Innovation: eQuality Solutions for Patients and Clinicians: Enabling Safe and Effective Medical Practice while Decreasing Costs

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1) The ultimate health care record - (Sep 10 2007)
Mayo Clinic researchers are working on ways to make electronic health care records more intelligent. But can they get too smart for everyday providers?

2) Editor's Letter: To the edge and back - (Sep 10 2007)
The United States is no doubt one of the most innovative countries in its use of health IT.

3) iEHRs await federal action (Oct 22, 2008)
An expert predicts that federal standards for electronic quality monitoring will drive the market for intelligent EHRs.

4) Health IT success: How cool is that? (Nov 20, 2008)
Energizing public-sector health care organizations should be near the top of Obama’s management agenda. Dr. Peter Elkin at the Mount Sinai School of Medicine is working on electronic health record technology that would automate clinical data gathering. Using so-called intelligent EHRs, clinicians would get swift feedback about the quality of the care their patients receive.

OBJECTIVE. To evaluate an electronic quality (eQuality) assessment tool for dictating disability examination records.

METHODS. We applied automated concept-based indexing techniques to automated quality screening at Department of Veterans Affairs spine disability examinations that had previously undergone standard quality review by human experts using established quality indicators. We developed automated quality screening rules and refined them iteratively on a training set of disability examination reports. We applied the resulting rules to a novel test set of spine disability examination reports. The initial data set was composed of all electronically available examination reports (N=125,576) furnished by the Veterans Health Administration between July and September 2001.

RESULTS. Sensitivity was 91% for the training set and 87% for the test set (P<.001). Specificity was 74% for the training set and 71% for the test set (P=.44). Human performance ranged from 4% to 6% higher (P<.001) than the eQuality tool in sensitivity and 13% to 10% higher in specificity (P<.001). In addition, the eQuality tool was equivalent or higher in sensitivity for 5 of 6 individual quality indicators.

CONCLUSION. The results demonstrate that a properly authored computer-based expert systems approach can perform quality measurement as well as human reviewers for many quality indicators. Although automation will likely always rely on expert guidance to be accurate and meaningful, eQuality is an important new method to assist clinicians in their efforts to practice safe and effective medicine.
Healthcare Value

• **Value** = Quality / Cost

• **Quality** is composed of:
  – Outcomes
  – Safety
  – Service

• Reliability

• **Only what gets measured can be effectively managed! You can’t manage what you can’t describe.**
Minimally Invasive Informatics (MII)

- Minimize the need for Change in the Practice
- Maximize the ROI for Investing in HIT
  - Providing eQuality Monitoring
  - Clinical Decision Support Systems
  - Multiple pathways for clinical communication
  - Ubiquitous and Interoperable Availability of Clinical Records for Care Purposes
  - Knowledge based Care Delivery Empowered by Informatics (e.g. Care Coordination and Continuous Learning Environments)
iEHR Overall Goal

Data

Information

Knowledge

INTELLIGENCE

Clinical Outcomes

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Level One Ontology

- Entity
- Role
- Role Relationship
- Participation
- Act
- Act Relationship

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Level Three Ontology

• Fully Encoded Health Record
• Consistent with the Level One and Two Ontologies for Health
• Compositional Expressions are assigned Automagically
• Information is gathered through the usual documentation of patient care.
• Example……………. 
Unstructured Text Converted to Indexed & Q.A.’d Electronic Health Record

Unstructured Medical Text

Parsed Electronic Health Record

Indexed Electronic Health Record

Q.A.’d Electronic Health Record

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Medical Record Info:

Visit Purpose

CHIEF COMPLAINT/REASON FOR VISIT: This is a 57-year-old gentleman who presents with multiple complaints.

