The Philosophy of Medicine

Die Philosophie der Medizin

31 July & 1 August 2009
Internationales Begegnungszentrum

Bergstraße 7a, 18057 Rostock

What do SNOMED CT Concepts Represent?

Stefan Schulz

University Medical Center, Freiburg, Germany

Why ontology matters for medicine

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*, *Diseases*, and the several Changes of the said 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 sold at the
sign of the *Bell* in St. *Pauls* Church-yard.
MDCLXV.

The Table of CASUALTIES.

The Years of our Lord	1647	1648	1649	1650	1651	1652	1653	1654	1655	1656	1657	1658	1659	1660	1629	1630	1631	1632	1633	1634	1635	1636	1629 1630 1631 1632	1633 1634 1635 1636	1647 1648 1649 1650	1651 1652 1653 1654	1655 1656 1657 1658	1629 1649 1659
Abortive and Stil-born	335	329	327	351	389	381	384	433	483	419	463	467	421	544	499	439	410	445	500	475	507	523	1793	2005	1342	1587	1832	1247
Aged	916	815	889	696	780	834	864	974	743	892	869	1176	909	1095	579	712	661	671	704	623	794	714	2475	2814	3336	3452	3680	2377
Ague and Fever	1260	884	751	970	1038	1212	282	1371	689	875	999	1800	2303	2148	956	1091	1115	1108	953	1279	1622	2360	4418	6235	3865	4903	4363	4010
Apoplex and Suddenly	68	74	64	74	106	111	118	86	92	102	113	138	91	67	22	36		17	24	35	26		75	85	280	421	445	177
Bleach			1	3	7	2				1															4	9	1	1
Blasted	4	1			6	6																4	54	14	5	12	14	16
Bleeding	3	2	5	1	3	4	3	2	7	3	5	4	7	2	5	2	5	4	4	3			16	7	11	12	19	17
Bloody Flux, Scouring and Flux	155	176	802	289	833	762	200	386	168	368	362	253	346	251	449	438	352	348	278	512	346	330	1587	1466	1422	2181	1161	1597
Burnt and Scalded	3	6	10	5	11	8	5	7	10	5	7	4	6	6	3	10	7	5	1	3	12	3	25	19	24	31	26	19
Calenture	1			1		2	1	1			3										1	3		4	2	4	3	
Cancer, Gangrene and Fistula Wolf	26	29	31	19	31	53	36	37	73	31	24	35	63	52	20	14	23	28	27	30	24	30	85	112	105	157	150	114
Canker, Sore-mouth and Thrush	66	28	54	42	68	51	53	72	44	81	19	27	73	68	6	4	4	1			5	74	15	79	190	244	161	133
Child-bed	161	106	114	117	206	213	158	192	177	201	236	225	226	194	150	157	113	171	132	143	163	230	590	668	498	769	839	490
Chrisoms and Infants	1369	1254	1065	990	1237	1280	1050	1343	1089	1393	1162	1144	858	1123	2596	2378	2035	2268	2130	2315	2113	1895	9277	8453	4678	4910	4788	4519
Colick and Wind	103	71	85	82	76	102	80	101	85	120	113	179	116	167	48	57					37	50	105	87	341	359	497	247
Cold and Cough							41	36	21	58	30	31	33	24	10	58	51	55	45	54	50	57	174	207	00	77	140	43
Consumption and Cough	2423	2200	2388	1988	2350	2410	2286	2868	2606	3184	2757	3610	2982	3414	1827	1910	1713	1797	1754	1955	2080	2477	5157	8266	8999	9914	12157	7197
Convulsion	684	491	530	493	569	653	600	828	702	1027	807	841	742	1131	52	87	18	241	221	386	478	709	498	734	2198	2656	3377	1324
Cramp			1														1	0	0	0	0	0	01	00	01	0	0	1
Cut of the Stone		2	1	3		1	1	2	4	1	3	5	6	4				5	1	5	2	2	5	10	6	4	13	5
Dropsie and Tympany	185	434	421	508	444	556	617	704	660	706	631	911	646	872	235	252	279	280	266	250	329	389	1045	1734	1538	2321	2982	1302
Drowned	47	40	30	27	49	50	53	30	43	49	63	60	57	48	43	33	29	34	37	32	32	45	135	147	144	182	215	130
Excessive drinking			2																						2			2
Executed	8	17	29	43	24	12	19	21	19	22	20	18	7	18	19	13	12	18	13	13	13	13	62	52	97	76	75	55
Fainted in a Bath					1																				1			
Falling-Sickness	3	2	2	3		3	4	1	4	3	1		4	5	3	10	7	7	2	5	6	8	27	21	10	8	8	9
Flox and small Pox	139	400	1190	184	525	1279	139	812	1294	823	835	409	1523	354	71	40	58	531	72	1354	393	127	701	1846	1913	2755	3361	2785
Found dead in the Streets	6	6	9	8	7	9	12	4	3	4	9	11	2	6	18	33	20	6	13	8	24	24	83	69	29	34	27	29
French-Pox	18	29	15	18	21	20	20	20	29	23	25	53	51	31	17	12	12	12	7	17	12	22	53	48	80	81	130	83
