Electronic Medical Records

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http://jenders.bol.ucla.edu -> Documents & Presentations
Overview:
Electronic Health Record Systems

• Using the EHR: Why we need it, What it is

• History & characteristics of the EHR

• Adoption:
  – Barriers
  – Improving adoption

• Case study: CSMC
  – Centricity, Web/VS
Need for EHR = CDSS: Medical Errors

Estimated annual mortality

<table>
<thead>
<tr>
<th>Condition</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air travel deaths</td>
<td>300</td>
</tr>
<tr>
<td>AIDS</td>
<td>16,500</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>43,000</td>
</tr>
<tr>
<td>Highway fatalities</td>
<td>43,500</td>
</tr>
<tr>
<td>Preventable medical errors</td>
<td>44,000-</td>
</tr>
</tbody>
</table>
  *(1 jet crash/day)*          | 98,000    |

Costs of Preventable Medical Errors:

$29 billion/year overall

Need for EHR/CDSS: Evidence of Poor Performance

- **USA:** Only 54.9% of adults receive recommended care for typical conditions
  - community-acquired pneumonia: 39%
  - asthma: 53.5%
  - hypertension: 64.9%
  

- **Delay in adoption:** 10+ years for adoption of thrombolytic therapy

Examples of EHR/CDSS Effectiveness

• **Reminders of Redundant Test Ordering**
  – *intervention*: reminder of recent lab result
  – *result*: reduction in hospital charges (13%)

• **CPOE Implementation**
  – Population: hospitalized patients over 4 years
  – Non-missed-dose medication error rate fell 81%
  – Potentially injurious errors fell 86%
Examples (continued)

- **Systematic review**
  - 68 studies
  - 66% of 65 studies showed benefit on physician performance
    - 9/15 drug dosing
    - 1/5 diagnostic aids
    - 14/19 preventive care
    - 19/26 other
  - 6/14 studies showed benefit on patient outcome

Summary: Need for EHR

• **Medical errors are costly**
  – Charges/Costs
  – Morbidity/Mortality

• **CDSS technology can help reduce**
  – errors
  – costs

• **EHR**
  – Collection and organization of data
  – Vehicle for decision support
Evolving Definitions

- **Computer-based Patient Record (CPR):** Electronic documentation of care, integrating data from multiple sources (clinical, demographic info)
  - **EMR:** Single computer application for recording and viewing data related to patient care, typically ambulatory
  - **EHR:** Suite of applications for recording, organizing and viewing clinical data
    - Ancillary systems, clinical data repository, results review, “CIS”, “HIS”
    - “Record” (patient data) vs “Record System” (computer application containing patient data)
EHR = EMR + PHR + CPOE + (etc)

- **EMR**: A computer-accessible resource of medical and administrative information available on an individual collected from and accessible by providers involved in the individual’s care within a single care setting.

- **EHR**: A computer-accessible, interoperable resource of clinical and administrative information pertinent to the health of an individual. Information drawn from multiple clinical and administrative sources is used primarily by a broad spectrum of clinical personnel involved in the individual’s care, enabling them to deliver and coordinate care and promote wellness.

ONC Terms Standardization Project, Defining Key Health IT Terms, Interim Draft Report, 21 February 2008
Personal Health Record

• **PHR**: A computer-accessible, interoperable resource of pertinent health information on an individual. Individuals manage and determine the rights to the access, use, and control of the information. The information originates from multiple sources and is used by individuals and their authorized clinical and wellness professionals to help guide and make health decisions.

• **Recent Examples**: Microsoft HealthVault, Google Health, embedded patient portals (Centricity), Pre-Key (CSMC OB/GYN)

ONC Terms Standardization Project, Defining Key Health IT Terms, Interim Draft Report, 21 February 2008
Computer-based Provider Order Entry

- **CPOE**: Order entry + communication + management using computers
- **Local effort**: EpicCare
- **Advantages**: Reduction in errors, improved documentation, clinical decision support
- **Challenge**: Profound workflow change for the entire organization
History of the Medical Record

- **1910**: Flexner Report--Advocated maintaining patient records
- **1940s**: Hospitals need records for accreditation
- **1960s**: Electronic HIS--communication (routing orders) & charge capture
- **1969**: Weed--POMR
- **1980s**: IOM report, academic systems
- **1990s - present**: Increasing commercial systems, increasing prevalence, emphasis on interoperability & standards (ONCHIT, etc)
Trend Toward Outpatient Records

• Inpatient record structured first
  – Regulatory requirement
  – Many contributors (vs solo family practitioner)
  – Reimbursement: More money than outpatient visits

• Now, more attention to outpatient records
  – Multidisciplinary/team care
  – Managed care
Uses of the Medical Record

