Secondary Use of Clinical Data

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Promise of the Secondary Use of Clinical Data

- Holds the promise of Electronic Records
- Seamless Care: Requires Clinically Meaningful EHRs
 - Patient Centered Medical Home
 - Continuity of Care
 - Community Involvement
 - Fully Automated Electronic Quality Monitoring
 - Clinical Decision Support
 - Automated eStudies (Empowering Translational Research)
- *i*EHRs Require:
 - Interoperability (We have Gaps => Ed Hammond)
 - Ontology & Logic based Knowledge Representation

Barriers to Secondary Use

- Lack of Interoperability => Linked to Sharing Credit
- Un-Usable Systems
- Free text records
- Incomplete Data Recording
- Data stored as Images
- The need for knowledgebases to assist in both quality monitoring and Clinical Decision Support
- Dangerous Systems that cause harm to patients
- Poor understanding that the practice is the best laboratory to improve clinical care and to create an international system of care

- The United States Agency for Healthcare Research and Quality (AHRQ) list five reasons for poor quality in healthcare as follows:
 - Variation in services,
 - Underuse of services,
 - Overuse of services,
 - Misuse of services, and
 - Disparities in quality.

Mount Sinai Medical Center





Usability



Subjectively pleasing

Reasons for Hard-to-Use Products

- Development Emphasis was on the Machine or System, Rather than the User
- Target Audience is a Moving Target
- Lack of Design Verification (Science vs. "Common Sense")
- Development Teams are not well Integrated
- Skills necessary for the interface Design are Different than those necessary for the Technical Implementation of Systems!

Usability Studies

- Developers and Evaluators
- Observe without Intervention
- Feel the Users Pain
- Come to Grips with Imperfection
- Resist the Impulse to Blame the User
- Resist the Impulse to Blame Yourself
- Acceptance
- Progress

But Seriously!!!!!!!!!!!



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Usability Studies

- Useful Mechanisms for Objective Evaluation
- Designed to Answer Specific Questions
- Designed to Discover Questions to Answer

Creating Value in Healthcare eQuality Solutions for Patients and Clinicians: Enabling Safe and Effective **Medical Practice while Decreasing Costs**

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.





Transformation to iEHRs

Depends on "whether the systems installed are designed to produce the information required to make possible the quality and cost reforms that are sought." by the Federal Government and by Healthcare Practitioners and Healthcare Organizations

Information Technology Comes to Medicine;

Blumenthal D, Glaser JP, N Eng J Med 356;24 June 14, 2007

Barriers to iEHR Adoption

- Disruptions to the Practice of Medicine
- Change in Practice Style
- Cost of Systems Purchase and Implementation
- Payment for Clinician's time spent on Web-based Consultation
- Lack of Interoperability
- Lack of Decision Support

Information Technology Comes to Medicine; Blumenthal D, Glaser JP, N Eng J Med 356;24 June 14, 2007

Business Process Excellence

A Framework that aligns the entire organization to what is important to the customer, allowing the organization to excel at the critical activities and reduce time spent on the things that don't matter



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)

Intelligent Electronic Health Record (iEHR)





The Qualifications of the Laboratory: Biomedical Informatics Research Collaborative



AHIC – Quality Use Case

The Institute of Medicine defines Quality as "the degree to which health services for individuals and populations increase the likelihood of desired outcomes and are consistent with current professional knowledge."

AHIC – Quality Use Case

- 1) Provide the data needed for the development of quality measures,
- 2) Automate the measurement, feedback and reporting of a comprehensive and future set of quality measures,
- Accelerate the use of clinical decision support to improve performance on these quality measures, and
- 4) How performance measures should align with the capabilities and limitations for HIT.

Our Investment in Healthcare Quality

Government Health IT [•]

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) <u>iEHRs await federal action</u> (Oct 22, 2008)

An expert predicts that federal standards for electronic quality monitoring will drive the market for intelligent EHRs.