Frighted	4	4	1		3		2		1	1				9	1			1				3	2	3	9	5	2	2
Gout	9	5	12	9	7	7	5	6	8	7	8	13	14	2	2	5	3	4	4	5	7	8	14	24	35	25	36	28
Grief	12	13	16	7	17	14	11	17	10	13	10	12	13	4	18	20	22	11	14	17	5	20	71	56	48	55	45	47
Hanged, and made away themselves	11	10	13	14	9	14	15	9	14	16	24	18	11	36	8	8	6	15		3	8	7	35	18	48	47	72	32
Heach-Ach		1	11	2		2	6	6	5	3	4	5	35	26							4	2	6	6	14	14	17	46
Jaundice	57	35	39	49	41	43	57	71	61	41	46	77	102	76	47	59	35	43	35	45	54	63	184	197	186	212	225	188
Jaw-falu	1	1			3			2	2		3	1			10	16	13	8	10	10	4	11	47	35	02	5	6	10
Impostume	75	61	65	59	80	105	79	90	92	122	80	134	105	96	58	76	73	74	50	62	73	130	282	315	260	354	428	218
Itch		1																	10				00	10	01			
Killed by several Accidents	27	57	39	94	47	45	57	58	52	43	52	47	55	47	54	55	47	46	49	41	51	60	202	201	217	267	194	148
King's Evil	27	26	22	19	22	20	26	26	27	24	23	28	28	54	16	25	18	38	35	20	20	69	97	150	94	92	102	66
Lethargy	3	4	2	4	4	4	3	10	9	4	6	2	6	4	1		2	2	3		2	2	5	7	13	21	21	9
Leprosie			1									1		2	2						2		2	2	1		1	3
Liver-grown, Spleen and Rickets	53	46	56	59	65	72	67	65	52	50	38	51	8	15	94	12	99	87	82	77	98	99	392	356	213	265	191	158
Lunatick	12	18	6	11	7	11	9	12	6	7	13	5	14	14	6	11	6	5	4	2	2	5	28	13	47	35	31	26
Megrom	12	13		5	8	6	6	14	3	6	7	6	5	4			24					22	24	22	30	34	22	05
Measles	5	92	3	33	33	62	8	52	11	153	15	80	6	74	42	2	3	80	21	33	27	12	127	83	133	155	259	51
Mother	2					1	1	2	2	3		3	1	8	1							3	01	3	2	4	8	02
Murdered	3	2	7	5	4	3	3	3	9	6	5	7	70	20							6	5	8	10	19	17	13	27	77
Overlaid and starved at Nurse	25	22	36	28	28	29	30	36	58	53	44	50	46	43	4	10	13	7	8	14	10	14	34	46	111	123	215	86
Palsie	27	21	19	20	23	20	29	18	22	23	20	22	17	21	17	23	17	25	14	21	25	17	82	77	87	90	87	53
Plague	3597	611	67	15	23	16	6	16	9	6	4	14	36	14		1317	274	8		1		10400	1599	10401	4292	61	33	103
Plague in the Guts				1		110	32		87	315	446		253	402									00	00	61	142	844	253
Pleurisie	30	26	13	20	23	19	17	23	10	9	17	16	12	10	26	24	26	36	21		45	24	112	90	89	72	52	51
Poisoned		3		7															2				00	4	10	00	00	00
Purples and Spotted Fever	145	47	43	65	54	60	75	89	56	52	56	126	368	146	32	58	58	38	24	125	245	397	186	791	300	278	290	243
Quinsie and Sore-throat	14	11	12	17	24	20	18	9	15	13	7	10	21	14	01	8	6	7	24	04	5	22	22	55	54	71	45	34
Rickets	150	224	216	190	260	329	229	372	347	458	317	476	441	521									14	49	50	00	113	780	1190	1598	657
Mother, rising of the Lights	150	92	115	120	134	138	135	178	166	212	203	228	210	249	44	72	99	98	60	84	72	104	309	220	777	585	809	369
Rupture	16	7	7	6	7	16	7	15	11	20	19	18	12	28	2	6	4	9	4	3	10	13	21	30	36	45	68	21
Scal'd-head	2				1				2																2	1	2	
Scurvy	32	20	21	21	29	43	41	44	103	71	82	82	95	12	5	7	9		9		00	25	33	34	94	132	300	115
Smothered and stifled			2													24							24		2			2
Sores, Ulcers, broken and bruised	15	17	17	16	26	32	25	32	23	34	40	47	61	48	23		20	48	15	19	22	29	91	89	65	115	144	141
Shot (Limbs													7	20														07
Spleen	12	17					13	13		6	2	5	7	7											29	26	13	07
Shingles													1						1					1				1
Starved		4	8	7	1	2	1	1	3	1	3	6	7	14									14		19	5	13	29
Stitch				1																					1			
Stone and Strangury	45	42	29	28	50	41	44	38	49	57	72	69	22	30	35	39	58	50	58	49	33	45	188	185	144	173	247	51
Sciatica														2					1	3	1	6	1	4				
Stopping of the Stomach	29	29	30	33	55	67	66	107	94	145	129	277	186	214								6		6	121	293	247	216
Surfet	217	137	136	123	104	177	178	212	128	161	137	218	202	192	63	157	149	86	104	114	132	371	445	721	613	671	644	401
Swine-Pox	4	4	3				1	4	2	1	1	1	2		5	8	4	6	3		10		23	13	1	5	5	10
Teeth and Worms	767	597	540	598	709	905	691	1131	803	1198	878	1036	839	1008	440	506	335	470	432	454	539	1207	1751	2632	2503	3436	3915	1819