- Main purpose: Facilitate patient care
- Historical record: What happened, what was done
- Communication among providers (& patients)
- Preventive care (immunizations, etc)
- Quality assurance
- Legal record
- Financial: coding, billing
- Research: prospective, retrospective
Characterizing the Record: Representing the Patient’s True State

True State of Patient
  - Diagnostic study

Clinician
  - Paper chart
  - Dictation
    - Data entry clerk
    - Transcription

EMR/Chart Representation

Hogan, Wagner. JAMIA 1997;4:342-55
Characterizing the Record: Representing the Patient’s True State

- **Completeness**: Proportion of observations actually recorded
  - 67 - 100%

- **Correctness**: Proportion of recorded observations that are correct
  - 67 - 100%
Functional Components

• Integration of data
  – Standards: Messaging (HL7), terminology (LOINC, SNOMED, ICD9, etc), data model (HL7 RIM)
  – Interface engine
• Clinical decision support
• Order entry
• Knowledge sources
• Communication support: Multidisciplinary, consultation
Who Enters Data

- Clerk
- Physician: Primary, consultant, extender
- Nurse
- Therapist
- Lab reports/ancillary systems
- Machines: Monitors, POC testing
Fundamental Issue: Data Entry

- **Data capture**: External sources
  - Laboratory information systems, monitors, etc
  - Challenges: Interfaces, standards

- **Data input**: Direct entry by clinicians & staff
  - Challenge: Time-consuming and expensive
  - “Free text” vs structured entry
Data Input

• Transcription of dictation: Very expensive, error-prone
• Encounter form: Various types
  – Free-text entry
  – Scannable forms
• Turnaround document: Both presents & captures data
• Direct electronic entry
  – Free-text typing
  – Structured entry: Pick lists, etc
  – Voice recognition
Weakness of Paper Record

- Find the record: Lost, being used elsewhere
- Find data within the record: Poorly organized, missing, fragmented
- Read data: Legibility
- Update data: Where to record if chart is missing (e.g., “shadow chart”)
- Only one view
  - Redundancy: Re-entry of data in multiple forms
  - Research: Difficult to search across patients
- Passive: No decision support
Advantages of EMRs

• **Access:** Speed, remote location, simultaneous use (even if just an “electronic typewriter”)
• **Legibility**
• **Reduced data entry:** Reuse data, reduce redundant tests
• **Better organization:** Structure
• **Multiple views:** Aggregation
  – **Example:** Summary report, structured flow sheet (contrast different data types)
  – **Alter display based on context**
Advantages of EMRs (continued)

• **Automated checks on data entry**
  – Data prompts: Completeness
  – Range check (reference range)
  – Pattern check (# digits in MRN)
  – Computed check (CBC differential adds to 100)
  – Consistency check (pregnant man!)
  – Delta check
  – Spelling check
Advantages of EMRs (continued)

• **Automated decision support**
  – Reminders, alerts, calculations, ordering advice
  – Limited by scope/accuracy of electronic data
    • **Tradeoff:** Data specificity/depth of advice vs time/cost of completeness

• **Cross-patient analysis**
  – Research
  – Stratify patient prognosis, treatment by risks

• **Data review:** Avoid overlooking uncommon but important events
Advantages of EMRs (continued)

- Saves time?
  - **1974 study**: find data 4x faster in flow sheet vs traditional record (10% of subjects could not even find some data)
  - **2005 systematic review**
    - RN POC systems: decreased documentation time 24%
    - MD: increased documentation time 17%
      - CPOE: More than doubled time

Disadvantages of EMRs

• **Access:** Security concerns
  – Still, logging helps track access

• **Initial cost**
  – **Attempted solutions:** Reimbursement, Office VistA

• **Delay between investment & benefit**

• **System failure**
Disadvantages of EMRs (continued)

- Challenge of data entry
- Coordination of disparate groups
- **Data diversity:** Different data elements, media (images, tracings), format, units, terminology, etc
- **Unintended consequences**
  - Increase in overall mortality after CPOE (2.8% -> 6.57%)
  - Highlighted poor use of older technology

“C’mon, c’mon—it’s either one or the other.”
Examples: “Classical” EMRs

• COSTAR
  – Originally in 1960s, disseminated in late 1970s
  – Encounter form input
  – Modular design: security, registration, scheduling, billing, database, reporting
  – MQL: ad hoc data queries
  – Display by encounter or problem (multiple views)
“Classical” EMRs (continued)

- **RMRS**: McDonald (IU), 1974
- **TMR**: Stead & Hammond (Duke), 1975
- **STOR**: Whiting-O’Keefe (UCSF), 1985
Commercial EMRs

- **General use**: EpicCare, Centricity, NextGen, etc

- **Specialty use**: Velos (clinical research), RemedyMD (clinical research), TeleResults (transplant), Easydent (dental)

- **“Free”**: Office VistA EHR
Adoption

• No advantage if not used!

