

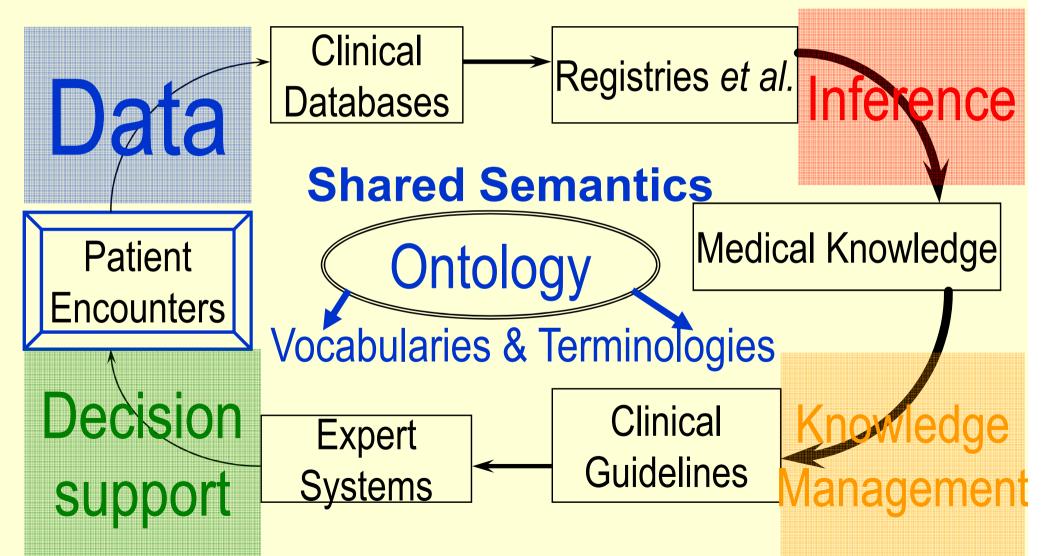
Terminologies and Classifications Health Data Interoperability and the ICD

Christopher G. Chute, MD DrPH Professor, Biomedical Informatics Mayo Clinic College of Medicine Rochester, Minnesota

10th International HL7 Interoperability Conference Kyoto, May 2009



From Practice-based Evidence to Evidence-based Practice





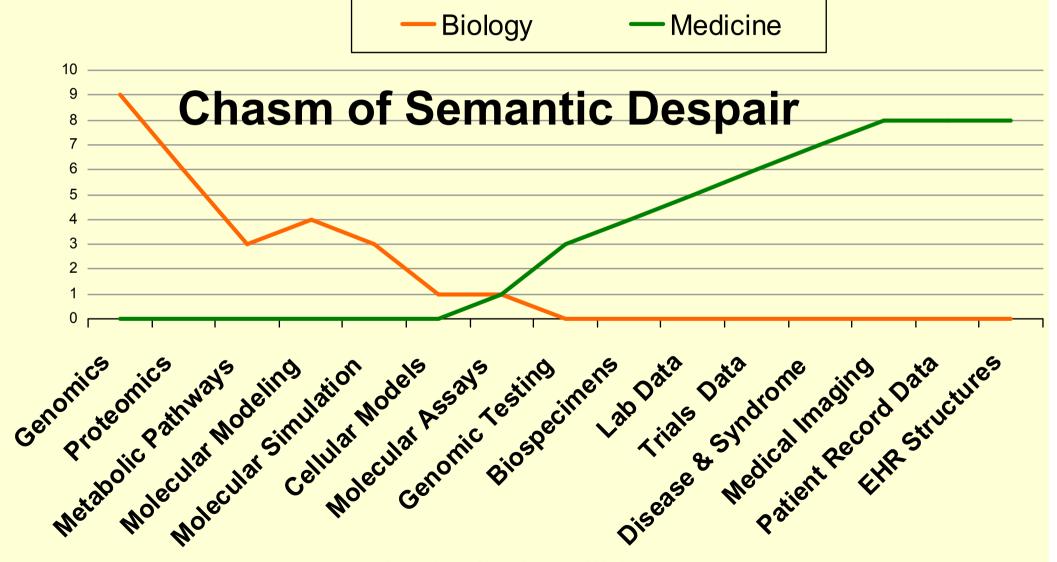
Blois, 1988

Medicine and the nature of vertical reasoning

- Molecular: receptors, enzymes, vitamins, drugs
- Genes, SNPs, gene regulation
- Physiologic pathways, regulatory changes
- Cellular metabolism, interaction, meiosis,...
- Tissue function, integrity
- Organ function, pathology
- Organism (Human), disease
- Sociology, environment, nutrition, mental health...