The Table of CASUALTI

The Years of our Lord	1647	1648	1649	1650	1651	1652	1653	1654	1655	1656	1657	1658	1659	1660	1629	163
Abortive and Stil-born	335	329	327	351	389	381	384	433	483	419	463	467	421	544	499	43
Aged	916	835	889	696	780	834	864	974	743	892	869	1176	909	1095	579	71
Ague and Fever	1260	884	751	970	1038	1212	282	1371	689	875	999	1800	2303	2148	956	109
Apoplex and Suddenly	68	74	64	74	106	111	118	86	92	102	113	138	91	67	22	3
Bleach			1	3	7	2				1						
Blasted	4	1			6	6			4		5	5	3	8	13	
Bleeding	3	2	5	1	3	4	3	2	7	3	5	4	7	2	5	
Bloody Flux, Scouring and Flux	155	176	802	289	833	762	200	386	168	368	362	233	346	251	449	43
Burnt and Scalded	3	6	10	5	11	8	5	7	10	5	7	4	6	6	3	1
Calenture	1			1		2	1	1			3					
Cancer, Gangrene and Fistula	26	29	31	19	31	53	36	37	73	31	24	35	63	52	20	14
Wolf				8												
Canker, Sore-mouth and Thrush	66	28	54	42	68	51	53	72	44	81	19	27	73	68	6	4
Child-bed	161	106	114	117	206	213	158	192	177	201	236	225	226	194	150	157
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Cramp			1													
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Dropsie and Tympany	185	434	421	508	444	556	617	704	660	706	631	911	646	872	235	252
Drowned	47	40	30	27	49	50	53	30	43	49	63	60	57	48	43	33
Excessive drinking			2													

International Classification of Diseases

Code-Suche:
Dreisteller-Eingabe:
OK!

ICD-10 Homepage

Kapitel II:

Neubildungen
(C00-D48)

C00-C97 Bösartige Neubildungen
- C00-C75 Bösartige Neubildungen an genau bezeichneten Lokalisationen, als primär festgestellt oder vermutet, ausgenommen lymphatisches, blutbildendes und verwandtes Gewebe
  - C00-C14 Lippe, Mundhöhle und Pharynx
  - C15-C26 Verdauungsorgane
  - C30-C39 Atmungsorgane und sonstige intrathorakale Organe
  - C40-C41 Knochen und Gelenkknorpel
  - C43-C44 Haut
  - C45-C49 Mesotheliales Gewebe und Weichteilgewebe
  - C50 Brustdrüse [Mamma]
  - C51-C58 Weibliche Genitalorgane
  - C60-C63 Männliche Genitalorgane
  - C64-C68 Harnorgane
  - C69-C72 Auge, Gehirn und sonstige Teile des Zentralnervensystems
  - C73-C75 Schilddrüse und sonstige endokrine Drüsen
- C76-C80 Bösartige Neubildungen ungenau bezeichneter, sekundärer und nicht näher bezeichneter Lokalisationen
- C81-C96 Bösartige Neubildungen des lymphatischen, blutbildenden und verwandten Gewebes, als primär festgestellt oder vermutet
- C97 Bösartige Neubildungen als Primärtumoren an mehreren Lokalisationen

D00-D09 In-situ-Neubildungen
D10-D36 Gutartige Neubildungen
D37-D48 Neubildungen unsicheren oder unbekannten Verhaltens [siehe Hinweis am Anfang der Krankheitsgruppe D37 D48]

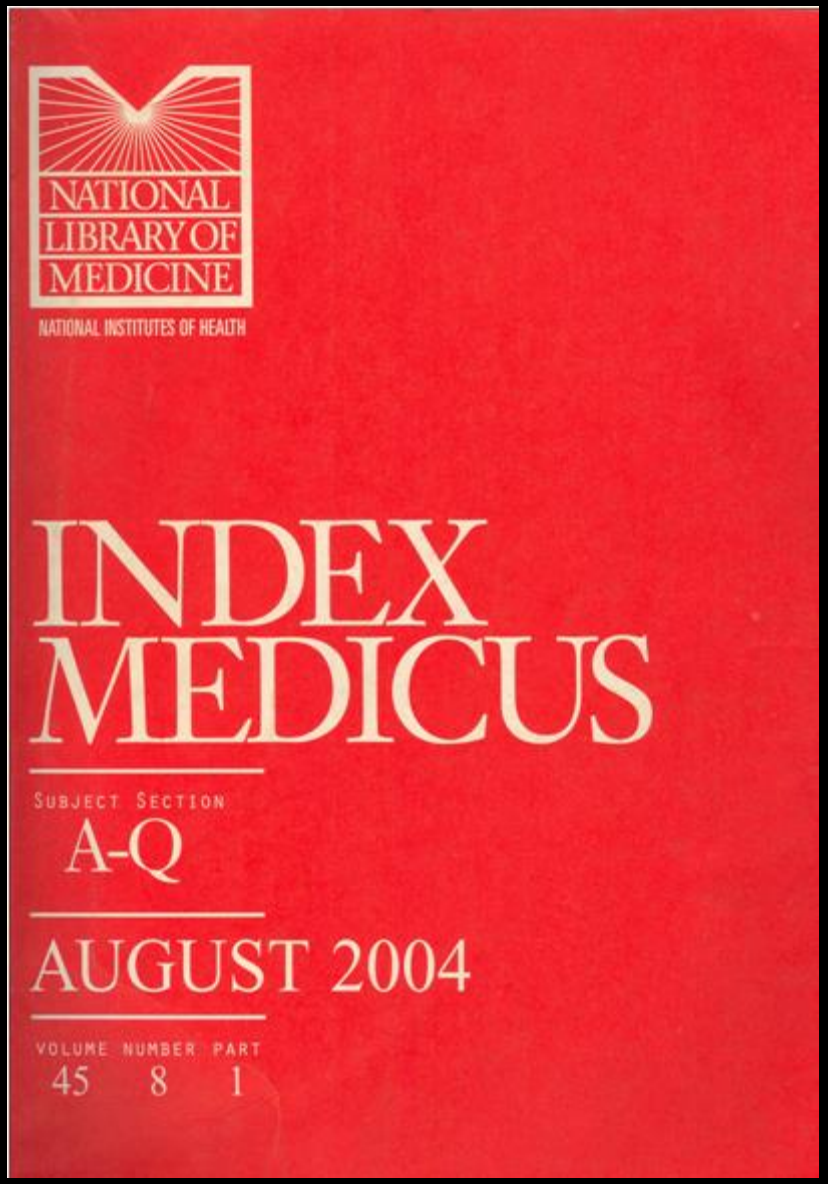
Kapitel III:

Krankheiten des Blutes und der blutbildenden Organe sowie bestimmte Störungen mit Beteiligung des Immunsystems
(D50-D90)

D50-D53 Alimentäre Anämien
D55-D59 Hämolytische Anämien
D60-D64 Aplastische und sonstige Anämien
D65-D69 Koagulopathien, Purpura und sonstige hämorrhagische Diathesen
D70-D77 Sonstige Krankheiten des Blutes und der blutbildenden Organe
D80-D90 Bestimmte Störungen mit Beteiligung des Immunsystems

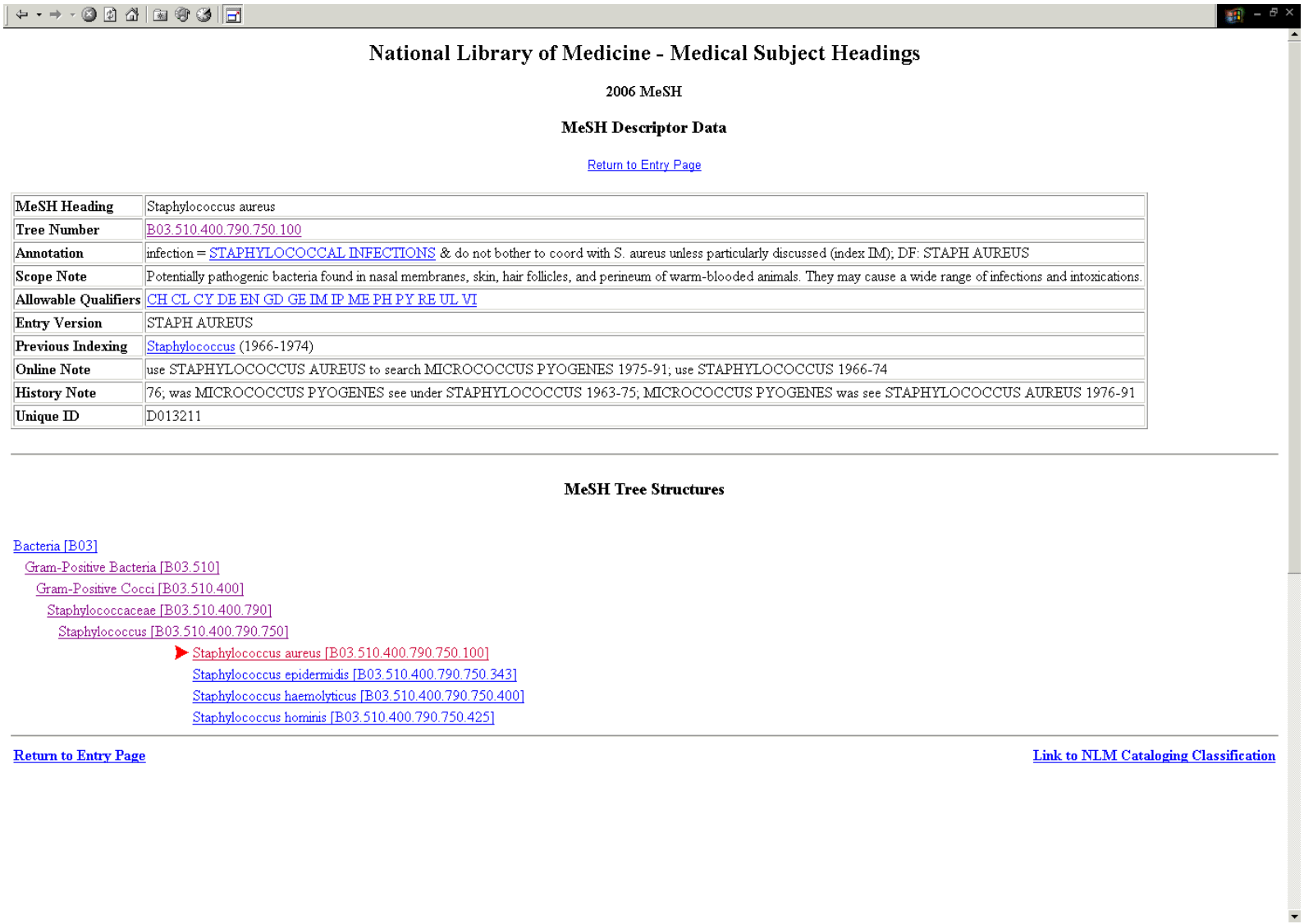
Why ontologies matter for medicine

- Create taxonomies of natural kinds
  - classify instances in the world
  - basic for health statistics
  - exemplified in disease & procedure classification systems