• Varying prevalence in USA
  – 20% (MGMA, January, 2005)
  – 17% (CDC ambulatory medical care survey 2001-3, published March, 2005)

• Higher prevalence elsewhere
  – Netherlands = 90%, Australia = 65%
  – Reasons: Single-payer system, certification, cost-sharing
Barriers to EHR Adoption

- **Financial**: Up-front costs, training, uncertain ROI (misalignment of benefits & costs), finding the right system
- **Cultural**: Attitude toward IT
- **Technological**: Interoperability, support, data exchange
- **Organizational**: Integrate with workflow, migration from paper
Improving Adoption

• **Interoperability**: Increase chance that EHRs can be used with each other + other systems
  – Standards: CCR
  – Harmonization: HITSP
  – Certification: CCHIT

• **Compensation**
  – CPT code: CMS trial
  – P4P: Reporting measures; decision support to improve performance

• **Donation**
  – “Safe harbor” provisions in federal law
Improving Adoption: Interoperability Standards

• **Continuity of Care Record**: ASTM E31 WK4363 (2004). Coalition = AAP, AAFP, HIMSS, ACP, AMA, etc.

• **Continuity of Care Document**: Further standardization

• Defines the core data elements & content of the patient record in XML

• **Uses**: Record sharing (paper or electronic), eRx (allergies, medications), certification
Improving Adoption: Interoperability Standards

- EHR Functional Model and Specification
- HL7 2004: Funded by US Government
- Identifies key functions of the EHR
- Purpose
  - Guide development by vendors
  - Facilitate certification
  - Facilitate interoperability
- Certification governance: CCHIT
<table>
<thead>
<tr>
<th>Direct Care</th>
<th>Supportive</th>
<th>Information Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC1.0 Care Management</td>
<td>S1.0 Clinical Support</td>
<td>I 1.0 EHR Security</td>
</tr>
<tr>
<td>DC2.0 Clinical Decision Support</td>
<td>S2.0 Measurement, Analysis, Research, Reporting</td>
<td>I 2.0 EHR Information and Records Management</td>
</tr>
<tr>
<td>DC3.0 Operations Management and Communication</td>
<td>S3.0 Administrative and Financial</td>
<td>I 3.0 Unique identity, registry, and directory services</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I 4.0 Support for Health Informatics &amp; Terminology Standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I 5.0 Interoperability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I 6.0 Manage business rules</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I 7.0 Workflow</td>
</tr>
<tr>
<td>ID</td>
<td>Formative Ballot Content</td>
<td>Functional Description</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>DC.1.1.3.2</td>
<td>Manage medication list Create and maintain patient-specific medication lists.</td>
<td>Medication lists are managed over time, whether over the course of a visit or stay, or the lifetime of a patient. All pertinent dates, including medication start, modification, and end dates are stored. The entire medication history for any medication is viewable. Medication lists are not limited to medication orders recorded by providers, but may include patient-reported medications.</td>
</tr>
<tr>
<td>DC.1.1.3.3</td>
<td>Manage allergy and adverse reaction list Create and maintain patient-specific allergies and reactions.</td>
<td>Allergens and substances are identified and coded (whenever possible) and the list is managed over time. All pertinent dates, including patient-reported events, are stored and the description of the patient allergy and reaction is modifiable over time. The entire allergy history, including reaction, for any allergen is viewable.</td>
</tr>
<tr>
<td>DC.1.1.4</td>
<td>Manage Patient History Capture, review, and manage medical, procedural, social, and family history including the capture of pertinent negative histories, patient-reported or externally available patient clinical history.</td>
<td>Patient historical data related to previous medical diagnoses, surgeries and other procedures performed on the patient, and relevant health conditions of family members is captured through such methods as patient reporting (for example interview, medical alert band or electronic or non-electronic historical data. This data may take the form of a positive or a negative such as: &quot;The patient/family member has had...&quot; or &quot;The patient/family member has not had...&quot;) When first seen by a health care provider, patients typically bring with them clinical information from past encounters. This and similar information is captured and presented.</td>
</tr>
</tbody>
</table>
Improving Adoption:
Standards Process in USA

• Standards are created

• Competing standards are harmonized by HITSP

• Vendors incorporate standards in software

• CCHIT certifies that software complies with standards

• Clinicians use certified software
Improving Adoption: DOQ-IT

- **Doctor’s Office Quality - Information Technology**
  - Outgrowth of CMS-funded QIOs
  - ACP, Lumetra, etc
  - **Goal:** Overcome barriers to EHR adoption

- **Interventions**
  - **Expert advice:** Needs assessment, vendor selection, case management, workflow integration
  - **Peer-to-peer dialog:** Share best practices
  - **Does not provide funding, day-to-day assistance**
Improving Adoption: Office VistA