The Continuum Of Biomedical Informatics Bioinformatics meets Medical Informatics





Whither Phenotype? Spans spectrum from enzymes to disease

- Pharmacogenomics enzyme functionality
- Physiologist cellular function
- Systems biologist pathway circuit flow
- Sub-specialist organ functioning
- Patient/Clinician disease manifestation
- Public Health population characteristics *Highly specific to use-case context*



The Historical Center of the Health Data Universe Billable Diagnoses



Billable Diagnoses



Copernican Healthcare

(Niklas Koppernigk)

Clinical Data

Billable Diagnoses

Scientific Literature

Clinical Guidelines

Medical Literature

Clinical Data



First Formal Health Data Model London Bills of Mortality

- Commissioned 1542 (1598)
- Intended to Track Plague (Black Death)
 - ~60 disease categories
 - Variously Defined
 - Collected by Parish Clerks (Chanters)
 - Irregularly Printed in Folio
 - Data Table Layout
 - 16th Century Spreadsheet



Natural and Political OBSERVATIONS

Mentioned in a following INDEX, and made upon the Bills of Mortality.

BY Capt. JOHN GRAUNT, Fellow of the Royal Society.

With reference to the Government, Religion, Trade, Growth, Air, Difeafes, and the feveral Changes of the faid CITY.

----- Non,me ut miretur Turba, laboro, Contentus paucis Lectoribus. ----

> The Third EDITION, much Enlarged.

LONDON, Printed by John Martyn, and James Allestry, Printers to the Royal Society, and are to be fold at the fign of the Bell in St. Pauls Church-yard. MDC LX V.



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The Table of CASUALTIES.

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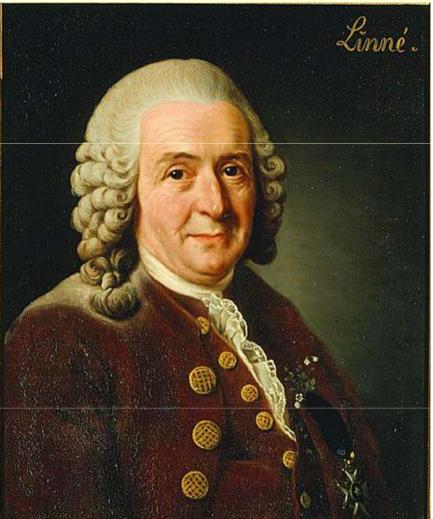
Inferences from 16th Century Data Models

- John Graunt, First Epidemiologist 1662
 - Estimate of Population
 - Age-specific Mortality
 - Disease Specific Mortality
 - Foci of Mortality
 - Recognize Epidemic and Endemic Disease
 - Notions of Etiology and Causation
- Modern Epidemiology and Demographics
- Work ignored for 200 years (Farr)



Flawed Information Model

- Carolus Linnaeus
 Carl von Linné
 Genera Morborum (1763)
- Underscored Content Difficulty
 - Pathophysiology vs Manifestation
 e.g. Rabies as psychiatric disease



Lacked the Germ Theory of Disease
Was not incorporated into an information model



Weights and Measures

- "The nomenclature is of as much importance in this department of inquiry, as weights and measures in the physical sciences, and should be settled without delay."
 - William Farr, about Cullenian system
 - First Annual Report of the Registrar-General of Births, Deaths, and Marriages in England. London: 1839 p. 99.



The Birth of a Formal Data Model for Cause of Death Classification

- First Statistical Congress, 1853 (Brussels)
 - William Farr (London)
 - Marc d'Espine (Geneva)
 - Achille Guillard (Paris) Sponsor
- First International List (139 rubrics)
 - Il y a lieu de former une nomenclature uniforme des causes de déces applicable a tous les pays.

• Sixteenth Annual Report of Registrar-General of England, 1853, Appendix, p. 73.



