CTSI Module 8 Workshop
Biomedical Informatics, Data Standards & Practical Tools

Data Standards & Terminologies, Part III

Coordinators: William Hsu, PhD & Corey Arnold, PhD
Medical Imaging Informatics Group
Dept of Radiological Sciences
UCLA School of Medicine
**Objective:** Provide basic and clinical translational scientists with a working understanding of biomedical informatics principles and their applications in biomedical data collection, standardization, representation, and analysis.

<table>
<thead>
<tr>
<th>Intro to Biomedical Informatics</th>
<th>Data Standards &amp; Terminologies</th>
<th>Practical Tools in Informatics</th>
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<tbody>
<tr>
<td>Familiarize participants with the basic principles of biomedical informatics demonstrated by ongoing projects and services across the CTSI sites.</td>
<td>Describe the use of data standards for representation and exchange of clinical information in the context of electronic health records and clinical decision support.</td>
<td>Provide a demonstration of CTSI-specific applications and resources that facilitate the management and analysis of clinical and experimental data.</td>
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- Introduce the foundational concepts of biomedical informatics and its subfields
- Understand the role of informatics in evidence-based medicine
- Distinguish the different types of health information
- Learn about UCLA CTSI efforts related to this area and whom to contact for expert consultation

- Describe the use of standards for data coding, knowledge representation and exchange of clinical information
- Discuss the importance of controlled terminologies as a specific class of standards
- Learn about health information system architecture

- Demonstrate data collection using REDCap
- Discuss software tools and resources for data collection, extraction and representation, and analysis
- Showcase resources available through the CTSI, member campuses, and the UC system
Lecture Outline

- **5/7 Part I: Informatics in healthcare and translational research (D. Bell, 1.5 hrs)**
  - Introduce the fundamental concepts of biomedical informatics and its subfields
  - Learn about UCLA CTSI efforts related to this area and whom to contact for expert consultation

- **5/9 Part II: Community-based informatics research (O. Ogunyemi, 1.5 hrs)**
  - Summarize the role of informatics in public health and addressing health disparity issues
  - Define disease registries, their implementation and applications, and considerations
  - Discuss development towards a national learning health care system

- **5/14 Part III: Electronic health record systems (R. Jenders, 1.5 hrs)**
  - Introduce principles of health information system architecture and design
  - Describe the use of standards for data coding, knowledge representation and exchange of clinical information

- **5/16 Part IV: Clinical decision support (R. Jenders, 1.5 hrs)**
  - Enumerate techniques for clinical decision support (e.g., alerts, infobuttons)
  - Present standards for clinical decision support

- **5/23 Part V: Practical tools in biomedical informatics (W. Hsu/C. Arnold, 3 hrs)**
  - Demonstrate data collection using REDCap (Martin Lai, UCLA CTSI)
  - Services provided by the biostatistics core (David Elashoff, UCLA Biostatistics)
  - Discussion of advanced tools and services available (William Hsu/Corey Arnold, UCLA Medical Imaging Informatics)
Module Resources

• Recorded webcast & materials
  – [http://www.ctsi.ucla.edu/education/training/webcastmodules](http://www.ctsi.ucla.edu/education/training/webcastmodules)

• CTSI virtual home
  – [http://intranet.ctsi.ucla.edu/](http://intranet.ctsi.ucla.edu/)
  – Biomedical Informatics Program
    [http://www.ctsi.ucla.edu/about/pages/bip2](http://www.ctsi.ucla.edu/about/pages/bip2)
Electronic Health Record Systems

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Professor of Medicine
Charles Drew University
Visiting Professor, Department of Medicine, UCLA
Attending Physician, Harbor-UCLA Medical Center

CTSI Biomedical Informatics Module
14 May 2013

http://jenders.bol.ucla.edu
Biomedical Informatics: Definitions

• “Medical informatics is a developing body of knowledge and a set of techniques concerning the organizational management of information in support of medical research, education, and patient care. Medical informatics combines medical science with several technologies and disciplines in the information and computer sciences and provides methodologies by which these can contribute to better use of the medical knowledge base and ultimately to better medical care.” – AAMC (1986)
## TIGER Nursing Informatics Competencies Model