- **VistA**: Veterans Information System Technology Architecture
  - M-based comprehensive VA EHR
  - Includes CPRS = Computer-based Patient Record System
- **Office VistA**
  - Outpatient version
  - Available under FOIA
- **Challenge**: Free up front, but need to implement and maintain
Improving Adoption: RHIOs + HIEs

• Facilitates interoperability: Mechanism for exchanging data between organizations

• Important elements
  – Standards: Messaging, data model, terminology
  – Mechanism: Clearinghouses

• Part of a federated NHIN

• Important driver: Public health
  – Integrate data from many HCOs
  – Syndromic surveillance (e.g., RODS, etc)

• Examples: Santa Barbara; Indiana; CalRHIO
Improving Adoption: “Safe Harbor”

- **Goal**: Facilitate adoption by having hospitals cover part of the cost of the EMR
- **Challenge**: Federal law restricts the business relationship between MDs and hospitals
  - Anti-kickback law
  - Anti-self-referral law (“Stark”)
- **Medicare Modernization Act of 2003**: Mandated creation of a “safe harbor” exception for HIT
  - Final rule adopted 8/2006
  - Allows donation of hardware & software to promote e-prescribing
  - Software must be certified (CCHIT)
EHR at CSMC

• **Components**
  – Central data repository
  – Ancillary systems (lab, radiology)

• **Accessing data:** Electronic medical records
  – Web/VS
  – Centricity
  – EpicCare: On the way

• **Knowledge sources**
  – Electronic textbooks + libraries
  – InfoButtons
  – Order Sets
Hypertension Visit

History of Present Illness - Hypertension

Current symptoms: none

Current Status
Compliance with tx: poor
Comments: Copious salt consumption

Risk Factors
Tobacco use: current
   cigarettes: 1 pack(s) per day

Review of Systems
General: Dullness, fever, chills, sweats, anorexia, fatigue, malaise, weight loss

Vital Signs
Height: 70 inches
Blood Pressure: 200/100 mm Hg

Physical Exam
General appearance: well developed, well nourished, no acute distress

Ears, Nose and Throat
Teeth/Gums/Palate: poor dentition

Neck
Neck veins: no JVD, a, v or cannon a waves
Thyroid: no nodules, masses, tenderness, or enlargement

Respiratory
<table>
<thead>
<tr>
<th>Formulary Medication</th>
<th>Quantity</th>
<th>Previous Rx</th>
<th>Date</th>
<th>Refill</th>
<th>Quantity</th>
<th>Date</th>
<th>Refill</th>
<th>Pharmacy</th>
<th>Authorized By</th>
<th>Prescribing Method</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYTRIN CAP 8MG (TERAZOSIN HCL)</td>
<td>30</td>
<td>0</td>
<td>10/20/1998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 Hour Pharmacy</td>
<td>Jenoff MD, Robin C</td>
<td>Telephone</td>
<td>Oregon</td>
</tr>
<tr>
<td>1 mg po</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>737 SW 189th</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSYNYL TABS 20 MG (LESINOPRIL)</td>
<td>30</td>
<td>2</td>
<td>10/20/1998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Alpha, OR 97007 USA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mg po</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>903-642-5547</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUMULINI 70 MG (ISLORIN REO &amp; ISOPHANE)</td>
<td>600</td>
<td>0</td>
<td>10/20/1998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 units po</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 units po</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Breakfast</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRODAC CAPS 10 MG (FLUORETIN HCL)</td>
<td>30</td>
<td>2</td>
<td>10/20/1998</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 po od</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CALAN SR 188 MG TBXR (VERAPAMIL HCL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 tab po</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2 tab po</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For Help, press F1
### Results reported from 9/23/05 through 9/27/05

<table>
<thead>
<tr>
<th>Collection Date/Time</th>
<th>Result Date/Time</th>
<th>Test Name</th>
<th>Result</th>
<th>Ref. Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/23/05 09:31</td>
<td>9/23/05 11:33</td>
<td>Logician HEMATOLOGY-ONCOLOGY OFFICE VISIT by Chaisanguanathing</td>
<td>1443087104351910</td>
<td></td>
</tr>
<tr>
<td>9/23/05 09:31</td>
<td>9/26/05 01:18</td>
<td>Outpatient Clinic MEDICATION LIST</td>
<td>1443087104351910</td>
<td></td>
</tr>
<tr>
<td>9/23/05 08:02</td>
<td>9/26/05 13:00</td>
<td>POC INR</td>
<td>Accession No. F8632</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>INR REFERENCE RANGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>THERAPEUTIC: 2.0-3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HIGH DOSE 2.5-3.5</td>
</tr>
</tbody>
</table>

Confidentiality Warning: The information in this system should only be viewed by patient care personnel with a "need to know" for purposes of diagnosis and treatment. All accesses are logged with your name, the patient's name, the type of data viewed, the date and time. Inappropriate accesses are subject to disciplinary measures and/or legal action, up to and including termination of employment on the first offense. Any printouts from this system should be disposed of properly.
### Outpatient Medications

