HISTORY:  
weight gain

PHYSICAL EXAMINATION:  
Temperature: 98.6 F (37.0 C) (08/20/2010 11:30)  
Pulse: 68 (08/20/2010 11:30)  
Respiration: 24 (08/20/2010 11:30)  
BP: 194/88 (08/20/2010 11:30)  
Pain: 0 (08/20/2010 11:30)  
Height: 70 in (177.8 cm) (08/20/2010 11:30)  
Weight: 199 lb (90.5 kg) (08/20/2010 11:30)

INTERVAL LABS:  
ASSESSMENT & PLAN:  
Diet Modification  
/es/ ONE DOCTOR  
Signed: 08/23/2010 20:22

/Templates  
New Note

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# Writing a new note

**SEVEN, INPATIENT** 3E S 3E-100-4 Primary Care Team Unassigned  
 666-00-0807 Mar 09,1945 (65) Provider: DOCTOR.ONE Attending: Doctor.Two

Last 100 Signed Notes  
 New Note in Progress  
 Feb 14,11 ADMISSION EVALASSESSMENT, 3E NORTH, DO  
 All signed notes  
 Aug 23,10 SCI GENERAL NOTE, 3E NORTH, ONE DOCTOR  
 Aug 22,10 Adverse ReactiAllergy, 7A GEN MED, ONE DOCTOR  
 Aug 03,10 OPHTHALMOLOGIST CONSULT NOTE, GENERAL

ADMISSION EVALASSESSMENT Feb 14,2011@07:09 Doctor.ONE  
 Adm: 07/23/10 3E NORTH

81 y o man with DM, Neuropathy, hypertension, non-ulcer dyspepsia, here for F/U. On last visit, AAA was suspected on exam, but has been RULED OUT by abd sono.  
 Reports he continue to have nausea when first gets up in AM, has difficulty swallowing food. (Prior EGD 8-02 was grossly nl, but bx showed H. pylori). Also gets bloating sx p-prandially. Cimetidine not helpful. Has changed his diet some. Reports sx all started after an episode of "stomach flu" which never fully resolved. Got better until last episode of "food Poisoning".  
 Home glucoses 120 - 150.  
 BP 160/84 L arm, seated, reg cuff  
 Lungs: clear  
 Heart: reg rhythm, nl sis2, II/VI SEM apex  
 Abd: nl BS, soft, non-tender, no masses/megaly  
 Extas: no edema A: GI sx are predominant complaint.  
 EGD sched for 06-10-03. F/U 1 week after EGD, with Chem Profile and A1C before visit.

<No encounter information entered>

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# Viewing labs

**SEVEN, INPATIENT** 3E S 3E-100-4 Primary Care Team Unassigned  
 666-00-0807 Mar 09,1945 (65) Provider: DOCTOR.ONE Attending: Doctor.Two

Lab Results  
 Most Recent  
 Cumulative  
 All Tests by Date  
 Selected Tests by Date  
 Worksheet  
 Graph  
 Microbiology  
 Anatomic Pathology - All Reports  
 Blood Bank

Headings  
 Cbc Profile  
 Chem Profile  
 Ria (serum)  
 Cell Count (csf)  
 Urinalysis  
 Miscellaneous Tests  
 Date Range  
 Date Range...  
 Today  
 One Week  
 Two Weeks  
 One Month  
 Six Months  
 One Year  
 Two Years  
 All Results

Cumulative (From: EARLIEST RESULT to Feb 14,2011)

--- CBC PROFILE ---

BLOOD	08/23 2010 15:00	08/23 2010 13:00	08/23 2010 13:00	08/23 2010 13:00	08/23 2010 09:00	Reference
						Units Ranges
WBC	15.0 H					k/cmm 3.5 - 8.3
RBC	4.50 L					M/cmm 4.7 - 6.1
RSB	14.3				14.3	g/dL 14 - 18
HCT	41 L			41 L		% 42 - 52
MCV	88.0		88.0			cmu 80 - 94
MCH	31	31				uug 27 - 35
MCHC	31 L					gm/dL 33 - 36
RDW	14					% 11 - 14
PLT	145					K/cmm 140 - 420
LYMPH %						

Comments:  
 a. Correction  
 MCH reported incorrectly as 88 by [10000000086-VA500].  
 Changed to 31 on Aug 24, 2010@17:05 by [10000000086-VA500].  
 MCH flagged incorrectly as H\* by [10000000086-VA500].  
 Changed to normal on Aug 24, 2010@17:05 by [10000000086-VA500].