<table>
<thead>
<tr>
<th>Component of the Model</th>
<th>Standard</th>
<th>Source (Standard-Setting Body)</th>
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<tbody>
<tr>
<td>Basic Computer Competencies</td>
<td>European Computer Driving License</td>
<td>European Computer Driving License Foundation</td>
</tr>
<tr>
<td>Information Literacy</td>
<td>Information Literacy Competency Standards</td>
<td>American Library Association</td>
</tr>
<tr>
<td>Information Management</td>
<td>Electronic Health Record Functional Model – Clinical Care Components</td>
<td>Health Level Seven (HL7)</td>
</tr>
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<td>International Computer Driving License – Health</td>
<td>European Computer Driving License Foundation</td>
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Educational Objectives

- Learn the need for EHRs
- Identify key components of an EHR system
- Recognize the role standards play in HIT
- Understand the principles and purpose of controlled terminologies
Overview: EHRs

• **Using the EHR**
  – Why we need it
  – History & aspects of the EHR

• **Adoption**
  – Barriers
  – Improving adoption: standards, interoperability
  – Core features: Messaging, data models, terminologies

• **Case study:** Archetypal Hospital EHRs
**Need for EHR = CDSS: Medical Errors**

<table>
<thead>
<tr>
<th>Estimated annual mortality</th>
<th></th>
</tr>
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<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>
<tr>
<td></td>
<td><em>(1 jet crash/day)</em></td>
</tr>
</tbody>
</table>

**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 (CDSS)

• **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
Need for EHRs: “Meaningful Use”

- Monetary incentive program created by ARRA HITECH (2009): Payments by CMS for participation
- **Key ingredients:** Use information technology "meaningfully" (eRx), health data exchange, reporting quality measures
- **Phases**
  - Stage I (2011-2012): Hospitals report 20/24 quality measures
  - Stage II (2013) + Stage III (2015)
- **Other programs:** NCQA, NQF
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.

- **EHRs**: 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
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

Data entry clerk

CPR/Chart Representation

Dictation

Transcription

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

• **Architecture:** Integration of data
  - **Standards:** Messaging (HL7), terminology (LOINC, SNOMED, ICD9, etc), data model (HL7 RIM)
  - Interface engine
  - **Repositories:** CDR (real-time clinical practice), CDW (batch, for research + administration)

• **Clinical decision support**
• **Order entry**
• **Knowledge sources**
• **Communication support:** Multidisciplinary, consultation
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
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 Computer Records

- **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 Computer Records (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 Computer Records (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 Computer Records (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

Key Ingredients for EHR Success

- Wide scope of data
- Sufficient duration of data
- Understandable representation of data
- Sufficient access
- Structured data: More than just a giant word processor
Disadvantages of Computer Records

• Access: Security concerns
  – Still, logging helps track access
• Initial cost
  – Attempted solutions: Reimbursement, Office VistA
• Delay between investment & benefit
• System failure
• Challenge of data entry
• Coordination of disparate groups
• Data diversity: Different data elements, media (images, tracings), format, units, terminology, etc
Examples: “Classical” EHRs

- **COSTAR**: MGH (Barnett et al)
  - 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” EHRs (continued)

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

• **Trend:** Vendor-supported solutions as technology has diffused
  – **Range:** General medical practice to highly specialized

• **Examples**
  – **General:** Centricity, Epic, Eclipsys, Siemens, Cerner, Office VistA EHR
  – **Research:** Remedy MD, Velos
  – **Specialized:** Tele-Results (transplant)
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)
  - Now: Approximately 50% (“meaningful use”)

• **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
  – Systemic Interoperability Commission

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

• **Standards**
  – Certification: CCR/CCD, EHR Functional Model & Specification
  – HIPAA/NCVHS & CHI
Improving Adoption: CCR / CCD