Thanks: Christopher Chute, Mayo Clinic

Medical Subject Headings



National Library of Medicine - Medical Subject Headings

2006 MeSH

MeSH Descriptor Data

Return to Entry Page

MeSH Heading	Staphylococcus aureus
Tree Number	B03.510.400.790.750.100
Annotation	infection = STAPHYLOCOCCAL INFECTIONS & do not bother to coord with S. aureus unless particularly discussed (index IM); DF: STAPH AUREUS
Scope Note	Potentially pathogenic bacteria found in nasal membranes, skin, hair follicles, and perineum of warm-blooded animals. They may cause a wide range of infections and intoxications.
Allowable Qualifiers	CH CL CY DE EN GD GE IM IP ME PH PY RE UL VI
Entry Version	STAPH AUREUS
Previous Indexing	Staphylococcus (1966-1974)
Online Note	use STAPHYLOCOCCUS AUREUS to search MICROCOCCUS PYOGENES 1975-91; use STAPHYLOCOCCUS 1966-74
History Note	76; was MICROCOCCUS PYOGENES see under STAPHYLOCOCCUS 1963-75; MICROCOCCUS PYOGENES was see STAPHYLOCOCCUS AUREUS 1976-91
Unique ID	D013211

MeSH Tree Structures

Bacteria [B03]
- Gram-Positive Bacteria [B03.510]
  - Gram-Positive Cocci [B03.510.400]
    - Staphylococcaceae [B03.510.400.790]
      - Staphylococcus [B03.510.400.790.750]
        - Staphylococcus aureus [B03.510.400.790.750.100]
        - Staphylococcus epidermidis [B03.510.400.790.750.343]
        - Staphylococcus haemolyticus [B03.510.400.790.750.400]
        - Staphylococcus hominis [B03.510.400.790.750.425]

Return to Entry Page Link to NLM Cataloging Classification

1: Clin Infect Dis. 2005 Apr 1;40(7):941-7. Epub 2005 Mar

Comment in:
Clin Infect Dis. 2005 Apr 1;40(7):948-50.

```
MH  - Adult
MH  - Anti-Bacterial Agents/therapeutic use
MH  - Bacterial Toxins/metabolism
MH  - Enterotoxins/metabolism
MH  - Exotoxins/metabolism
MH  - Female
MH  - Humans
MH  - Leukocidins
MH  - Male
MH  - Middle Aged
MH  - Purpura, Schoenlein-Henoch/*etiology/microbiology/pathology
MH  - Sepsis/complications/microbiology
MH  - Shock, Septic/etiology/pathology
MH  - Staphylococcal Infections/*complications/drug
      therapy/*microbiology/pathology
MH  - Staphylococcus aureus/*isolation & purification/metabolism
MH  - Superantigens/metabolism
```

Purpura fulminans due to Staphylococcus aureus.

Kravitz GR, Dries DJ, Peterson ML, Schlievert PM.

St. Paul Infectious Disease Associates, St. Paul, Minnesota, USA.

BACKGROUND: Purpura fulminans is an acute illness commonly associated with meningococcemia or invasive streptococcal disease, and it is typically characterized by disseminated intravascular coagulation (DIC) and purpuric skin lesions. In this article, we report the first 5 cases (to our knowledge) of purpura fulminans directly associated with Staphylococcus aureus strains that produce high levels of the superantigens toxic shock syndrome toxin-1 (TSST-1), staphylococcal enterotoxin serotype B (SEB), or staphylococcal enterotoxin serotype C (SEC). METHODS: Cases were identified in the Minneapolis-St. Paul, Minnesota, metropolitan area during 2000-2004. S. aureus infection was diagnosed on the basis of culture results, and susceptibility to methicillin was determined. The ability of the isolated organisms to produce TSST-1, SEB, SEC, and Panton-Valentine leukocidin (PVL) was determined. TSST-1, SEB, and SEC levels were also quantified after in vitro growth of the organisms. RESULTS: In 3 of the 5 cases, the infecting S. aureus strain was isolated from the blood cultures. In 2 of the 5 cases, the infecting S. aureus strain was isolated only from the respiratory tract, indicating that purpura fulminans and toxic shock syndrome resulted from exotoxin and/or other host factors, rather than septicemia. One of these latter 2 patients also had necrotizing pneumonia, and the isolated S. aureus was a methicillin-resistant strain that produced both SEC and PVL. Only 2 of the 5 patients survived, and 1 of the survivors received activated protein C. CONCLUSIONS: Staphylococcal purpura fulminans may be a newly emerging illness associated with superantigen production. Medical practitioners should be aware of this illness.

PMID: 15824983 [PubMed - indexed for MEDLINE]

child due to Panton-Valenti
Staphylococcal purpura ful
Purpura fulminans in a chil producing Staphylococcus
Review [Clinical aspects o
Review Menstrual toxic sho case report and review.

Cited by 9 PubMed Central a
Review Pathogenesis of m
Superantigen profile of Sta steroid-resistant atopic der
Alpha and beta chains of h aureus exotoxins.