--- CHEM PROFILE ---

SERUM	08/23 2010 11:00	08/23 2010 11:00	08/23 2010 10:00	08/23 2010 09:00	08/23 2010 09:00	Reference
						Units Ranges

KEY: "L" = Abnormal Low. "H" = Abnormal High. "\*" = Critical Value

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## Including critical values

Vista CPRS in use by: Doctor,One (BROKERSERVER)

SEVEN, INPATIENT 3E S 3E-100-4 Primary Care Team Unassigned  
666-00-0807 Mar 09,1945 (65) Provider: DOCTOR,ONE Attending: Doctor,Two

Lab Results

Most Recent

Test	Result	Flag	Units	Ref Range
GLUCOSE	310	H*	MG/DL	84 - 128
UREA NITROGEN	14			
SODIUM	145			
CHLORIDE	89			
CO2	30			
CREATININE	1.0			
POTASSIUM	7.5			
CALCIUM	10.00			

Specimen: BLOOD; Accession: CH 0825 3; Provider: DOCTOR,ONE  
Report Released Date/Time: Aug 25, 2010 08:10:53  
Performing Lab: ALBANY VA MEDICAL CENTER VA MEDICAL CENTER ALBANY, NY 12180-0097

KEY: "L" = Abnormal Low, "H" = Abnormal High, "\*" = Critical Value

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## More information on lab tests

Lab Test Description

Cbc & Diff (with Morphology)

Cbc & Diff (with Morphology)

Cbc

Cd4

Cd4 %

Cdf

Cea

Cell Count (fluid)

Ceruloplasmin

Chem 10 Test (bronx)

Chem 20

Chem 3

Chem 4

Chem 7

Chem/Ria Panel

Chemistry Admission Panel

Chemistry Fluids

Cbc & Diff (with Morphology)

Highest urgency allowed: ASAP

Unique collection sample: BLOOD LAVENDER

Lab collect sample: BLOOD LAVENDER

Collection sample: BLOOD LAVENDER

Form name/number: HEM

Minimum volume (in mls): 5

Maximum order frequency: 1

Maximum daily order frequency: 1

Tests included in panel:

CBC

DIFFERENTIAL COUNT

Close

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## Including (for some) cost

**Lab Test Description**

Cbc \$2.34  
Highest urgency allowed: STAT  
Tests included in panel:

- WBC
- RBC
- HGB
- HCT
- MCV
- MCH
- MCHC
- RDW
- PLATELET COUNT
- MPV

Close

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## Another patient

**Vista CPRS in use by: DoctorOne (BROKERSERVER)**

**EIGHT, PATIENT** 666-00-0008 Apr 07, 1935 (75) **Visit Not Selected** Provider: DOCTOR.ONE Primary Care Team Unassigned

Active Problems: Headache, Hypertension, Hyperlipidemia, Acute Myocardial Infarction, Unspecified Site, Episode Of Care Unspecified, Chronic Systolic Heart Failure, Diabetes Mellitus Type II Or Unspecified

Allergies / Adverse Reactions: Penicillin, Chocolate

Postings: Allergies, Crisis Note, Advance Directive Completed, Advance Directive, Advance Directive

Active Medications: Metoprolol Tartrate 50mg Tab, Simvastatin 40mg Tab, Non-VA Aspirin 81mg Ec Tab

Clinical Reminders: Depression Screening, PC Nutritional Screening, Diabetes - Urinalysis, Influenza Vaccine, Pneumococcal vaccine (Pneumovax)

Recent Lab Results: No Orders Found.

Vitals: T 98.5 F, P 74, R 22, BP 134/81, HT 70 in, WT 178 lb, PN 1, POX 98, BMI 25.59

Appointments/Visits/Admissions: Aug 26, 10 21:19 Cardiology Action Required, Aug 12, 10 08:00 General Medicine Action Required, Aug 11, 10 09:00 General Medicine Action Required, Aug 10, 10 08:00 General Medicine Action Required, Aug 09, 10 08:00 General Medicine Action Required

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## Clinical decision support: reminders

Clinical Maintenance: Diabetes - Retinal Exam DUE NOW

--STATUS-- --DUE DATE-- --LAST DONE--  
DUE NOW DUE NOW unknown  
Frequency: Due every 1 year for all ages.