- ASTM E31 WK4363 (2004). Coalition = AAP, AAFP, HIMSS, ACP, AMA, etc
- Defines the core data elements & content of the patient record in XML
  - Read/write standard data elements: Snapshot of the record
  - Therefore increases interoperability
- Uses: Record sharing, eRx (allergies, medications), certification
- Components: standard content; elements spreadsheet; implementation guide; XML schema
- CCD = CCR implemented using HL7 CDA
<xml version="1.0" encoding="UTF-8" >
  <ContinuityOfCareRecord xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:astm-org:CCR CCR9.xsd" xmlns="urn:astm-org:CCR">
    <CCRDocumentObjectID>632485590297343750</CCRDocumentObjectID>
    <DateTime>2005-04-08T12:10:29Z</DateTime>
    - <Patient>
      <ActorID>AA0001</ActorID>
    </Patient>
    - <From>
      <ActorLink>
        <ActorID>AA0002</ActorID>
        - <ActorRole>
          <Text>Primary Care Provider</Text>
        </ActorRole>
      </ActorLink>
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    - <Purpose>
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        <Text>Data Transfer</Text>
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    - <Body>
      - <Problems>
        - <Problem>
          <CCRDataObjectID>BB0001</CCRDataObjectID>
          - <DateTime>
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              <Text>Onset</Text>
            </Type>
            <ExactDateTime>1999-04-01T05:00:00Z</ExactDateTime>
          </DateTime>
        </Problem>
      </Problems>
    </Body>
  </ContinuityOfCareRecord>
Improving Adoption: EHR Functional Model & 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>
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<tr>
<th>Direct Care</th>
<th>Supportive</th>
<th>Information Infrastructure</th>
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<tbody>
<tr>
<td>DC1.0</td>
<td>S1.0</td>
<td>I1.0 EHR Security</td>
</tr>
<tr>
<td></td>
<td>S2.0</td>
<td>I2.0 EHR Information and Records Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I3.0 Unique identity, registry, and directory services</td>
</tr>
<tr>
<td>DC2.0</td>
<td>S3.0</td>
<td>I4.0 Support for Health Informatics &amp; Terminology Standards</td>
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<tr>
<td></td>
<td></td>
<td>I5.0 Interoperability</td>
</tr>
<tr>
<td>DC3.0</td>
<td></td>
<td>I6.0 Manage business rules</td>
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<td>I7.0 Workflow</td>
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<td>Operations Management and Communication</td>
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<td></td>
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<tr>
<td>ID</td>
<td>Function Name</td>
<td>Function Statement</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DC.1.1.3.2</td>
<td>Manage medication list</td>
<td>Create and maintain patient-specific medication lists.</td>
</tr>
<tr>
<td>DC.1.1.3.3</td>
<td>Manage allergy and adverse reaction list</td>
<td>Create and maintain patient-specific allergies and reactions.</td>
</tr>
<tr>
<td>DC.1.1.4</td>
<td>Manage Patient History</td>
<td>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>
</tr>
</tbody>
</table>
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
  - Due for release Q4 2005 (available under FOIA)

- **Challenge**: Free up front, but need to implement and maintain
Improving Adoption: 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 through Standards: Architectural Elements to Support EHRs

- **Components to support decision support**
  - Central data repository: Data models
  - Controlled, structured vocabulary
  - Data messaging (HL7 v2.x, v3)

- **Decision Support**
  - Knowledge acquisition
  - Knowledge representation (KR)
HL7 EHR/CDSS Standards Efforts

- **Components**
  - Data model: RIM
  - Standard vocabularies
  - CDA: documents
  - Access: CCOW

- **Knowledge representation**
  - Arden Syntax
  - InfoButton
  - Order Set
  - Health eDecisions (HeD)

- **EHR Functional Model and Standard**
Standard Data Models

- **Candidates**
  - RIM = HL7 Reference Information Model
  - vMR = Virtual Medical Record

- **Purpose:** Promote knowledge transfer
  - Standardize references to patient data in “rules”
  - **Goal:** Avoid manual rewriting of data references when sharing “rules”
Standard Data Models: HL7 RIM

- High-level, abstract model of all exchangeable data
  - Concepts are objects: Act (e.g., observations), Living Subject, etc
  - Object attributes
  - Relationship among objects

- Common reference for all HL7 v3 standards

- Facilitates interoperability: Common model for messaging, queries

Schadow G, Russler DC, Mead CN, McDonald CJ. Integrating medical information and knowledge in the HL7 RIM. Proc AMIA Symp 2000;:764-768.
Virtual Medical Record (vMR): RIM for Decision Support

- **Goal:** Provide common information model upon which interoperable clinical decision support resources (e.g., rules) can be developed

- **Status:** R1 adopted in 2011 as HL7 standard, R2 in progress

- More detailed than the high-level RIM
vMR Problem Model

**DeniedProblem**

**Problem**
- ageAtOnset : PQ [0..1]
- importance : CD [0..1]
- problemStatus : CD [0..1]
- severity : CD [0..1]
- wasCauseOfDeath : BL [0..1]

**ProblemBase**
- affectedBodySite : BodySite [0..*]
- diagnosticEventTime : IVL_TS [0..1]
- problemCode : CD
- problemEffectiveTime : IVL_TS [0..1]

**BodySite**
- bodySiteCode : CD
- laterality : CD [0..1]

**ClinicalStatement**
- dataSourceType : CD [0..1]
- id : IL
- templateId : IL [0..*]

+relatedClinicalStatement 0..*
Why Not Just Use the CCD as the vMR?