4) <u>Health IT success: How cool is that?</u> (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. ORIGINAL ARTICLE

eQuality: Electronic Quality Assessment From Narrative Clinical Reports

STEVEN H. BROWN, MS, MD; THEODORE SPEROFF, PHD; ELLIOT M. FIELSTEIN, PHD; BRENT A. BAUER, MD; DIETLIND L. WAHNER-ROEDLER, MD; ROBERT GREEVY, PHD; AND PETER L. ELKIN, MD

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

METHODS: We applied automated concept-based indexing techniques to automated quality screening of Department of Veterans Affairs spine disability examinations that had previously undergone gold 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) finalized 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=.02). 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 16% higher in specificity (P<.001). In addition, the eQuality tool was equivalent or higher in sensitivity for 5 of 9 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.

Mayo Clin Proc. 2006;81(11):1472-1481

a single medical record needs to be reviewed in the care of an individual patient, sentences and paragraphs of prose are resources not obstacles. However, when hundreds or thousands of medical records must be reviewed in search of specific facts (eg, for research, population-based care, or quality improvement), manual data abstraction from volumes of free text becomes a time-consuming chore. The costs of manual data abstraction include reviewer time, record logistics (eg, availability, handling, and storage), data identification errors, data transcription errors, data representation errors, sample size reductions, and study design impacts. Electronic health record systems that store free text begin to address the logistical problems but otherwise do little to make data available in a computer-usable form.

Three basic methods exist to automatically extract computer-usable information from free text. String matching (keyword searching) is a simple, often effective, approach to detect various medical terms.⁶⁹ For example, simple keyword searches have used trigger words, such as *complication, mental status*, or *rash*, to identify adverse events with moderate success.¹⁰ However, string matching does not identify synonyms or closely related terms. For example, *myocardial infarction* and *heart attack* are syn-

Brown SH, Speroff T, Fielstein EM, Bauer BA, Wahner-Roedler DL, Greevy R, <u>Elkin PL</u>. *e*Quality: Automatic assessment from narrative clinical reports. Mayo Clin Proc 2006 81(11):1472-1481

Case Study

 Bill Kneivel is a 49 w male on vacation with his family in Florida. Driving conditions are wet and slippery and after being cut off his car impacts an embankment. Unconscious he is taken to FGH ED. He routinely gets his care at St. Elsewhere in Boston MA. Records are requested by FGH and text records are sent which show Mr. K to have a PMHx of hypertension and Type II DM. He is currently taking Lisinopril, HCTZ, Metformin, and ASA.

Case Study

 In ED he is found to have an MI with a Troponin-T of 0.42, his CBC was wnl, he had a creatinine of 2.7, normal electrolytes and a glucose of 187, Beta-Hydroxybuterate was not elevated, and his Bicarb was 24. He was found to have ketones in his urine.

Case Study: As Is Model

 Mr. K is continued on his present medication. A beta-blocker is started. However, two days later his serum K+ was 7.2 and pts Bicarbonate was 14. Mr. Kneivel's rhythm degenerates into ventricular tachycardia, followed by a cardiac arrest and in spite of an aggressive resuscitation attempt he passes away.

Case Study: To be Model

 Data from St. Elsewhere was transmitted to FGH in a standards-based codified interoperable format. The Dr. Overworked (admitting physician) uses an order entry system that provides decision support and incorporates into its logic engine the data transferred from St. Elsewhere. The system alerts the admitting physician that "with a creatinine of 2.7 (>2.0) the metformin should be discontinued due to the risk of a serious metabolic acidosis." Dr. O d/cs the Metformin and orders a SS Insulin regimen.

Case Study: To be Model

- Two days later Mr. K's K+ is 4.7 and his bicarbonate is 24, his creatinine is 1.7 and trending toward his baseline of 1.3. On the fourth hospital day he is discharged in good condition and his family decides to plan a repeat trip to Disney World next year when dad feels a little better.
- For Mr. K, Informatics standards and FGH's clinical decision support system made an immeasurable difference for him and his family.