Recent Activity

Why ontologies matter for medicine

- Create taxonomies of natural kinds
  - classify instances in the world
  - basic for health statistics
  - exemplified in disease & procedure classification systems

- Creating common vocabularies / terminologies
  - normalization of word meanings
  - annotation of research data
  - facilitate document and fact retrieval

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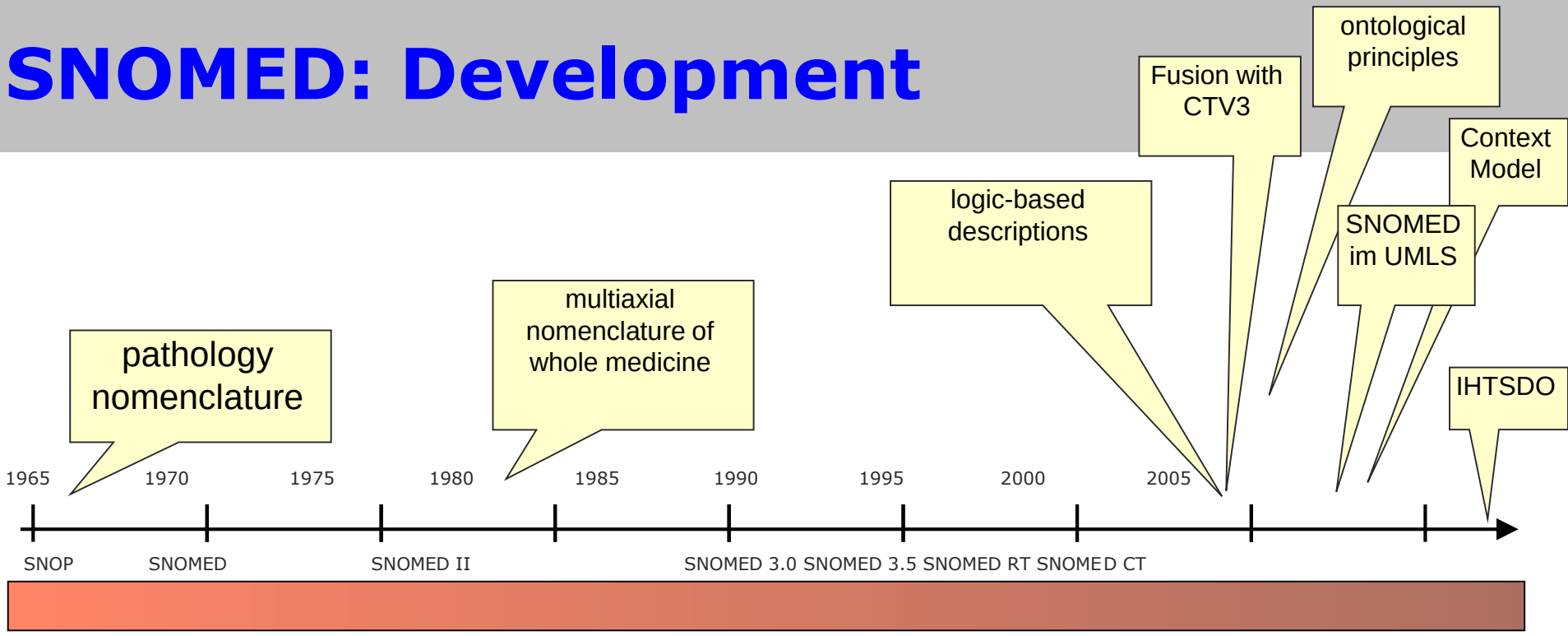
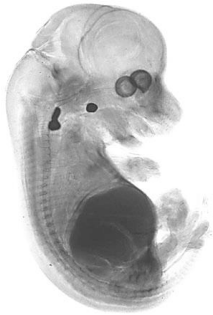
set theory
extensionality
real things

- Creating common terminologies
  - normalization of word meanings
  - annotation of research data
  - facilitate document and fact retrieval