Cohort:  
Problem Diagnosis:  
02/14/2011 250.00 DMII WO CMP NT ST UNCNT Priority: CHRONIC Status:  
ACTIVE  
Prov. Narr. - Diabetes Mellitus Type II or unspecified

The patient has a diagnosis of diabetes - a dilated retinal exam by an Optometrist or Ophthalmologist is recommended on at least a yearly basis unless the patient has had a recent normal retinal exam, is not on insulin, and has a controlled HbA1c of <7.5.

Print Close

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## Clinical decision support uses allergy information

Penicillin

Causative agent: PENICILLIN  
Nature of Reaction: Adverse Reaction  
Signs/symptoms: ITCHING, WATERING EYES  
Drug Classes: PENICILLINS AND BETA-LACTAM ANTIMICROBIALS  
Originator: DOCTOR, EIGHT (PHYSICIAN)  
Originated: Mar 17, 2005@20:09  
Verified: <auto-verified>  
Observed/Historical: Historical

Add New Entered in Error Print Close

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## Let's try to prescribe a medication

Vista CPRS in use by: Doctor,One (BROKERSERVER)

File Edit View Action Tools Help

**EIGHT,PATIENT** Visit Not Selected Primary Care Team Unassigned

666-00-0008 Apr 07,1935 (75) Provider: DOCTOR,ONE

Sort by Status/Exp. Date (IMO first on Inpt)

Action	Outpatient Medications	Expires	Status	Last Filled
	METOPROLOL TARTRATE 50MG TAB Qty: 180 for 90 days Sig. TAKE ONE TABLET BY MOUTH TWICE A DAY	02/28/11	Active	Feb 27,10
	SIMVASTATIN 40MG TAB Qty: 90 for 90 days Sig. TAKE ONE TABLET BY MOUTH EVERY EVENING	02/28/11	Active	Feb 27,10

Action	Non-VA Medications	Start Date	Status
	Non-VA ASPIRIN 81 MG EC TAB 81MG MOUTH EVERY MORNING. Non-VA medication recommended by VA provider.		Active

Action	Inpatient Medications	Stop Date	Status	Location
--------	-----------------------	-----------	--------	----------

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## How about some amoxicillin?

Medication Order

AMOXICILLIN CAP,ORAL Change

Dosage	Complex	Schedule
500MG	ORAL (BY MOUTH)	Q8H <input type="checkbox"/> PRN
250MG	ORAL (BY MOUTH)	Q8H
500MG		Q8H*
1000MG		QAM
1500MG		QAMINSULIN
2000MG		QDAY

Comments:

Days Supply: Pick Up 30 ☐ Clinic ☐ Mail ☒ Window Priority ROUTINE

AMOXICILLIN CAP,ORAL 500MG  
TAKE 1 CAPSULE BY MOUTH EVERY 8 HOURS  
Quantity: 90 Refills: 0

Accept Order Quit

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## Oops, patient is allergic

Order Checking

Remote Order Checking not available - checks done on local data only

Previous adverse reaction to: (INACTIVE) PENICILLINS: (LOCAL)

Accept Order Cancel Order

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## Maybe erythromycin?

Medication Order

ERYTHROCIN <ERYTHROMYCIN TAB > Change

Dosage	Complex	Schedule
250MG	ORAL (BY MOUTH)	BID
250MG	ORAL (BY MOUTH)	5XD
250MG	ORAL (BY MOUTH)	AT ONSET
500MG	ORAL (BY MOUTH)	BID
500MG	ORAL (BY MOUTH)	BID AC
1000MG	ORAL (BY MOUTH)	CONTINUOUS DRIP

Comments:

Days Supply: Pick Up: 30  
Clinic Mail Window

Priority: ROUTINE

ERYTHROMYCIN TAB 250MG  
TAKE ONE TABLET BY MOUTH TWICE A DAY  
Quantity: 60 Refills: 0

Accept Order Quit

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## No, interacts with statin drugs

Order Checking

CRITICAL drug-drug interaction: ERYTHROMYCIN & SIMVASTATIN (SIMVASTATIN TAB 40MG TAKE ONE TABLET BY MOUTH EVERY EVENING [ACTIVE])

Accept Order Cancel Order

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## Another patient – drug interactions

Vista CPRS in use by: DoctorOne (BROKERSERVER)

File Edit View Action Tools Help

ZZZTWO,IMAGEPATIENT Visit Not Selected Primary Care Team Unassigned Flag VistaWeb No Postings

666-06-1002 Apr 15,1953 (57) Provider: DOCTOR,ONE Remote Data

Sort by Status/Exp. Date (IMO first on Inpt)