Case Study: To be Model

Michael, Mr K's son, is inconsolable. His pediatric records from St. ۲ Elsewhere shows that he is considered healthy, but due to his behavior and separation from his parents, he is visited by child psychiatry. It is determined that Michael is suffering from an acute stress reaction and they wish to prescribe a selective serotonin reuptake inhibitor, namely escitalopram (Lexapro). However, Michael's St. Elsewhere records show his DNA sequence data to have a polymorphism associated with nonfunctioning CYP3A4 enzyme indicating that Michael would likely be a poor metabolizer of escitalopram. Therefore, he is placed on sertraline (Zoloft) which is metabolized by the p450 CYP2D6 and CYP2C19 pathways where he is known to have a *1/*1 phenotype. This medication decision avoids subjecting Michael to potentially serious medication sideeffects that may have occurred through inadvertent overdosing of escitalopram.

Personalized eQuality Monitoring

- What is eQuality Monitoring?
 - An electronic method for following the quality of care that a patient is receiving.
 - Ensure guidelines are met.
- How is it personalized?
 - Can alert patients and physicians when the standard of practice is not being met.
 - Can allow personal goal setting by patients for their healthcare and their providers of healthcare.

Level One Ontology



EHR architecture (Level 2 Ontology: Healthcare Specific)



Level Two Ontology

1

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



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History HPI PMH Social History Family History Systems Review Medications Allergies Exam Diagnostic Tests Assessment						
Medical Record Info :						
Visit Purpose						
CHIEF COMPLAINT/REASON FOR VISIT: This is a 57-year-old gentleman who presents with multiple complaints.						
History Section						
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 his father had a heart attack at age 43. Patient does not exercise very much He drinks 2 ounces of						
alconol a day. He does not nave diabetes mentus, hypertension, not does he know his cholesterol level. Fatient was in his usual state of health until 2 months ago when he began having exerciseal dyspnea and chest nain at neak 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 as bad as 8 out of 10. 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 <u>interest</u> in quitting <u>smoking</u> , <u>denies</u> <u>palpitations</u> , <u>syncope</u> , <u>pre</u> - <u>syncope</u> , <u>PND</u> , <u>or orthopnea</u> . <u>Patient</u> has had <u>no peripheral</u>						
edema or shortness of breath at rest. no episodes where the pain lasted greater than half hour.						
#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. It pops occasionally, never locks. not						
given out on him, he has constant pain for which he takes ibuprofen on a regular basis. Patient used to be an avid golfer, not been able to						
northernate cance the miner. This has also officeted his work, as he has had difficulty elimbing which is cometimes required in his						
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Exam Section							
	Vital Signs	PHYSICAL EXAMINATION: HEIGHT:190 cm WEIGHT:110 kg TEMP: PULSE:84 RHYTHM: Regular SBP:138 DBP 82 Position Date / Time: General- Obese male in no apparent distress.					
	Eyes	Eyes Non- icteric. Pupils were equal and reactive to light and accomodation.					
	ENT	ENT Ears are clear. Oral cavity, oral pharynx is clear.					
	Thyroid	<u>Thyroid Neck</u> is <u>supple</u> without nodes or <u>masses</u> . <u>Thyroid</u> is <u>within normal limits</u> .					
	Vessels	Vessels Carotid Arteries are 2+ without bruits.					
	Heart	Heart Normal S1, normal S2; without murmurs, gallops, rubs , or <u>clicks</u> .					
Lungs Lungs Clear without wheezing, rales, rhonchi, or rubs.							
Abdomen <u>Abdomen Soft, flat, non-</u> tender, normal active bowel sounds without hepatosplenomegaly or masses or bruits.							
	Rectum <u>Rectum brown</u> stool at the <u>verge</u> , no other masses.						
	Genitalia <u>Genitalia Within normal limits</u> . no lesions. no testicular masses.						
	Extremities Extremities Without clubbing, cyanosis, or edema.						
	Gait Gait Within normal limits.						
	17	Neuro Cranial nerves 2 through 12 were intact. Visual fields were within normal limits. Sensation was intact and bilaterally	-				
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Links					
I have encouraged him to stop smoking. We t	talked at length about prevention mechanisms and different treatments, have	him visit with our Nicotine			
Dependence Center, place him on appropriate therapy at our next visit depending on his cardiac status. In the meantime, have him taper off the					
cigarettes slowly to minimize the <u>adverse</u> sympt	comatology.				
#3 <u>Right knee</u> <u>discomfort</u>]		
Patient has anterior draw sign on my exam no pain on valgus or verus 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 meanwhile, I have advised him to ice his knee if he has pain.					
#4 <u>Obesity</u>					
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 metabolic rate is to plan a more appropriate exercise program. think 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 <u>Nicotine dependence</u> .					
#3 <u>Right</u> anterior cruciate ligament injury.					
	Injury (disorder) [122549002] [K]				
#4 Morbid obesity	has Finding Site				
	Entire anterior cruciate ligament of knee joint (body structure) [182443006] [M]				
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#3 <u>Right knee</u> <u>discomfort</u>			
Patient has <u>anterior draw sign</u> on <u>my</u> examp x- <u>ray</u> of his <u>knee</u> . To <u>further</u> evaluate this, <u>ma</u> <u>after seeing</u> the <u>Orthopedic Service</u> . In the m	io pain on valgus or verus <u>stress. suspect may</u> have an <u>anterior cruciate ligame</u> y <u>need</u> an <u>MRI.</u> In order to evaluate this <u>further</u> , also have him <u>seen</u> by Orthoped eanwhile, I have advised him to <u>ice</u> his <u>knee</u> if he has <u>pain</u> .	ent injury. send him for an åics. <u>re</u> - <mark>visit</mark> with him	
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MCVS - Architecture Implementation