Competing Concept Models about Cause of Death Classificaitons

- Farr Anatomical Organization vs.
- d'Espine Systemic Disease (Humors)
 - Necessary to Pick One
- Codes Linked to Disease Order
- Single Hierarchy Structure
- Vague Distinction between Term and Concept
 - Multi-Lingual (French Master)
- Revisions:
 - 1857, 1855, 1864 (model of Farr), 1874, 1880, 1886



Jacque Bertillon ICD-1

- Introduced 1886 version in Chicago, 1893
 - International Statistical Institute (161 rubrics)
 - American Public Health Assoc. adopted 1898
 - Basis for decennial census
- Bertillon, Permanent Secretary General
 - International Commission (French Government)
 - Decennial revisions 1900, 1909, 1920 (Paris)



ICD not Catalog of Disease

"The International List of Causes of Death makes no pretension of being a proper nomenclature of diseases or of including a scientific classification of diseases."

Introduction ICD-2, 1909



Post-Bertillon ICD

- French Government continued sponsorship
 (1929, 1938) 5th revision: 200 rubrics
- WHO assumed sponsorship, 1948. (6th rev)
- Greatly expanded to include morbidity
 - 612 diseases and morbid conditions
 - 153 external causes of injury
 - 189 categories of injuries, by lesion, nature
 - decimal sub-divisions
 - 1955, 7th revision (minor)
- Pressure to Index Hospital Patients



ICD-9-CM Resolution?

- 185 Malignant neoplasm of prostate
 - 232,000 cases in the US each year
 - Cannot distinguish stage or extend of disease

E845.9 Accident involving spacecraft injuring other person

- No person in history has ever died from this
- Not to be confused with death of astronaut or ground crew



Combination Platter Coding in Diabetes Mellitus

- 250.0 DM without mention complications
- 250.1 Diabetes with ketoacidosis
- 250.2 Diabetes with hyperosmilarity
- 250.3 Diabetes with other coma



- 250.4 Diabetes with renal manifestations
- 250.5 Diabetes with ophthalmic manifestations
- 250.5 Diabetes with neurological manifestations
- 250.7 Diabetes with peripheral circulatory disorders
- 250.8 Diabetes with other specified manifestation
- 250.9 Diabetes with unspecified complications



ICD-10 Improved Resolution?

C61 Malignant neoplasm of prostate

- Alphanumeric format
- No substantial improvement in resolution
- Continues tabular (non-axial, unidimensional) format



		The ICDs	
1853	Farr/d'Espine	139	
1893	Bertillon	161	
1900	ICD 1	179	
1909	ICD 2	189	
1920	ICD 3	205	
1929	ICD 4	214	
1938	ICD 5	200	
1948	ICD 6	954*	*Decimal subdivisions
1955	ICD 7	965*	
1968	ICD 8	1,040*	
1968	H-ICDA2	905	4,334
1975	ICD 9	1,164*	8,173
1979	ICD-9-CM	1,179	14,473
1993	ICD 10	1,967*	10,468
2007	ICD-10-CM		68,000