HISTORY OF PRESENT ILLNESS:

1) Chest pain. Patient is a 57-year-old gentleman with a 20-pack-year smoking history. He has a family history of early coronary disease on his father's side. As a child, he had a heart attack at age 43. Patient does not exercise very much. He drinks 2 ounces of alcohol a day. He does not have diabetes mellitus, hypertension, or does he know his cholesterol level. Patient was in his usual state of health until 2 months ago when he began having exertional dyspnea and chest pain at peak exercise. Patient could walk 4 blocks and up 2 flights of stairs before he would have crushing substernal chest pain, which radiated to his left arm. On a scale of 0 to 10, it was at 7. Patient had some diaphoresis and dyspnea associated with the chest pain. He would sit down and this would be relieved after about 15 minutes. Patient has taken it upon himself to limit his activities based on this symptomatology. Patient has an interest in quitting smoking, frequent palpitations, syncope, pre-syncope, PVD, or orthostatic. Patient has had no peripheral edema or shortness of breath at rest. No episodes where the pain lasted greater than 3 days.

2) Right knee pain. Patient has had an 8-year history of right knee pain. Patient works as a construction worker and had a fork lift injury 8 years ago. Since that time, he has had more difficulty getting around on his right knee. He piano occasionally, never lifts, and does not lift on him, he has constant pain for which he takes ibuprofen on a regular basis. Patient used to be an avid golfer, but has been able to participate since the injury. This has also affected his work, as he has had difficulty climbing, which is something required in his work.
**Exam Section**

**Vital Signs**
- **Physical Examination**: Height: 190 cm, Weight: 110 kg, Temp: 38.4°C, Pulse: 88 bpm, Regular, SH: 138/80, Position.

**Eyes**
- Eyes: Non-irritated, pupils equal and reactive to light and accommodation.

**ENT**
- ENT: Ears are clear, Oral Cavity: Oral pharynx is clear.

**Thyroid**
- Thyroid Neck: Soft, without nodes or masses. Thyroid: Rule out normal limits.

**Vessels**
- Vessels: Carotid Arteries: 2+, without bruits.

**Heart**
- Heart: Normal S1, normal S2, without murmurs, gallops, rubs, or clicks.

**Lungs**
- Lungs: Clear, without wheezing, rales, rhonchi, or rubs.

**Abdomen**
- Abdomen: Soft, flat, non-tender, normal active bowel sounds, without hepatosplenomegaly, or masses or bruits.

**Rectum**
- Rectum: Normal, stool at the verge, no other masses.

**Genitalia**
- Genitalia: Within normal limits, no lesions, no testicular masses.

**Extremities**
- Extremities: Without clubbing, cyanosis, or edema.

**Gait**
- Gait: Within normal limits.

**Neurological**
- Cranial nerves 2 through 12 were intact. Visual fields were within normal limits. Sensation was intact and bilaterally.
Right knee discomfort

Patient has anterior draw sign on my exam vs pain of vein stress, suspect may have an anterior cruciate ligament injury. Send him for an x-ray of his knee. To further evaluate this, may need an MRI. In order to evaluate this further, also have him seen by Orthopedics re-visit with him after seeing the Orthopedic Service. In the meantime, I have advised him to ice his knee if he has pain.

Obesity

Patient knows he needs to lose weight. We talked at length about exercise and diet programs that may be helpful. He is very much interested in doing something about this. I have sent him to the Nutrition Clinic so that he can understand what his base metabolism rate is to plan a more appropriate exercise program. Even once we get his cardiac situation and his orthopedic situation under control, he will be in a much better position to make progress with his weight loss.

DIAGNOSIS

1. Chest pain which is likely angina pectoris
2. Nicotine dependence
3. Right anterior cruciate ligament injury
4. Morbid obesity

MARGIN CODE: NS TOTAL TIME: COL
I have encouraged him to stop smoking. We talked at length about prevention mechanisms and different treatments. He has visited our Nicotine Dependence Centre, plans to have appropriate therapy at our next visit depending on his cardiac status. In the meantime, have him taper off the cigarette slowly to minimize the adverse symptonatology.

**#3 Right knee discomfort**

Patient has anterior draw sign on my exam no pain on valgus or varus stress. Suspect may have an anterior cruciate ligament injury. Send him for an x-ray of his knee. To further evaluate this, may need an MRI in order to evaluate this further. Also have him seen by Orthopedics re-visit with him after seeing the Orthopedic Service. In the meantime, I have advised him to ice his knee if he has pain.