Comparable Data • SNOMED-CT

- Description Logic-Based Terminology
- Compositional System
- -~370,000 Concepts
- -~1,000,000 Terms
- LBI version adds 790,000 Terms
- Over 60,000,000 Indices to the SNOMED-CT Terminology

Compositional Systems



Its all about Meaning.....



"DOC_ID	SEC_ID	PROP_ID	CONCEPT_CODE	INEX_TYPE	PTS"
"2	52	1	23685000	7	1"
"2	52	1	255302009	7	1"
"2	52	1	79619009	7	1"
"2	52	2	53059001	7	1"
"2	52	2	237679004	7	1"
"2	52	2	11092001	7	1"
"2	52	3	49436004	7	1"
"2	51	13	43364001	7	1"
"2	51	14	258707000	7	1"
"2	51	14	255260001	7	1"
"2	51	14	102522009	7	1"
"2	51	15	226630009	7	1"
"2	51	15	51440002	7	1"
"2	51	15	182334003	7	1"
"2	51	15	43364001	7	1"
"2	56	43	229799001	7	1"
"2	56	43	258684004	7	1"

Data Representation

- Pseudo-Anonymized Records
 - Translation tables held locally in a secure fashion
 - Trackable across visits and episodes of care
- No Text => Not Human Readable
- The data exists without the story
- Facts are recoverable
 - Patient
 - Document
 - Section
 - » SubSection / Problem / Sentence
 - » Compositional Expression / Concept



Case One

Case Two

Semantic Network

Multi-Center Data Sharing and Interchange







Intelligent Agents



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



Biomedical Ontology : Neuronal interaction between diseases, systems, organs, substances, tissues, cells, proteins and genetics





Healthcare Services Goal



Bird Flu



Preliminary Work: Gold Standard Development in support of our Experimental Design

- VA Disability Exam Study*
 - Reviewed by two reviewers
 - Disagreements adjudicated by a Super reviewer
- Rules for what constitutes a good exam are translated into computable rules (HAL-42)
- eQuality System reviewed the quality criteria against each record
- The eQuality System Review was compared with the human review.
- Surveilling for Pneumonias in CXR reports

*Brown SH, Elkin PL et al *e*Quality: Electronic Quality Assessment From Narrative Clinical Reports; Mayo Clin Proc. 2006;81(11):1472-1481

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The Semantic Biome: Diabetic patients who had an Acute Myocardial Infarction and did not have Chest Pain