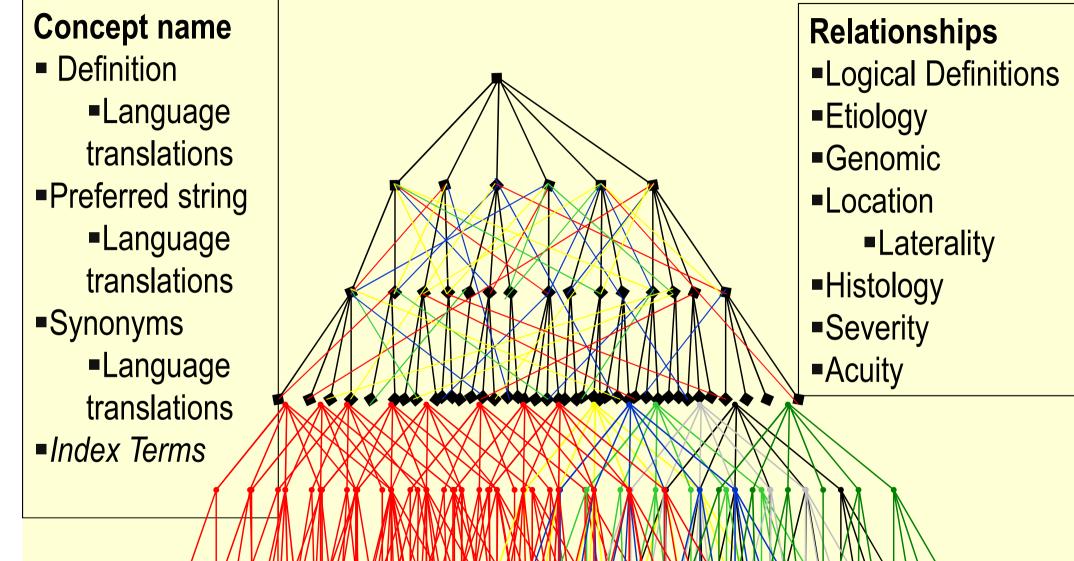


ICD11 Use-Cases

- Scientific Consensus on Clinical Phenotype
- Mortality
- Morbidity
- Case Mix
- Primary Care
- Quality and Safety



ICD11 - An Enriched Information Model





Manifestation Attributes

- Symptoms
- Signs
- Diagnostic results
- Functional impact
- Etiology
 - causal agents
 - mechanism
 - Genomic characteristics
- Temporal Relations
 - chronicity (including acute)
 - episodicity
- Severity and/or Extent
- Hierarchical relationships (parents and children)



Discussions with IHTSDO International Health Terminology (IHT)

- IHT (SNOMED) will require high-level nodes that aggregate more granular data
 - Use-cases include mutually exclusive, exhaustive,...
 - Sounds a lot like ICD
- ICD-11 will require lower level terminology for aggregation logic definitions
 - Detailed terminological underpinning
 - Sounds a lot like SNOMED



ICD-11

Potential Future States

SNOMED

Ghost ICD



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Alter control in approach in a transmission provid press? (3) many (16th course) and (3)-M((3) (3)-M(mail) and (3)-M((3

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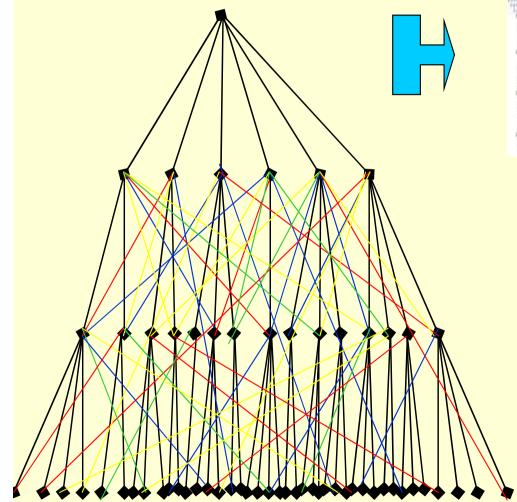
TAN BERT AT THE WAY AND ALL THE WAY HE HAD

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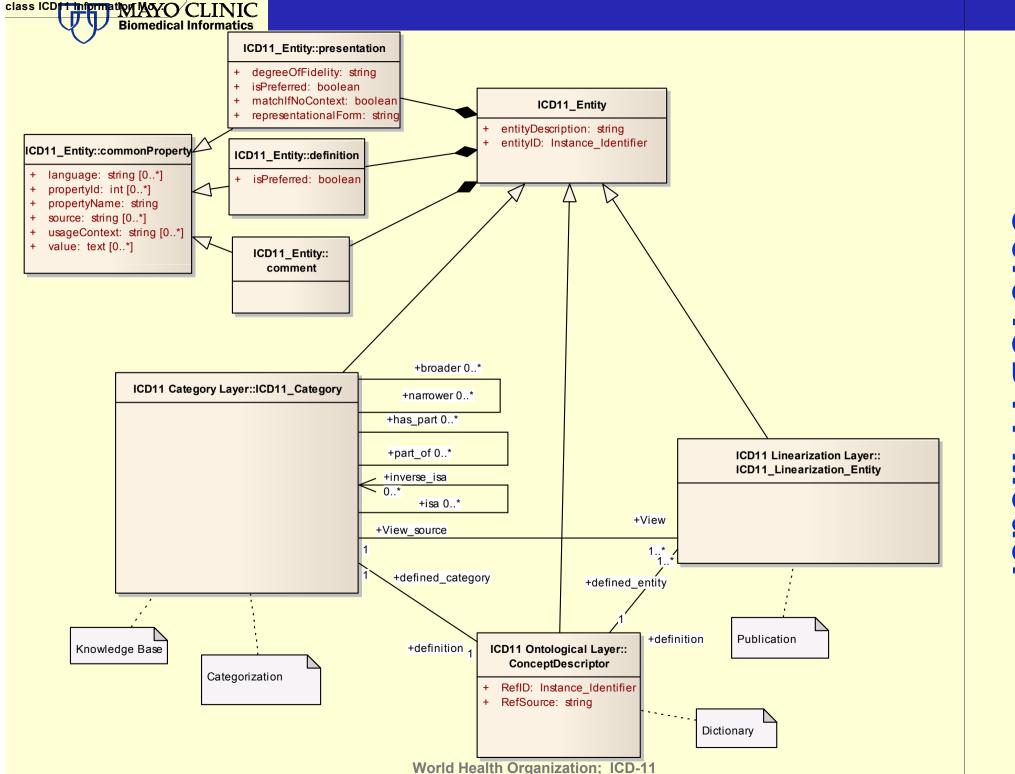
Linear views may serve multiple use-cases Morbidity, Mortality, Quality, ...