- CCD does not include all needed information
  - E.g., Family history model suitable for CDS

- CCD is not sufficiently intuitive for direct use by CDS knowledge authors
HL7 vMR – Tools and Use

• Tools
  – OpenCDS: open-source reference implementation

• Known users of vMR standard (partial list)
  – Alabama Department of Public Health
  – eClinicalWorks
  – HLN Consulting, LLC
  – HP Advanced Federal Healthcare Innovation Lab
  – Intermountain Healthcare Homer Warner Center
  – Medical-Objects
  – New York City Department of Health & Mental Hygiene
  – University of Utah Health Care
  – VHA Knowledge Based Systems Office
Database Management System

- **DBMS** = suite of domain-independent programs for managing data
- Typical model = relational (data in “tables”)
- Functions
  - Data entry forms
  - Security: Access control & backup
  - Data modeling (schema implementation)
  - APIs for linkages to other software
  - Data integrity: Type-checking, consistency-checking
- Typical commercial DBMS: Access (low end), Oracle
Standard Vocabularies

- CHI + NCVHS efforts: Patient Medical Record Information (PMRI) terminology standards

- Examples: SNOMED-CT, ICD-9, LOINC, CPT, etc

- Facilitation: Free licensing of SNOMED in USA as part of UMLS

- Use: HL7 Common Terminology Services (CTS) standard
What is a vocabulary?

- **Terminology**: Controlled list of concepts
- **Vocabulary**: 1+ terminologies with additional information (relationships, definitions, etc)
- **Controlled**: limited list of terms (clinician may not use any old term to express a concept)
- **Structured**: Concepts have explicit relationships (ISA, PART-OF, etc) that create a hierarchy with classes & subclasses of related concepts
Vocabulary Structure

Medical Entity

Substance
  - Chemical
    - Carbohydrate
      - Glucose
    - Bioactive Substance
      - Plasma
  - Anatomic Substance
    - Plasma

Laboratory Specimen
  - Substance Measured
  - Substant Sampled

Event
  - Diagnostic Procedure
    - Laboratory Procedure
      - CHEM-7
  - Laboratory Test
    - Has Specimen
      - Plasma Glucose

Part of
Concept Structure

- Plasma Glucose
  - CSMC code
  - SNOMED code
  - Misys code
  - Reference range lower limit
  - Reference range upper limit
  - Units
  - Analyte
  - ...
Why do we need one? Uses

• **Comprehensive data dictionary:** Describe data collected electronically

• **Different names for the same thing**
  – Data stored using one coding scheme can be translated to another
  – Data from different sources can be stored using a consistent set of concepts

• **Uniform representation of data**
  – Queries for the CDR, data warehouse
Retrieving Results by Class

K#1 = 4.2
K#1 = 3.3
K#2 = 3.2
K#1 = 3.0
K#3 = 2.6
Standard Vocabularies: Examples

• **Endorsed by CMS (45 CFR 162 = HIPAA requirement)**
  – ICD9-CM (ICD10 in Canada/Europe)
  – NDC
  – CPT-4
  – HCPCS (subsumes CPT + non-MD services)
  – Code on Dental Procedures & Nomenclature

• **Others**
  – SNOMED (sponsored by IHTSDO)
  – LOINC
CDEs

• **Challenge:** Burgeoning electronic means for capturing data, but those data are not necessarily standardized
  – Example: REDCap

• **Goal:** Create standard libraries of instrument items and coded answer lists
  – Example: PROMIS (now coded in LOINC)