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Rule Engine Results Page

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All A	HISTORY OF PRESENT ILLNESS: #/ Chest pain Patient is a 57- year old gentleman w	Patient has anterior draw sign on my exam no pain on valges of verus stress, support may have an anterior cruciate ligament injury, send him fit s- ray of his knew To further evaluate this, may need an <u>MRI</u> in order to evaluate this <u>further</u> , also have him seem by Orthopedics. re- <u>visit</u> with him after seeing the <u>Orthopedic Service</u> . In the meanwhile, I have advised him to <u>ice</u> his knew if he has <u>pain</u> .	n an
High construction from the would have even many to 2 fights of static hybring the would have even was at ball as 8 out 10. Futions had some fight would be relieved after about 10 for the stations had non- the an intervent of program. Under construct about the state is an understand what his has methods rate is to glan a more appropriate exercise program. Under construct about the state is an understand what his has methods rate is to glan a more appropriate exercise program. Under construct about the state is an understand what his has methods rate is to glan a more appropriate exercise program. Under construct about the state is an understand what his has methods to exercise program. Under construct about the state is an understand what his has methods to exercise program. Under construct about the state is an understand what his has program. Under construct about the state is an understand what his has program. Under construct about the state is an understand what his has program. Under construct about the state is an understand what his has program. Under construct about the state is an under the state is an under the state is an under the state program. Under construct about the state is an under the	alcohol a day He does not have diabetes mellitu of health werd? months are when he hearth having	#4 <u>Obesity</u>	
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HPI Right knee pain Patient has had as 8- year hist inging 8 years ago. Since that fing, be har had an 8- year hist inging 8 years ago. Since that has costat being for which is Body angine pectoris. #1 Chest pain which is Body angine pectoris. start Start Start Start Start Start Start Start Start Start	#2	DIAGNOSIS	
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Sant Storsech Cost macho Secondor 43 Right anterior cruciate ligament injury.	given out on him, he has constant pain for which he participate since the inform. This has also offerend	#2 <u>Nicotine dependence</u> ,	
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Rules Written

The rules are written first in English and then converted to a machine readable format.



"Five Minutes" in the MCVS's HAL-42...



44	Pneumonias and Smokers of 469 Pneumonias
3	Pneumonias and Smokers who were counseled to Quit smoking
319	Smokers
202	Smokers who were counseled to quit smoking

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		Vi	sit Purpose			^
CHIEF	COMPLAINT/ REASON FOR	VISIT: This is a 57- year- old	gentleman presents	with multiple compl	aints.	

History Section

#1 Chest pain CE

Patient is a 57- year old gentleman ce with a 20- pack-year smoking history. ee He has a family history of early coronary disease on his father's side _____, as his father had a heart attack at age 43.____Patient does _____not exercise very much.____He drinks 2 ounces of alcohol a day. He does and have diabetes mellitus and hypertension of alcohol a day. The does are not have diabetes mellitus and hypertension of alcohol a day. Finding of tobacco smoking behavior (finding) was in his usual state of health until 2 months ago when he began having exertion [365981007] [K] is Modified By Patient could walk 4 blocks and up 2 flights of stairs before he would have crush Pack years (assessment scale) [315609007] [M] left arm. On a scale of 0 to 10 cm, it was as bad as 8 out of 10. Patient had so has Quantity Value 20with the chest pain. He would sit down and this would be relieved after about is Qualified By History of (contextual qualifier) (qualifier value) limit his activities based on this symptomatology. Patient has an interest in quitt [392521001] [Q] er, pre-syncope er, PND er, or orthopnea. er Patient has had er no peripheral edema er or shortness of breath at rest. er He has had no episodes where the pain lasted greater than half hour.

#2 Right knee pain cm

HPI

Patient has had an 8- year history of right knee pain. ce Patient works as a construction worker ce and had a fork lift injury 8 years ago. ce Since that time ce, he has had more difficulty getting around on his right knee. ce It pops occasionally ce, it never locks. It has not given out on him ce, he has constant pain for which he takes ibuprofen on a regular basis. ce Patient used to be an avid golfer ce, he has not been able to participate since the injury. ce This has also effected his work ce, as he has had difficulty climbing