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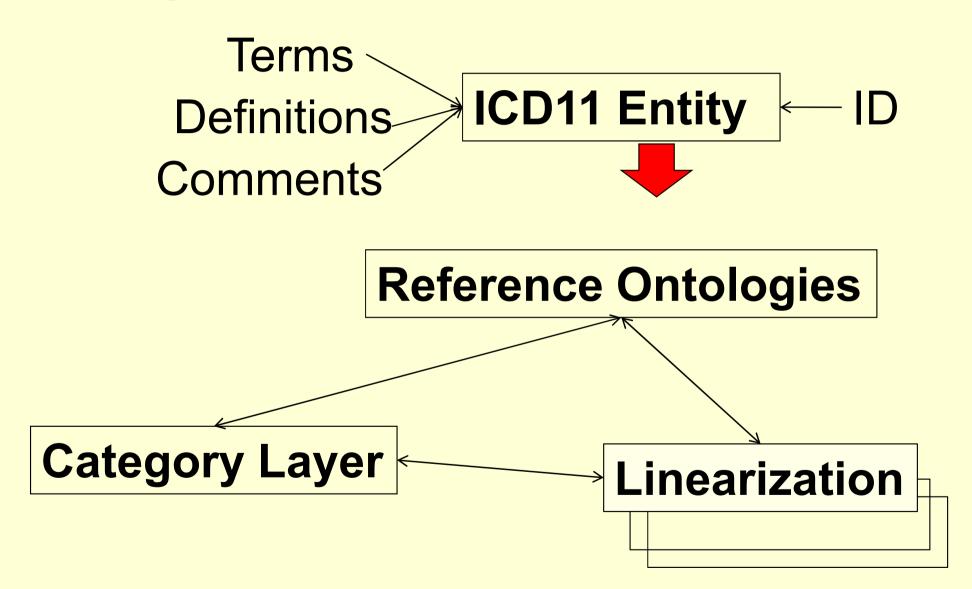
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World Health Organization; ICD-11