<table>
<thead>
<tr>
<th>Start Date</th>
<th>Medication</th>
<th>Instructions</th>
<th>Status</th>
<th>Micro Medex</th>
<th>Skolar MD</th>
<th>Care Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/1/2005</td>
<td>ASCORBIC ACID 500 MG</td>
<td>1 tab daily</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/4/2005</td>
<td>COREG</td>
<td>3.125 mg BID</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/12/2005</td>
<td>COUMADIN 5 MG TABS (WARFARIN SODIUM)</td>
<td>Take 7.5mg every Thurs &amp; 5mg on all other days of the week.</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/22/2005</td>
<td>FERROUS SULFATE 325 MG TABS</td>
<td>Take one tab daily</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/22/2005</td>
<td>ISOSORBIDE MONONITRATE CR 60 MG TB24</td>
<td>Take one daily</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LIPITOR 10 MG TABS (ATORVASTATIN CALCIUM)</td>
<td>take 1 daily</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/26/2005</td>
<td>LOVENOX 70MG</td>
<td>70 mg sub-q bid; restart lovenox after procedure</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/6/2005</td>
<td>PAXIL 20 MG</td>
<td>1 tab daily</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VASOTEC 10 MG TABS (ENALAPRIL MALEATE)</td>
<td>take 1 tab bid</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/23/2005</td>
<td>XELODA 150 MG TABS (CAPECITABINE)</td>
<td>2 tabs po bid</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/23/2005</td>
<td>XELODA 500 MG TABS (CAPECITABINE)</td>
<td>3 tabs po bid</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ZETIA 10 MG TABS (EZETIMIBE)</td>
<td>take 1 daily</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ZOFTRAN 4 MG TABS (ONDANSETRON HCL)</td>
<td>1 tab every 6-8 hours as needed for nausea after chemotherapy</td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Click medication dose for detailed dosing and administration information. Click 📚 for on-line search of information resources.

**Confidentiality Warning:** The information in this system should only be viewed by patient care personnel with a “need to know” for purposes of diagnosis and treatment. All accesses are logged with your name, the patient's name, the type of data viewed, the date and time. Inappropriate accesses are subject to disciplinary measures and/or legal action, up to and including termination of employment on the first offense. Any printouts from this system should be disposed of properly.
Protocol "USPS 65 Yrs & Older Males" :
    Male patients with an age of greater than 65 years.
    Should have the following:

<table>
<thead>
<tr>
<th>Test</th>
<th>Schedule</th>
<th>Last Done</th>
<th>Last RsIt</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEMOCULT</td>
<td>Every 12 months</td>
<td></td>
<td></td>
<td>Due Now</td>
</tr>
<tr>
<td>or SIGMOID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP DIASTOLIC</td>
<td>Every 24 months</td>
<td>06/18/2007</td>
<td>80</td>
<td>Due On: 06/18/2008</td>
</tr>
<tr>
<td>BP SYSTOLIC</td>
<td>Every 24 months</td>
<td>06/18/2007</td>
<td>140</td>
<td>Due On: 06/18/2008</td>
</tr>
<tr>
<td>FLU VAX</td>
<td>Every 12 months</td>
<td></td>
<td></td>
<td>Due Now</td>
</tr>
<tr>
<td>PNEUMOVAX</td>
<td>Every 7 years</td>
<td></td>
<td></td>
<td>Due Now</td>
</tr>
<tr>
<td>TD BOOSTER</td>
<td>Every 10 years</td>
<td></td>
<td></td>
<td>Due Now</td>
</tr>
</tbody>
</table>

Comment: "Height and weight are recommended as part of the periodic health examination. Visual screening questions, assessment for hearing impairment, and assessment for problem drinking are recommended as part of the health examination."

Protocol "Nursing Compliance" :
    Patients of either sex.
    Should have the following:

<table>
<thead>
<tr>
<th>Test</th>
<th>Schedule</th>
<th>Last Done</th>
<th>Last RsIt</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEATBELT USE</td>
<td>Every 6 months</td>
<td>06/18/2007</td>
<td>100</td>
<td>Due Now</td>
</tr>
<tr>
<td>FLU VAX</td>
<td>Every 12 months</td>
<td></td>
<td></td>
<td>Due Now</td>
</tr>
<tr>
<td>PAIN NOW?</td>
<td>Every 1 months</td>
<td></td>
<td></td>
<td>Due Now</td>
</tr>
<tr>
<td>TOBACCO USE</td>
<td>Every 6 months</td>
<td></td>
<td></td>
<td>Due Now</td>
</tr>
</tbody>
</table>
Inquiry

Find: Patients

☐ Active Patients Only

Where: Problem Code, Active (Diagnosis lookup)

is

Hypertension (ICD-401.9)

Count Result:

Search Result: Patients found: 18

Blair, Linda
Brandon, Marjorie L.
calloway, cab
Davenport, Scott L.
duck, donald
Geiner, Kevin S.
Greene, Loren
Inishi, Robert S.
Johnson, Cheryl L.
Lopez, Lisa
Mann, Michelle
Nygberg, Carl O.
O’Malley, Martha A.
PPEES, ALOT
Simpson, Laura P.
test, more
TESTING, CMIS A.
Training8, Test8
### Clinical Results

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Test Name</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/13/03 00:00</td>
<td>ECHOCARDIOGRAM - ECHO/DOPPLER/COLOR</td>
<td>by Kraam</td>
</tr>
<tr>
<td>10/13/03 16:55</td>
<td>DUAL CT CHEST W CONTRAST</td>
<td>by Kraam</td>
</tr>
<tr>
<td>10/13/03 16:35</td>
<td>DUAL CT NECK W CONTRAST</td>
<td>by Kraam</td>
</tr>
<tr>
<td>9/16/03 00:00</td>
<td>ADENOSINE MYOCARDIAL PERFUSION</td>
<td>by Friedman</td>
</tr>
<tr>
<td>7/6/03 01:56</td>
<td>ROUTINE BLOOD COUNT</td>
<td>by Mehoon</td>
</tr>
</tbody>
</table>

### Flow Sheets

- Blood Bank
- Reports
- Find Any Test

### Routine Blood Count

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC COUNT</td>
<td>9.6</td>
</tr>
<tr>
<td>BCC COUNT</td>
<td>5.33</td>
</tr>
<tr>
<td>HEMOGLOBIN</td>
<td>16.3</td>
</tr>
<tr>
<td>HEMATOCRIT</td>
<td>46.9</td>
</tr>
<tr>
<td>MCV</td>
<td>84.2</td>
</tr>
<tr>
<td>MCH</td>
<td>29.4</td>
</tr>
<tr>
<td>MCHC</td>
<td>34.7</td>
</tr>
</tbody>
</table>

### Diff, Automated

<table>
<thead>
<tr>
<th>Test</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLYS</td>
<td>56</td>
</tr>
<tr>
<td>LYMHPES</td>
<td>52</td>
</tr>
<tr>
<td>MONOES</td>
<td>6</td>
</tr>
<tr>
<td>EOS</td>
<td>4</td>
</tr>
<tr>
<td>BASOS</td>
<td>1</td>
</tr>
<tr>
<td>ABS POLYS</td>
<td>3.3</td>
</tr>
<tr>
<td>ABS LYMHPES</td>
<td>5.1</td>
</tr>
<tr>
<td>ABS MONOES</td>
<td>0.6</td>
</tr>
<tr>
<td>ABS EOS</td>
<td>0.3</td>
</tr>
<tr>
<td>ABS BASOS</td>
<td>0.1</td>
</tr>
</tbody>
</table>

### Platelet Count

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEAN PLATELET Vol.</td>
<td>7.4</td>
</tr>
</tbody>
</table>

### Differential Count

- **WBC Count:** 9.6
- **Hemoglobin:** 16.3 g/dL
- **Hematocrit:** 46.9%
- **Mean Corpuscular Volume (MCV):** 84.2 fl
- **Mean Corpuscular Hemoglobin (MCH):** 29.4 pg
- **Mean Corpuscular Hemoglobin Concentration (MCHC):** 34.7 g/dL
- **White Blood Cell (WBC) Differential:**
  - **Neutrophils (POLYS):** 56%
  - **Lymphocytes (LYMHPES):** 52%
  - **Monocytes (MONOES):** 6%
  - **Eosinophils (EOS):** 4%
  - **Basophils (BASOS):** 1%
  - **Absolute Neutrophils (ABS POLYS):** 3.3 x 10^3/μL
  - **Absolute Lymphocytes (ABS LYMHPES):** 5.1 x 10^3/μL
  - **Absolute Monocytes (ABS MONOES):** 0.6 x 10^3/μL
  - **Absolute Eosinophils (ABS EOS):** 0.3 x 10^3/μL
  - **Absolute Basophils (ABS BASOS):** 0.1 x 10^3/μL
- **Platelet Count:** 7.4 x 10^3/μL
ADENOSINE MYOCARDIAL PERFUSION STUDY

Reason: chest pain
Symptoms: atypical chest pain
History: CATH (03/10/2003), Valve surgery (03/13/2003)
Medication: beta blockers, calcium blocker

STRESS TEST RESULTS: Type walking adenosine
- Peak heart rate: 102
- Blood pressure: Rest: 148/82 Stress: 165/84
- Symptoms during test: none
- Resting ECG: 1st degree A-V block, nonspecific T wave abnormality
- Stress ECG: no 12-lead depression

NUCLEAR RESULTS: Dual isotope gated SPECT [stress perfusion (max+prox) rest thallium]
- Myocardial Perfusion results: Total defect 0% myocardium (0% reversible, 0% fixed)
  - LV enlargement: no, Lang angle normal
  - Visual TID: no, TID ranges: 1.13
- Myocardial Function results:
  - Rest: 135 ml
  - Post stress: (38 min after) 62%, 167 ml
  - Post exercise: (1 min after) 77%, 187 ml

CONCLUSION: Clinical response: Nonspecific
- Perfusion Normal
- ECG response: Nonspecific
- Function Normal

These rest test results indicate a low (<10%) likelihood for the presence of jeopardized myocardium.