P

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	\bigcirc	Case #: Title:	4 Ehlers-Danle	os Syndrome				de la	ARA	
	8	Case:	woman who medical hist bleeding an	ne hand and sk complains of e ory is notable d rectal prolap:	kin findings of a 26- early satiety. Her p for upper gastrointe se. What is the diag	year-old ast estinal jnosis		ALL.		
	A	Question(s) a): Ehlers-Danle b): Cutis Iaxa	os syndrome					6	
			 c): Osteogenesi d): Congenital o e): Marfan synd 	is imperfecta contractural ar- frome	achnodactyly					
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Her past medical history is notable for upper gastrointestinal bleeding and rectal prolapse.			Mayo Clinic	Scientific Pres	s, 2004.					
POSITIVE POSITIVE General PE:										
Assessment Section Ehlers-Danlos syndrome is characterized by highly elastic connective tissue Many forms (up to 15) of Ehlers-Danlo the disease account for 90% of reported cases Patients have hyperextensible and lax joints that are prone to dislocation hyperextensible , fragile skin that heals poorly, characteristically forming wide , thin , fish-mouth scars. The skin m the following: Gastrointestinal motility disorders Visceral diverticulosis Mitral valve prolapse (up to 50% of patient Degenerative arthritis Pneumothorax Dilatation of the pulmonary artery Angina	is syndrome exist Patients with sh ay have a velvety (s) Dilatation of t	The autosomal- cin manifestatic texture Patient the aortic root]	dominant forms o ons have is are predisposed to Pes planus Scolios	f o is						
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On-Going VA Projects

- POEMS
- Biosurveillance (TB, MRSA, etc.)
- PTSD / TBI
- CHF
- Post-Marketing Surveillance of Drugs

VA Content UML Model



VHA Text-based Reports



Conclusions

- Technology and standards have progressed to the point where NLP is a viable solution
- iNLP
 - Recall (Sensitivity) of 99.7%
 - Precision (PPV) of 99.8%.
- NLP can support electronic quality monitoring (eQuality) and clinical decision support, information retrieval for research and digital image education libraries.
 - Peter L. Elkin, MD1, Steven H. Brown, MD, Casey Husser, MD, Brent A. Bauer, MD, Dietlind Wahner-Roedler, MD, S. Trent Rosenbloom, MD, Ted Speroff, PhD; "An Evaluation of the Content Coverage of SNOMED-CT for Clinical Problem Lists", Mayo Clin Proc. 2006 Jun;81(6):741-8.

What have we learned from our case?

- That our patients deserve the highest quality, safest care that we can provide.
 - Requires the use of all of the patient's relevant data.
 - Utilizing that data in the context of best practice.
 - Our hypothetical Mr. Kneivel and his son Michael are representative of people who have put their trust in us to provide for them the very best care. This requires systems engineering that can help us to integrate and analyze patient data in order to provide clinicians with just-in-time point-of-care best practice advice, in support of their medical practice.

Recommendations:

- 1. A common data infrastructure is needed to standardize the representation of clinical knowledge
- 2. This common data infrastructure needs a common logical method that can link concepts as represented in description logics to standard healthcare models
- 3. A common standard messaging format is needed to exchange the common data infrastructure
- 4. The formalism must support knowledge representation at the same level of granularity at which healthcare is practiced.
- 5. We need to be able to measure the level of interoperability that is defined by any standard adopted
- 6. The standards must support international data exchange
- 7. The standards must support multiple languages
- 8. Solutions must be implementable in a three year timeframe
- 9. The common data infrastructure should support practice, education and research
- 10. Knowledge gained in the practice should be applicable and reusable across purposes and settings

Conclusions: eQuality

- Intelligent Electronic Systems (*i*EHR) can facilitate data capture in support of *e*Quality Monitoring
- Interoperable data must be represented at the same level of granularity at which we practice medicine
 - Formal terminologies
 - Formal logical systems to bind them to instance data
- Quality Rules can be encoded and compared with *i*EHR data
- eQuality data can help us identify cases and controls for our comparative electronic studies
- eQuality data can be fed back to clinicians in real time to improve decision making toward Best Practice of Medicine
- This data can also be used to surveil for emerging Infectious Diseases
- Biomedical Informatics => Empowering iEHR based Health eQuality solutions toward best practice of health and healthcare

"...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)
Biomedical Informatics



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- Weijia Zhang, PhD
- Avi Ma'ayan, PhD
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- Jenny Xiao
- Shirley Sun, MS
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Team

