Action	Outpatient Medications	Expires	Status	Last Filled
	SILDENAFIL CITRATE 50MG TAB Qty: 10 Sig: TAKE ONE TABLET BY MOUTH AS NEEDED		Pending	
	ATORVASTATIN CALCIUM 40MG TAB Qty: 90 Sig: TAKE ONE TABLET BY MOUTH EVERY DAY		Pending	

Action	Non-VA Medications	Start Date	Status
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Action	Inpatient Medications	Stop Date	Status	Location
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Cover Sheet Problems Meds Orders Notes Consults Surgery DIC Summ Labs Reports

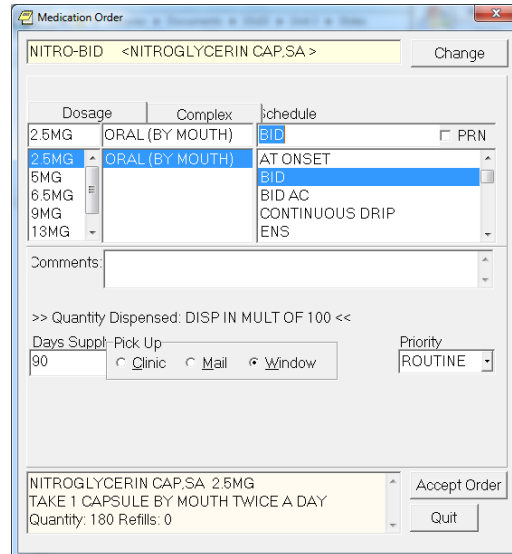
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## Prescribing nitrates for angina



Medication Order window showing the selection of Nitroglycerin capsules. The window title is "Medication Order". The main text area shows "NITRO-BID" and "<NITROGLYCERIN CAP,SA>". Below this is a table with columns "Dosage", "Complex", and "Schedule". The table lists various dosages (2.5MG, 5MG, 6.5MG, 9MG, 13MG) and their corresponding schedules (ORAL (BY MOUTH), AT ONSET, BID, BID AC, CONTINUOUS DRIP, ENS). The "2.5MG" dosage is selected, and the "ORAL (BY MOUTH)" schedule is also selected. Below the table is a "Comments" field. At the bottom, there is a summary section showing "NITROGLYCERIN CAP,SA 2.5MG", "TAKE 1 CAPSULE BY MOUTH TWICE A DAY", and "Quantity: 180 Refills: 0". There are buttons for "Accept Order" and "Quit".

Dosage	Complex	Schedule
2.5MG	ORAL (BY MOUTH)	BID
2.5MG	ORAL (BY MOUTH)	AT ONSET
5MG		BID
6.5MG		BID AC
9MG		CONTINUOUS DRIP
13MG		ENS

Comments:

>> Quantity Dispensed: DISP IN MULT OF 100 <<

Days Supply: Pick Up: 90

Priority: ROUTINE

Accept Order

Quit

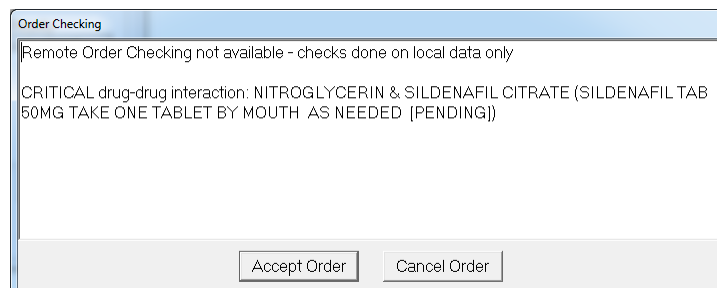
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## Oops!



Order Checking window showing a critical drug-drug interaction. The window title is "Order Checking". The main text area displays the message: "Remote Order Checking not available - checks done on local data only" and "CRITICAL drug-drug interaction: NITROGLYCERIN & SILDENAFIL CITRATE (SILDENAFIL TAB 50MG TAKE ONE TABLET BY MOUTH AS NEEDED [PENDING])". At the bottom, there are buttons for "Accept Order" and "Cancel Order".