Based on 5,073 patients undergoing adenosine myocardial perfusion SPECT at Cedars Sinai Medical Center and followed for 2.2 ± 1.1 years, the combined clinical, adenosine stress ECG and perfusion SPECT results observed in this patient are predictive of an annual cardiac death rate of <0.2%. These estimates of risk do not take into account ventricular function or the results of previous testing.

Thank you for referring this patient to us.

Sincerely yours,
John D. Friedman
Cardiologist, Imaging Specialist

[Signature]

[Date: 10/10/2003] [Printed: 10/10/2003 11:17]

[Patient's Medical Record]

[Laboratory Test Results]

[Blood Test Values]
## Physician Encounter Form

**Patient Name:** JENDERS, ROBERT  
**Medical Rec. No.:** 00147091

**Admitting Physician:**  
**Referring Physician:**  
**Billing Physician:** ROBERT A. JENDERS (877)

**Date of Admission:**  
**Date of Injury:**  
**Date of LMP:**  
**Physician Email:** jenders@csom.edu  
**Assistant’s Email:**

**Resident:**

**Latest Visit:**  
- I was physically present and directly participated with the resident/fellow in the patient’s care (CC modifier for Medicare only).
- I am a primary care physician for this patient.
- I am a consultant for this patient.

### Evaluation and Management

#### History
- **(PF) Problem Focused**  
  - Brief HPI (1-3 elements)
- **(EF) Expanded Problem Focused**  
  - Expanded HPI (4 or more elements)
- **(P) Problem-pertinentROS** (1 system)
- **(D) Detailed**  
  - Problem-pertinent ROS (2-9 systems)
  - Pertinent PFSH (1 area)
- **(C) Comprehensive**  
  - Complete ROS (10 or more)
  - Complete PFSH (2-3 areas)

#### Exam
- **(PF) Problem Focused**  
  - Limited exam of affected body area or organ system
- **(EF) Expanded Problem Focused**  
  - Expanded exam of affected body area/organ system
- **(D) Detailed**  
  - Extended exam of affected body area/organ system

#### Medical Decision Making
- **(S) Straightforward** (Q of 1)  
  - Minimal clinical decision making
  - Minimal risk
- **(L) Low Complexity** (Q of 2)  
  - Limited data
  - Low-risk clinical decision making
- **(M) Moderate Complexity** (Q of 3)  
  - Limited data
  - Moderate risk clinical decision making
- **(H) High Complexity** (Q of 5)  
  - Extensive data
  - High-risk clinical decision making

### Supplementary Documentation
- **Face-to-Face Time with Patient (minutes):**  
- **Consulting/Coordination Time (minutes):**

### Inpatient Encounter Type

- Initial Inpatient Hospital Care (Admit)
- Subsequent Inpatient Hospital Care
- Hospital Discharge Services
- Inpatient Consultation
- Inpatient Observation
- Observation or Admit with Same Day Discharge
- Follow-up Inpatient Consultation

### Prolonged Services
- **First Hour**  
- **Additional**  
- **30-Minute Increments**

### Critical Care Services
- **None**
- 30-74 minutes
- 75-104 minutes
- 105-134 minutes
- 135-164 minutes
- 165-194 minutes

### Inpatient E&M Codes
- Initial Inpatient Hospital Care (Admit):  
  - 99211 D or G/D or CSP or LC (30 min)
  - 99222 C/S/CMMC (30 min)
  - 99223 C/S/CNC (30 min)

- Subsequent Inpatient Hospital Care:  
  - 99231 P/P/S/EF or LC (15 min)

- Hospital Discharge Services:  
  - 99239 30 minutes or less (document time in medical record)
  - 99239 More than 30 minutes (document time in medical record)

- Inpatient Consultation:  
  - 99251 P/P/S (30 min)

- Critical Care Services (document time in medical record, must not include resident time, teaching time, or time performing separately billed procedure):  
  - 99251 First 30-74 minutes
  - 99252 Each additional 30 minutes

- Prolonged Inpatient Services (used only in addition to basic inpatient E&M services)
Clinical significance

- NOT helpful for diagnosis in patients without anemia.
- Red cell size distribution width should be used in conjunction with other diagnostic tests.
- Useful in the early classification of some anemias:
  - Red cell size distribution width often becomes abnormal earlier than other red cell parameters.
  - More sensitive in microcytic conditions than microcytosis.
  - Most useful to distinguish early iron deficiency from:
    - Anemia of chronic disease
    - Thalassemia minor.
  - Useful to improve detection of early iron, vitamin B12 or folate deficiency.
  - Usually interpreted in conjunction with the mean cell volume (MCV).