• **Multiple efforts underway**
  – NIH: ORDR, NINDS, NCI

• **Challenge:** Decentralized efforts not coordinated

Additional Standards: CHI

- Consolidated Health Informatics initiative = health care portion of eGov
- Coalition of DoD, VA and HHS
- **Endorsed common standards (3/2003)**
  - HL7: messages
  - NCPDP: ordering from pharmacies
  - IEEE 1073: Medical Information Bus (devices)
  - DICOM: imaging
  - LOINC: laboratory, vital signs
UMLS

• NLM’s Unified Medical Language System
  – Goal: Facilitate access to bibliographic material

• Interlingua of multiple terminologies (LOINC, SNOMED, ICD, MeSH, etc)
  – Built-in tools
  – Commercial applications: Apelone, Health Language Inc

• Parts
  – Metathesaurus: Codes + terms
  – Information Sources Map (ISM): Where knowledge is (journals, electronic textbooks, etc)
  – Semantic Network: Concept relationships
Standard Messaging: Health Level Seven

• Defines the envelope in which data travel
  – Vocabularies define the data themselves
  – v2.x: Predefined message formats consisting of “segments,” each of which has “fields”
  – V3: Model-based messaging

• Simplifies system implementation
  – Each interface does not mean reinventing the wheel

• HL7: Started as a messaging scheme
  – Most organizations use v2.x (CSMC = 2.3)
  – Transition in the (far) future: v3
HL7 Message Example

MSH!^~\&!resquery!cicsu9!bobsqry!cucis!19930330102416611!!OR
  F!19930330102416611!P!2.1!!''!
MSA!AA!19920720113142729000!RESULT LIST COMPLETED.!!
QRD!19920720113142!RI!0113142729!!!!1!3131313!RES!*!!
QRF!*!19900601000000!19930203000000!PDQRES2~*~*!78~56~54~PF~
  0001CM01921223144005~A~~*~*~*~*~*
OBR!!CM01921223765005!19921227651300344321!2203^^L^2235^^L!N
  !!19921223181300000000!!!!!!!!!!!!1992122819523961234!!!F!
  !!!!!!!!!!
OBX!!TX!910^^L^315^^L!1^0!KLEBSIELLA PNEUMONIAE!!!!!!!
OBX!!TX!1235^^L^1181^^L!2^1!>16  R!!!!!!!
OBX!!TX!1187^^L^1181^^L!3^1!S  S!!!!!!!
OBX!!TX!1184^^L^1181^^L!4^1!16  R!!!!!!!
OBX!!TX!1193^^L^1181^^L!5^1!>64  R!!!!!!!
OBX!!TX!1223^^L^1181^^L!6^1!<1  S!!!!!!!
Archetypal Hospital EHRs

- **Components**
  - Repositories: CDR, CDW
  - HL7 communication interfaces (lab, imaging, etc)
- **Accessing data:** Electronic health records
  - Web portal & viewing
  - Ambulatory EMRs (Centricity, Epic, etc)
  - CPOE (Epic, AllScripts, McKesson, etc)
- **Knowledge sources**
  - Electronic textbooks
  - Bibliographic access
  - InfoButtons
  - Order Sets
Laboratory
Web/VS
CMA
Medical Logic
Billing & Financial

Pharmacy

Radiology

Database Interface

CDR

Terminology Service (HLI)

Data Warehouse

Medical Logic

Terminology Service (HLI)
<table>
<thead>
<tr>
<th>Collection Date/Time</th>
<th>Result Date/Time</th>
<th>Test Name</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/30/04 18:00 JEHDES</td>
<td></td>
<td>Routine Blood Count</td>
<td>Accession No: 838560</td>
</tr>
<tr>
<td>7/5/03 23:41</td>
<td></td>
<td>RBC COUNT</td>
<td>3.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HEMOGLOBIN</td>
<td>14.18 C/DL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HEMATOCRIT</td>
<td>42.53%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCV</td>
<td>80.10 FL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCH</td>
<td>27.33 PO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCHC</td>
<td>32.46%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RBC ESTRUBIN WIDTH</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLATELET SCREEN</td>
<td>300000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MEAN PLATELET VOL</td>
<td>7.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DIFF, AUTOMATED</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POLYS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LYMPHS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MONOS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EOS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BASOS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABS POLYS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABS LYMPHS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABS MONOS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABS EOS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABS BASOS</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RBC MORPHOLOGY</td>
<td>ABNORMAL</td>
</tr>
</tbody>
</table>
ADENOSINE MYOCARDIAL PERFUSION STUDY