linguistics
intensionality
concepts

SNOMED: Development

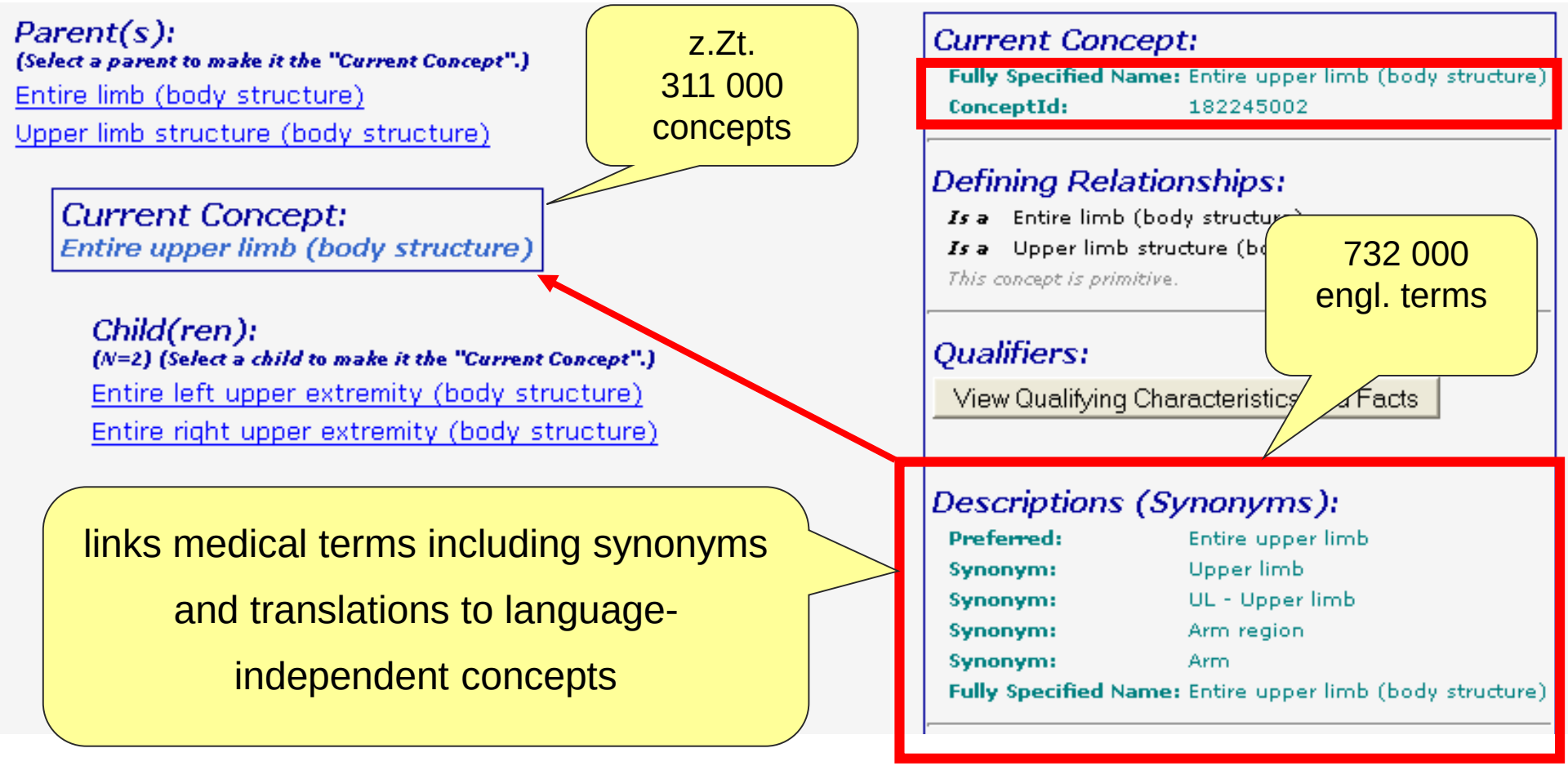




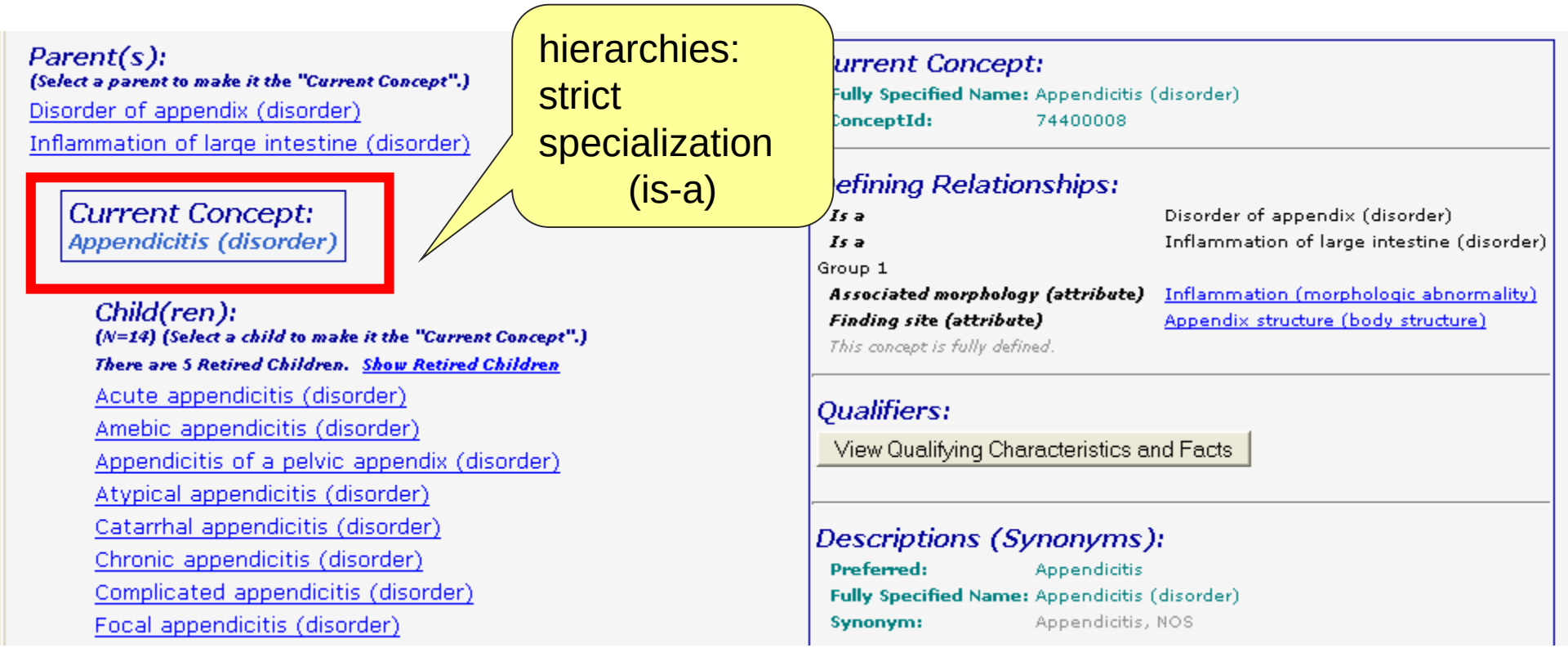
SNOMED CT

- "Standardized Nomenclature of Medicine – Clinical Terms"
- Comprehensive clinical terminology
  (> 300,000 representational units)
- Devised to represent the meaning of clinical terms for whole range of health and clinical care
- Increasingly guided by ontological design principles
- Using a formal language: (Basic) Description Logics **EL**:
  - equivalence ($\equiv$) , subsumption ($\sqsubseteq$)
  - existential role restriction ($\exists$), conjunction ($\sqcap$)