<table>
<thead>
<tr>
<th>Indices</th>
<th>Red cell size distribution width elevated</th>
<th>Red cell size distribution width normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCV low</td>
<td>Anemia of chronic disease (occasionally)</td>
<td>Anemia of chronic disease (occasionally)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ABLLYM</th>
<th>ABBLYMP</th>
<th>ABBLYMP</th>
<th>ABBLYMP</th>
<th>ABBLYMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.12</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Percentages:

- 1.2-1.1 1000/mL
- 4.5-6.0 MILL/L
- 14.18 G/DL
- 42.53 %
- 88-100 F/L
- 27.33 F/L
- 32.56 %
- 11.5-14.5 %
- 7.4-10.4 F/L

Refer to range values for more detailed interpretation.
Diabetes Mellitus – Adult > Ambulatory Hemoglobin A1c Reminder

Evoke

[A patient's electronic medical record is closed in an outpatient setting] OR [the “Adult Diabetes Ambulatory” order set is signed].

Logic

[The patient is age ≥ 18 years] AND [the problem list includes “diabetes mellitus”] AND [there is no hemoglobin A1c level recorded within the last year] AND [a hemoglobin A1c level has not been ordered on the “Adult Diabetes Ambulatory” order set] AND [a hemoglobin A1c level is not preselected on the customized “Adult Diabetes Ambulatory” order set defined by the hospital] AND [a “hemoglobin A1c testing exclusion form” has not been completed during this encounter]

Action

A reminder is presented that states: “No hemoglobin A1c level has been documented in the last year.”

Option: Display reminder
Option: Order a hemoglobin A1c level
Option: Document reason for not ordering a hemoglobin A1c level

Date Entered: 7/29/2002
Date Modified: 5/12/2003
Authors: Berta Yen MD, Victor Lee MD, David Rhew MD
Version: 1.7
Institution: Zynx Health
Purpose: When an electronic medical record is closed in an outpatient setting for an adult patient with diabetes mellitus, or an adult diabetes ambulatory order set is signed, a reminder that a hemoglobin A1c (HbA1c) level has not been documented in the last year will be displayed to the user if certain criteria are met.
Explanation: The annual testing of HbA1c in patients with diabetes mellitus is a quality of care measure in the 7th Scope of Work by the Centers for Medicare & Medicaid Services, and is a national performance measure according to the National Quality Forum.
Keywords: diabetes mellitus, hemoglobin A1c, Hba1c

© 2004, Zynx Health, Incorporated
<table>
<thead>
<tr>
<th>Order Set</th>
<th>Pneumonia - CAP, Adult</th>
<th>Admission to Med/Surg</th>
</tr>
</thead>
</table>

**Orders**
- Conditions
- Vital Signs
- Activity
  - Bed rest
  - Up to chair
- Nursing Orders
- Diet
- IV Fluids

**Medications**
- Antibacterial Agents
  - Ampicillin
  - Beta-lactamase Inhibitors
  - Carbapenems
- Cephalosporins, 2nd-Generation
- Cephalosporins, 3rd-Generation
- Cephalosporins, 4th-Generation
- Fluoroquinolones
- Lincomycins
- Macrolides
- Monobactams
- Nitroimidazoles
- Penicillins
- Tetracyclines

**Supporting Evidence**

**Laboratory**
- Chemistry
- Hematology
- Microbiology
- Pathology
- Serology
- Urine Studies
- Other

**Reminders**

**My Hospital Order Sets**
- Create New
- Go, Print
- Include order description
Summary

• **EHR needed:** Acquisition and management of clinical data
  – Many advantages, some disadvantages
  – Key: integration of data

• **Aspects of the EHR:** Functions, advantages, disadvantages

• **Improving adoption**
  – Standards, interoperability
Additional Resources


• HHS. http://www.hhs.gov/healthit/
Future Discussions

Lecture #1: Computers in Patient Care: The Basics of Medical Informatics  
Wednesday, 8 August 2007

Lecture #2: Electronic Medical Records  
Wednesday, 12 March 2008

Lecture #3: Computer-based Clinical Decision Support  
Wednesday, 13 August 2008

Lecture #4: Computer-based Information Retrieval and Use  
Wednesday, 11 March 2009
Thank you!

jenders@csmc.edu

jenders@ucla.edu

http://jenders.bol.ucla.edu

http://jenders.bol.ucla.edu -> Documents & Presentations