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

STRESS TEST RESULTS: Type: walking adenosine

- Peak heart rate: 102
- Blood pressure: Rest: 114/72; Stress: 160/84
- Symptom during test none.
- Resting ECG: 1st degree A-V block, nonspecific T wave abnormality.
- Stress ECG: no ST segment depression

NUCLEAR RESULTS: Dual isotope gated SPECT [stress sestamibi(sapin]+proof) / rest thallium]

- Myocardial Perfusion results: Total defect 0% myocardium (0% reversible, 0% fixed)
- LV ejection fraction: Normal
- Visual TID: no; TID mild: 1.13
- Myocardial Function results:
  - Rest: 65%
  - Post stress (38 min after): 62%
- Post adenosine testing gated SPECT revealed no wall motion abnormalities.

CONCLUSION: Clinical response: Nonischemic
- ECG response: Nonischemic
- Function: Normal

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

Based on 5,873 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 annual cardiac death rate of <0.2%. These estimates do not take into account ventricular function or the results of previous testing.

Thank you for referring this patient to us.

Sincerely yours,

[Signature]

Heart Imaging Specialist
Cardiac Imaging Specialist
JDF/JDP Processed: 10/10/2003 09:24 Printed: 10/10/2003 11:17
cc: [Name], [Kardia Fax 310-425-0245]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>BASOS</td>
<td>1</td>
</tr>
<tr>
<td>ABS POLY</td>
<td>1.6</td>
</tr>
<tr>
<td>ABS LYMPS</td>
<td>3.1</td>
</tr>
<tr>
<td>ABS MONOS</td>
<td>0.6</td>
</tr>
<tr>
<td>ABS RGB</td>
<td>0.3</td>
</tr>
<tr>
<td>ABS BASHOS</td>
<td>0.1</td>
</tr>
<tr>
<td>REO MORPHOLOGY</td>
<td>ABNORMAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ref. Range</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.11100000/UL</td>
<td>4.56000000/UL</td>
</tr>
<tr>
<td>1.0-1.00000000/UL</td>
<td>14-18 G/DL</td>
</tr>
<tr>
<td>42-53%</td>
<td>80-100 FL</td>
</tr>
<tr>
<td>27-33 PG</td>
<td>32-36 %</td>
</tr>
<tr>
<td>11.5-14.5 %</td>
<td>150000-2400000/UL</td>
</tr>
<tr>
<td>7.4-10.4 FL</td>
<td>%</td>
</tr>
<tr>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>%</td>
<td>%</td>
</tr>
</tbody>
</table>
Clinical Results

Results reported from 4/24/03 through 4/30/04

PATIENT: CEDARS-SINAI MEDICAL CENTER

MED REC:

DIRECTOR:

EMERGENCY TREATMENT RECORD
07/25/03

CHIEF COMPLAINT: Chest pain.

HISTORY OF PRESENT ILLNESS: A 35-year-old black male presents with chest pain. The patient reports that about 2-1/2 to 3 hours ago, he began complaining of a mild left-sided chest pain. He said he only noticed the pain with movement of the chest and the left arm. He said that he has no pain at the present time. He has no pain at rest. He has not had a similar problem in the past. He said the pain came on after he was wrestling with a 7-year-old child. He has had no shortness of breath. No nausea, no vomiting, no sweating, no cough, no spu- tum, no hemoptysis, no fever, no night sweats and no chills.

PAST MEDICAL HISTORY: Aortic valve replacement five months ago.

MEDICATIONS: Lotensin, Norvasc, hydrochlorothiazide, aspirin.

ALLERGIES: NO KNOWN DRUG ALLERGIES.

SOCIAL HISTORY: The patient smokes, occasional alcohol, no drugs. Lives with girlfriend.

EMERGENCY DEPARTMENT REVIEW OF SYSTEMS: All systems were reviewed and all systems were negative, except for HPI.

PHYSICAL EXAMINATION: GENERAL: A well-appearing black male, in no...