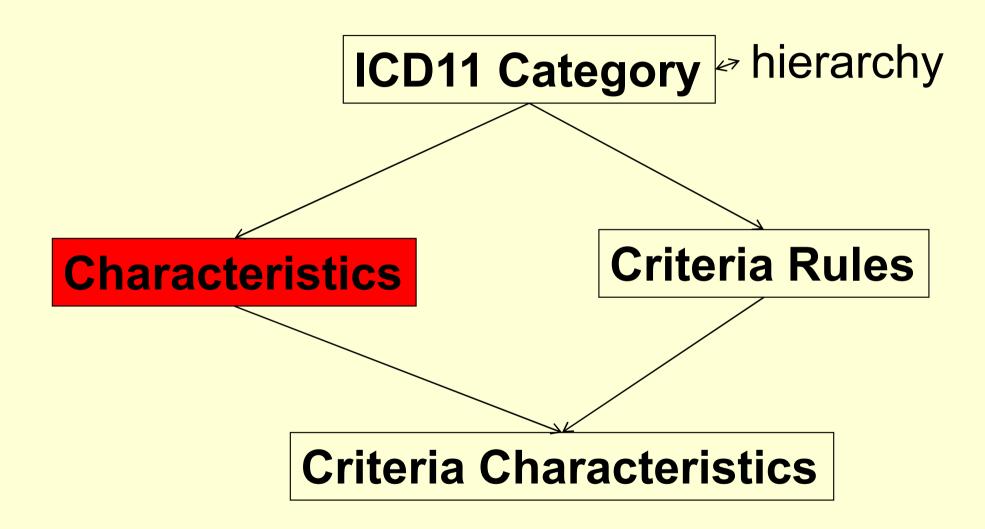


High Level Structure – Core Model



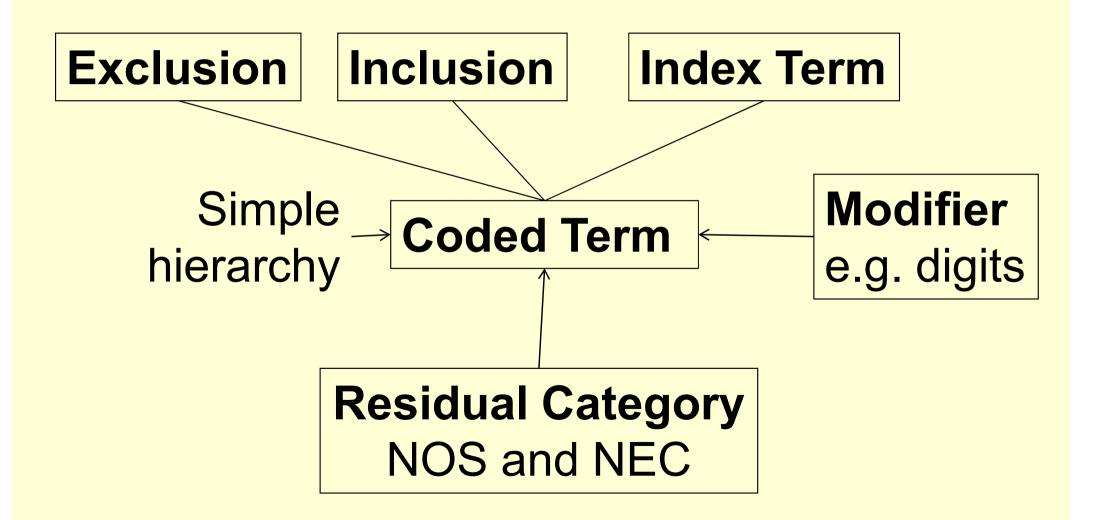


Category (Clinical) Layer





ICD Linearization







Basis for Light-weight editor

- The largest and most successful "social computing" project in history
- Tools and resources to permit huge communities to asynchronously author and edit complex resources
- Computer engineering of impressive capacity
 Wikipedia manages >12,000 hits/second
 - Includes transactional edits