**#4 Obesity**

Patient knows he needs to lose weight. We talked at length about exercise and diet programs that may be helpful. He is very much interested in doing something about this. I have sent him to the Nutrition Clinic so that he can understand what his base metabolics rate is to plan a more appropriate exercise program. Tank once we get his cardiac situation and his orthopedic situation under control, he will be in a much better position to make progress with his weight loss.

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**MARGIN CODE NS TOTAL TIME COU**

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<td>[240286007] [L]</td>
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Comparable Data

• **SNOMED-CT**
  – Description Logic-Based Terminology
  – Compositional System
  – ~370,000 Concepts
  – ~1,000,000 Terms
  – LBI version adds 790,000 Terms
  – Over 30,000,000 Indices to the SNOMED-CT Terminology
Compositional Systems
Its all about Meaning……

- **Myocardial infarction (disorder)** [22298006]
  - [has Finding Site] .
  - **Entire myocardium of anterolateral region (body structure)** [190762001]
  - [is Modified By] .
  - **Acute (qualifier value)** [53737009]

```
“Acute myocardial infarction of the anterolateral wall”
“Heart attack, Anterolateral cardiac wall, Acute”
“AMI, Anterolateral Wall”
“Acute MI of the Anterolateral Wall”
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Coordinating outputs to SNOMED-CT

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Case One

Case Two

Semantic Network

Multi-Center Data Sharing and Interchange

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Intelligent Agents

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Medical Ontology: Relationships between diseases, disorders, & systems, organs and tissues

- **tissue**
  - connective tissue
  - adipose tissue
- **digestive system**
  - liver
  - pancreas
  - Islet cells
- **Adipose Tissue** (Obesity)
- **Cardiovascular**
- **Liver** (Glucose metabolism)
- **Eye** (Retinal exudates)
- **Insulin**
- **Pancreas**
- **Islet cells impaired**
- **Blood vessel**
- **Retinal vessel**
- **Diabetes**

Mount Sinai
Biomedical Ontology: Neuronal interaction between diseases, systems, organs, substances, tissues, cells, proteins and genetics
**PHIRMS: eQuality Monitoring Solution**

**Ambulatory Care**
- 1 – Conduct Routine Check-ups
- 2 – Order cholesterol test
- 3 – Report test results
- 4 – Prescribe Medication and Treatment Plan
- 5 – Monitor Treatment
- 6 – Fill Prescription
- 7 – Report Data to Schools

**EHRS**
- 8 – Coordinate Care

**Laboratory**
- Decision Support
- Monitoring and Test Results

**Pharmacy**
- Media

**State Public Health Surveillance System**
- 9 – Monitor ER visits, hospitalizations data from EMRs & utilization data
- 10 – Conduct Health Education
- 11 – Send reports
- 12 – Conduct Surveys (BRFSS)

**Resource Management**
- Payor
- Hospital

**Resource**
- ER visits, hospitalizations data from EMRs & utilization data

**Encoded Data**
- Internal Quality Reporting
- Aggregate Anonymized Reports

**Licensed**
- PHIRMS Expert System

**Media**
- Mount Sinai School of Medicine 2008
The Semantic Biome: Diabetic patients who had an Acute Myocardial Infarction and did not have Chest Pain
Conclusions: eQuality toward a System of Healthcare

- Intelligent Electronic Systems (iEHR) can facilitate data capture in support of eQuality Monitoring and Reporting
- Quality Rules can be encoded and compared with iEHR data (ROI)
- eQuality data can help us move toward best practice at a lower cost
- eQuality data can be fed back to clinicians in real time to improve decision making
- This data can also be used to identify fraud and abuse saving federal dollars for direct patient care
- Biomedical Informatics => Empowering iEHR based eQuality solutions toward best practice of health and healthcare

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“...there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things. Because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new. “

Nicolo Machiavelli c. 1505
“The best way to predict the future, is to create it.”

---- Peter Drucker (Harvard University)