LABS:

- ABS POLYS: 2.5
- ABS LYMPH: 3.1
- ABS MONOS: 0.6
- ABS EOS: 0.3
- ABS BASOS: 0.1

RBC MORPHOLOGY: ABNORMAL
<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>9/26/05 01:18</td>
<td>Outpatient Clinic MEDICATION LIST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/23/05 09:31</td>
<td>9/23/05 11:33</td>
<td>HEMATOLOGY-ONCOLOGY OFFICE VISIT</td>
<td>by Chaisanghuanthum</td>
<td></td>
</tr>
<tr>
<td>9/23/05 08:02</td>
<td>9/23/05 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>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1.4</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 access is 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>Stop Date</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></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></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></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></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></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></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></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></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></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></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></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></td>
<td>Verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ZOFRAN 4 MG TABS (ONDANSETRON HCL)</td>
<td>1 tab every 6-8 hours as needed for nausea after chemotherapy</td>
<td></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.

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View Antibigram  Print
## Physician Encounter Form

<table>
<thead>
<tr>
<th>Patient Name:</th>
<th>JENDERS, ROBERT</th>
<th>Date of Admit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Rec. No.:</td>
<td>001417091</td>
<td>Date of Service:</td>
</tr>
<tr>
<td>Admitting Physician:</td>
<td></td>
<td>Date of Injury:</td>
</tr>
<tr>
<td>Referring Physician:</td>
<td></td>
<td>Date of LMP:</td>
</tr>
<tr>
<td>Billing Physician:</td>
<td>ROBERT A. JENDERS (379)</td>
<td>Physician Email: <a href="mailto:jenders@csmc.edu">jenders@csmc.edu</a></td>
</tr>
<tr>
<td>Resident:</td>
<td></td>
<td>Assistant’s Email:</td>
</tr>
</tbody>
</table>

### Inpatient Encounter Type

- Initial Inpatient Hospital Care (Admit)
- Subsequent Inpatient Hospital Care
- Hospital Discharges Services
- Inpatient Consultation
- Hospital 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)
  - 99221 (DC or CI) or 99222 (CI/CMS) or 99223 (CI/CMS)
  - 99224 (CI/CMS or LC) (30 min)
- Subsequent Inpatient Hospital Care
  - 99221 (DC or CI) or 99222 (CI/CMS) or 99223 (CI/CMS)

- Hospital Discharge Services
  - 99238 (30 minutes or less)
  - 99239 (More than 30 minutes (document time as medical record))

- Inpatient Consultation
  - 99211 (PR/PS/SP or LC) (30 min)

### Critical Care Services

- document time to medical record, must not include resident, teaching, or time performing separately billed procedures
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 macrocytic.
- Most useful to distinguish early iron deficiency from:
  - anemia of chronic disease
  - thalassemia minor.
- Useful to improve detection of early iron, vitamin B12 or folic acid deficiency.
- Usually interpreted in conjunction with the mean cell volume (MCV).

Indices

<table>
<thead>
<tr>
<th>MCV low</th>
<th>Red cell size distribution width elevated</th>
<th>Red cell size distribution width normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS LYMPHS</td>
<td>3.1</td>
<td>Anemia of chronic disease (occasionally)</td>
</tr>
<tr>
<td>ABS MONOS</td>
<td>0.6</td>
<td>Anemia of chronic disease (occasionally)</td>
</tr>
<tr>
<td>ABS EOS</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>ABS BASOS</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>RBC MORPHOLOGY</td>
<td>ABNORMAL</td>
<td></td>
</tr>
</tbody>
</table>
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: Dismiss 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: Eolina Yen MD, Victor Lee MD, David Rhow 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
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: Denies fevers, 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
Prescriptions: Raul R. Torres

Formulary: CCH Gold

<table>
<thead>
<tr>
<th>Formulary Medication</th>
<th>Quantity</th>
<th>Previous Rx</th>
<th>Refill</th>
<th>Date</th>
<th>New Rx</th>
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<tbody>
<tr>
<td>HYTRIN CAP 5MG (TERAZOSIN HCL)</td>
<td>30</td>
<td>0</td>
<td>2</td>
<td>10/22/1998</td>
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<td>1 po qd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PINNAM TABS 20 MG (LISINOPRIL)</td>
<td>30</td>
<td>2</td>
<td>0</td>
<td>10/22/1998</td>
<td></td>
</tr>
<tr>
<td>1 po qd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUMULIN INJ 70/30 INSULIN REG &amp; ISO (HUMAN)</td>
<td>600 u</td>
<td>0</td>
<td>0</td>
<td>10/22/1998</td>
<td></td>
</tr>
<tr>
<td>20 units ac breakfast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROZAC CAPS 10 MG (FLUOXETINE HCL)</td>
<td>30</td>
<td>2</td>
<td>0</td>
<td>10/22/1998</td>
<td></td>
</tr>
<tr>
<td>1 po qd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CALAN SR 150 MG TBCR (VERAPAMIL HCL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 tab po qd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pharmacy: 24 Hour Pharmacy
- 137 NW 18th St
- Aloha, OR 97007 USA
- Ph: 503-842-5647
- Fax: 503-842-5680