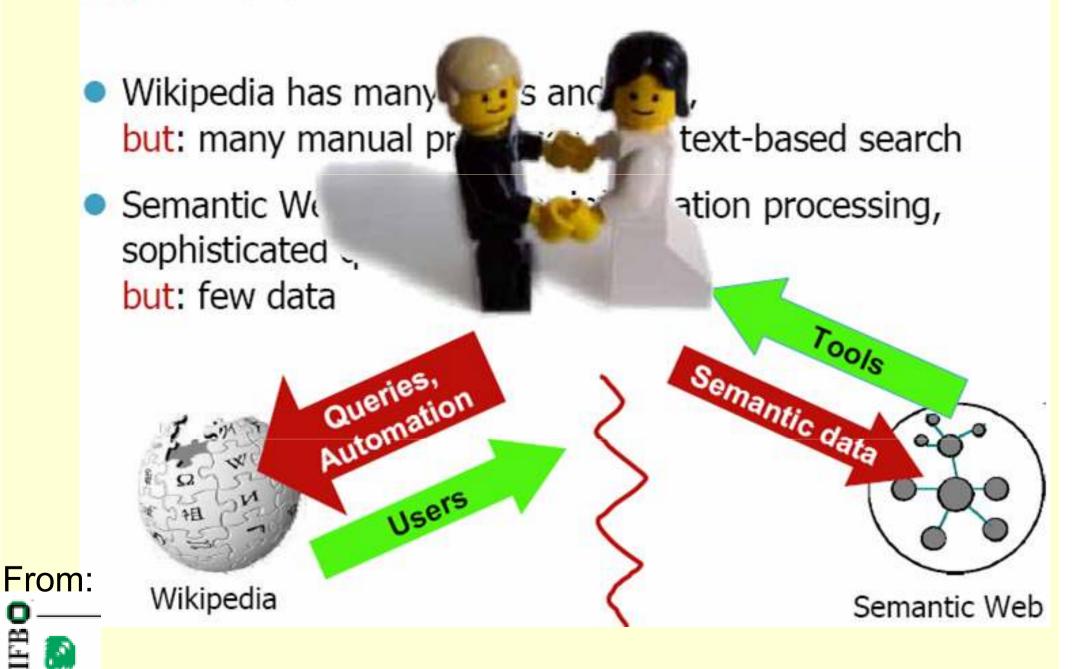


W3C Semantic Web

- Explosion of methods, standards, tools
- Transform the practicality of complex concept management
 - XML simple, interoperable syntax
 - RDF simple data structure for semantic content
 - OWL ontology authoring and interchange



Goal: Marrying Wikipedia and the Semantic Web





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Feedback	Defining				
documentation	Strength:	Pathognomonic -			
 Help 	Source:	arrison's Principles of Internal Medicine			
Video Tutorial	Reference URL	-			
 Beginner's Guide MeetingNotes 	(optional):				
classifications	Reference PMID				
ICD11 Draft	(optional):				
 ICD10WHO 	Reference ISBN				
ICD10CM	(optional):	78-0070202917			
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 Orphanet 	Remove this	Symptom(Manifestation Attribute)			
terminologies					
SNOMED CT	Add another	Symptom(Manifestation Attribute)			
			-		



(optional):

Genomic Characteristic:	HUGO proline/serine rich coiled coil 1(PSRC1)
Defining Strength:	Associated Occasionally -
Source (optional):	J Mol Biol
Reference URL (optional):	
Reference PMID (optional):	18649068
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Adding Genomic Characteristics



Partial I21.0 Anterior Transmural MI Defined

Symptom(Manifestation Attribute): Category:SCT Squeezing chest pain(371030007) (Pathognomonic) (Source:Harrison's Textbook of Medcine)

 Harrison's principles of internal medicine. New York: McGraw-Hill, Health Professions Division, 1998. isbn:978-0070202917. [isbn978-0070202917]

Sign(Manifestation Attribute): Category:Not Specified(Source:not specified) Diagnostic Finding(Manifestation Attribute): Category:Not Specified(Source:not specified) Functional Impact(Manifestation Attribute): Category:Not Specified(Source:not specified) Causal Agent(Etiology): Category:Not Specified(Source:not specified) Mechanism(Etiology): Category:Not Specified(Source:not specified)

Genomic Characteristic(Etiology): Category:HUGO proline/serine rich coiled coil 1(PSRC1) (Associated Occasionally) (Source:J Mol Biol)

 Samani NJ, Braund PS, Erdmann J, GDtz A, Tomaszewski M, Linsel-Nitschke P, Hajat C, Mangino M, Hengstenberg C, Stark K, Ziegler A, Caulfield M, Burton PR, Schunkert H, and Tobin MD. The novel genetic variant predisposing to coronary artery disease in the region of the PSRC1 and CELSR2 genes on chromosome 1 associates with serum cholesterol. J Mol Med 2008 Nov; 86(11) 1233-41. doi:10.1007/s00109-008-0387-2 pmid:18649068. PubMed [pmid18649068]

Genomic Characteristic(Etiology): Category:HUGO symbol withdrawn see CELSR2(EGFL2~withdrawn) (Associated Occasionally)(Source:J Mol Biol)

 Samani NJ, Braund PS, Erdmann J, GDtz A, Tomaszewski M, Linsel-Nitschke P, Hajat C, Mangino M, Hengstenberg C, Stark K, Ziegler A, Caulfield M, Burton PR, Schunkert H, and Tobin MD. The novel genetic variant predisposing to coronary artery disease in the region of the PSRC1 and CELSR2 genes on chromosome 1 associates with serum cholesterol. J Mol Med 2008 Nov; 86(11) 1233-41. doi:10.1007/s00109-008-0387-2 pmid:18649068. PubMed [pmid18649068]



Conclusion

- Comparable and consistent health data has five centuries of history
- Modern ontology principles are being leveraged to create the next-generation ICD
- Social computing infrastructure (wiki) can greatly extend WHO's capacity in this effort