Remote Order Checking not available - checks done on local data only

CRITICAL drug-drug interaction: NITROGLYCERIN & SILDENAFIL CITRATE (SILDENAFIL TAB 50MG TAKE ONE TABLET BY MOUTH AS NEEDED [PENDING])

Accept Order

Cancel Order

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## More about VistA

- Pure open-source version is also known as FOIA VistA
- There are two other streams of VistA activity
  - WorldVistA (<http://worldvista.org/>) follows a more traditional open-source pathway
  - OpenVista more commercially oriented, and some vendors have proprietary extensions from the base code (e.g., <https://www.medsphere.com/>)
- Transitioning to commercial Cerner EHR
  - Based on success of nearly complete transition by US Department of Defense
    - <https://www.health.mil/Military-Health-Topics/Technology/MHS-GENESIS>
  - But VA transition has been much more problematic (GAO, 2023)
    - <https://www.ehrm.va.gov/>

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## Other open-source EHRs

- Most recent analysis of free and open-source EHR systems (Purkayastha, 2019)
  - Many downloads but tiny operational usage
- Only two currently have ONC certification
  - OpenEMR – <https://www.open-emr.org/>
  - WorldVista – <https://worldvista.org>
- More use of other noteworthy systems
  - Indian Health Service Resource and Patient Management System (RPMS) – derived from VistA; future unclear (HIS, 2019; Cullen, 2020)
    - <http://www.ihs.gov/rpms/>
  - OpenMRS – <https://openmrs.org/>
  - OpenEHR – <https://www.openehr.org/>
  - LibreHealth – <https://librehealth.io/>

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## Despite appeal of open source, EHR market belongs to commercial vendors

- Market leader is Epic (Newman, 2019; Jennings, 2021)
  - <https://www.epic.com/>
  - Company privately held
  - Over 40 years old
  - Run by CEO Judy Faulkner
  - Lynchpin of Madison, WI economy (Eisen, 2020)
- Early research-oriented “home grown” EHR systems have given way to commercial systems (Hersh, 2017)
- Second-largest EHR is Cerner, which was purchased by DBMS vendor Oracle in 2022 (Landi, 2022)

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## How did Epic come to dominate EHR market?

- Halamka (aka, Geek Doctor) noted “Era of Epic,” where integration and vendor performance trump innovation and “best of breed” (Halamka, 2013)
  - Epic dominates high end of market, e.g., academic and other large medical centers
  - “No one ever got fired for buying Epic”
  - Epic methodology focuses on workflow
  - Product cycle creates effective demand management
- Epic focuses on integration – hospital and ambulatory, revenue cycle and billing, etc., especially in large medical centers (Bruce, 2023)
- Epic touts itself as “healthcare company,” different from technology companies (Perna, 2023)
- Almost all EHR vendors focused only on healthcare market

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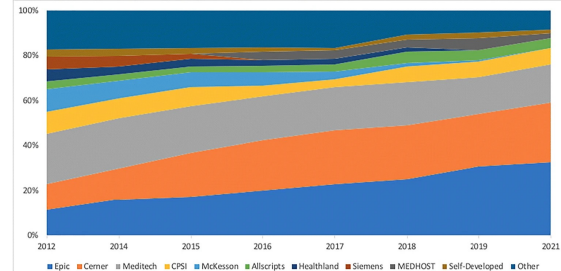
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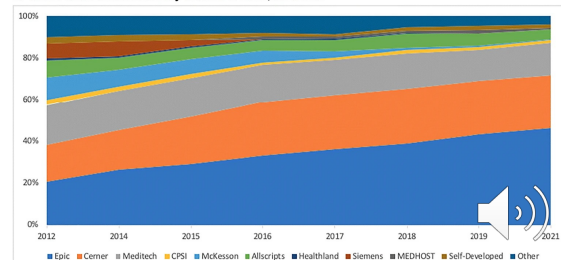
## US EHR market share

- Hospital EHR market has consolidated around two vendors – Epic and Cerner – especially among large hospitals (Holmgren, 2022)
- Four vendors provided service to largest hospitals (>500) beds in 2018 (Landi, 2020)

a EHR Vendor Market Share by Number of Hospitals, 2012-2021



b EHR Vendor Market Share by Number of Beds, 2012-2021



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## Ambulatory EHR marketplace in US (Definitive Healthcare, 2022)

Rank	Vendor	# of Installs	% of Market Share
1.	Epic Systems Corporation	2,502	41.10%
2.	Oracle Cerner	1,413	23.21%
3.	MEDITECH	805	13.22%
4.	Evident, a CPSI Company	486	7.98%
5.	Allscripts	182	2.99%
6.	Athenahealth	123	2.02%
7.	Altera Digital Health, a Harris Company	99	1.63%
8.	Netsmart Technologies	78	1.28%
9.	eClinicalWorks	41	.67%
10.	Proprietary Software	39	.64%

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