Authorized By: Janoff MD, Robin C.
Prescribing Method: Telephone
State: Oregon

For Help, press F1
## Raul R. Torres

**Age:** 73 Year Old Male  
**DOB:** 08/29/1930  
**Patient ID:** 103-TEST011  
**Home:** 503-649-2658  
**Insurance:** BH (Futura) Group BHI595

### Problems

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIABETES MELLITUS</td>
<td>ICD-250</td>
</tr>
<tr>
<td>HYPERTENSION, RENAL ESSENTIAL</td>
<td>ICD-405.1</td>
</tr>
<tr>
<td>HYPERPLASIA, PROSTATE</td>
<td>ICD-800.9</td>
</tr>
<tr>
<td>DEPRESSION</td>
<td>ICD-311</td>
</tr>
<tr>
<td>RETINOPATHY, DIABETIC</td>
<td>ICD-362.0</td>
</tr>
<tr>
<td>POLYNEUROPATHY IN DIABETES</td>
<td>ICD-357.2</td>
</tr>
<tr>
<td>ANXIETY</td>
<td>ICD-303.00</td>
</tr>
</tbody>
</table>

### Details

- **Onset Date:** 10/20/1990  
- **Entry Date:** 11/07/1998 3:54 AM  
- **Entered By:** Robin C. Janoff MD  
- **Responsible:** Robin C. Janoff MD

### Comments:

- **Empty**

### Assessments:

- **Empty**
**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 Rslt</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEMOCULT or SIGMOID</td>
<td>Every 12 months</td>
<td></td>
<td></td>
<td>Due Now</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>PNEUMO VAX</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 Rslt</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>
<tr>
<td>Date</td>
<td>Diabetes Patients</td>
<td>HbA1c Control (%)</td>
<td>Blood Pressure Control</td>
<td>Eye Examination (% Goal)</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>3.31.2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.28.2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140/90 mm Hg</td>
<td>(Goal 130 or less)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130/80 mm Hg</td>
<td>(Goal 120 or less)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120/80 mm Hg</td>
<td>(Goal 110 or less)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110/70 mm Hg</td>
<td>(Goal 100 or less)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Division of Internal Medicine at Georgetown University Hospital**

- FSH Family Health Center
- FSH Primary Care Center
- GSH Center for Primary Care
- GSH Medical Faculty Practice

**MedStar Physician Partners at Bethesda**

- MedStar Physicians at Bethesda
- MedStar Physicians at Silver Spring
- Metropolitan Medical Associates
- Rockville
- MedStar Physicians at Rockville

**MedStar Physician Partners at Harford**

- MedStar Physicians at Harford
- MedStar Physicians at Owings Mills
- MedStar Physicians at Silver Spring

**MedStar Physician Partners at Prince George's**

- MedStar Physicians at Prince George's
- MedStar Physicians at College Park
- MedStar Physicians at Largo

**MedStar Physician Partners at Montgomery**

- MedStar Physicians at Montgomery
- MedStar Physicians at Rockville

**MedStar Physician Partners at Clarksburg**

- MedStar Physicians at Clarksburg
- MedStar Physicians at Germantown

**Wiliams Medical Center**

- Williams Medical Center
- Williams Medical Center South
Summary

- **EHRs: Key tool for biomedical data acquisition and analysis**
  - Many advantages, some disadvantages
  - Key: integration of data

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

- **Important architectural elements: Repositories, messaging, data models and terminologies**
  - Standards are key


Additional Resources: Web

- www.astm.org
- www.hl7.org
- www.amia.org
- www.himss.org
- www.hhs.gov/healthit/
Thanks!

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jenders@cdrewu.edu

http://jenders.bol.ucla.edu