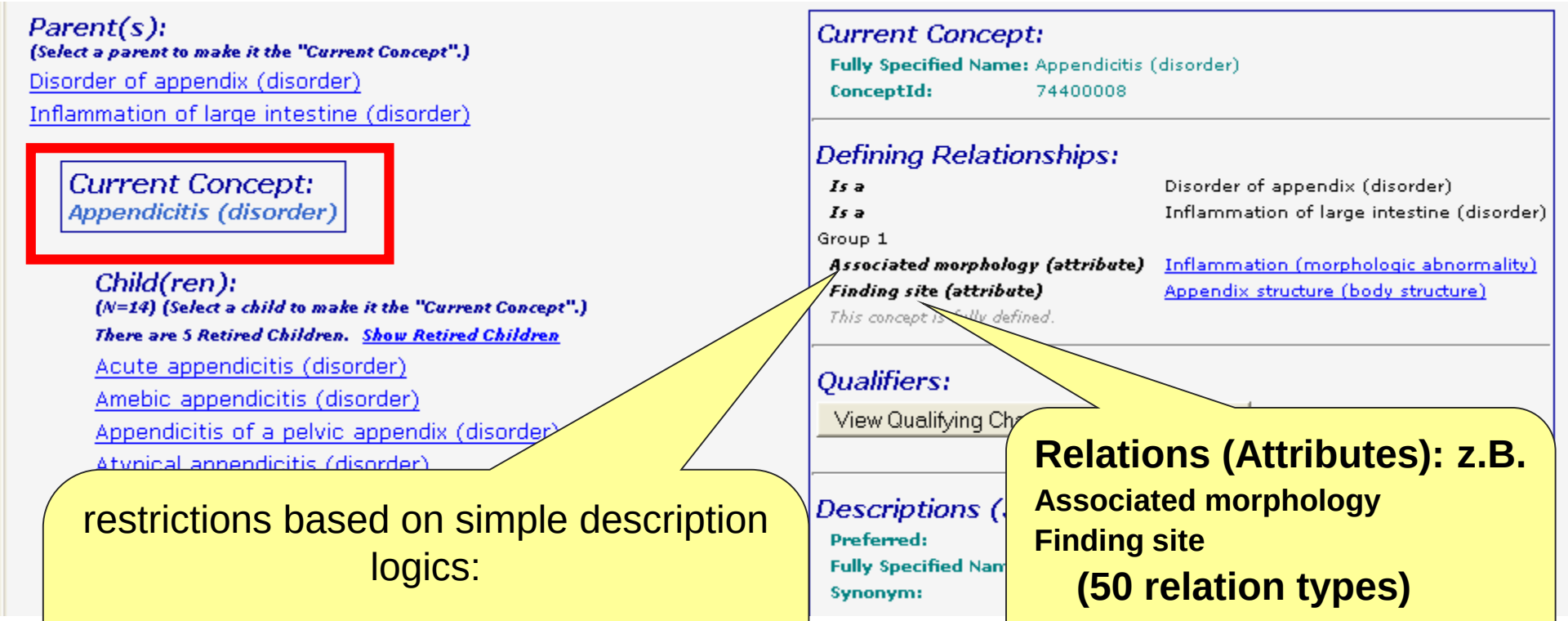
SNOMED CT as a controlled vocabulary



SNOMED CT as a formal system



SNOMED CT as a formal system



restrictions based on simple description logics:

C1 – Rel – C2 interpreted as:

$\forall x: instanceOf(x, C1) \Rightarrow$

$\exists y: instanceOf(C2) \wedge Rel(x,y)$

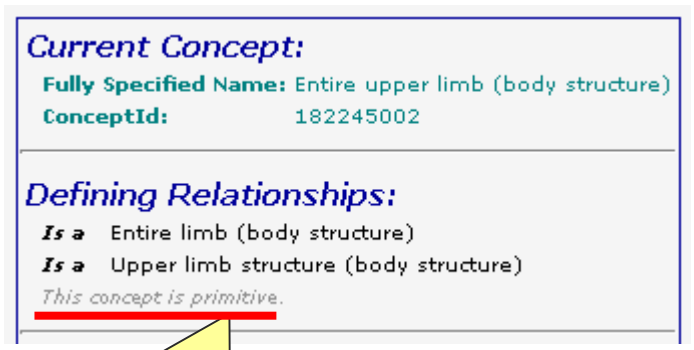
Relations (Attributes): z.B.

Associated morphology

Finding site

(50 relation types)

SNOMED CT als formales System



defined vs. primitive concepts

Deficit of previous non-formal SNOMED versions

D5-46210	Acute appendicitis, NOS

D5-46100	Appendicitis, NOS
G-A231	Acute

M-41000	Acute inflammation, NOS
G-C006	In
T-59200	Appendix, NOS

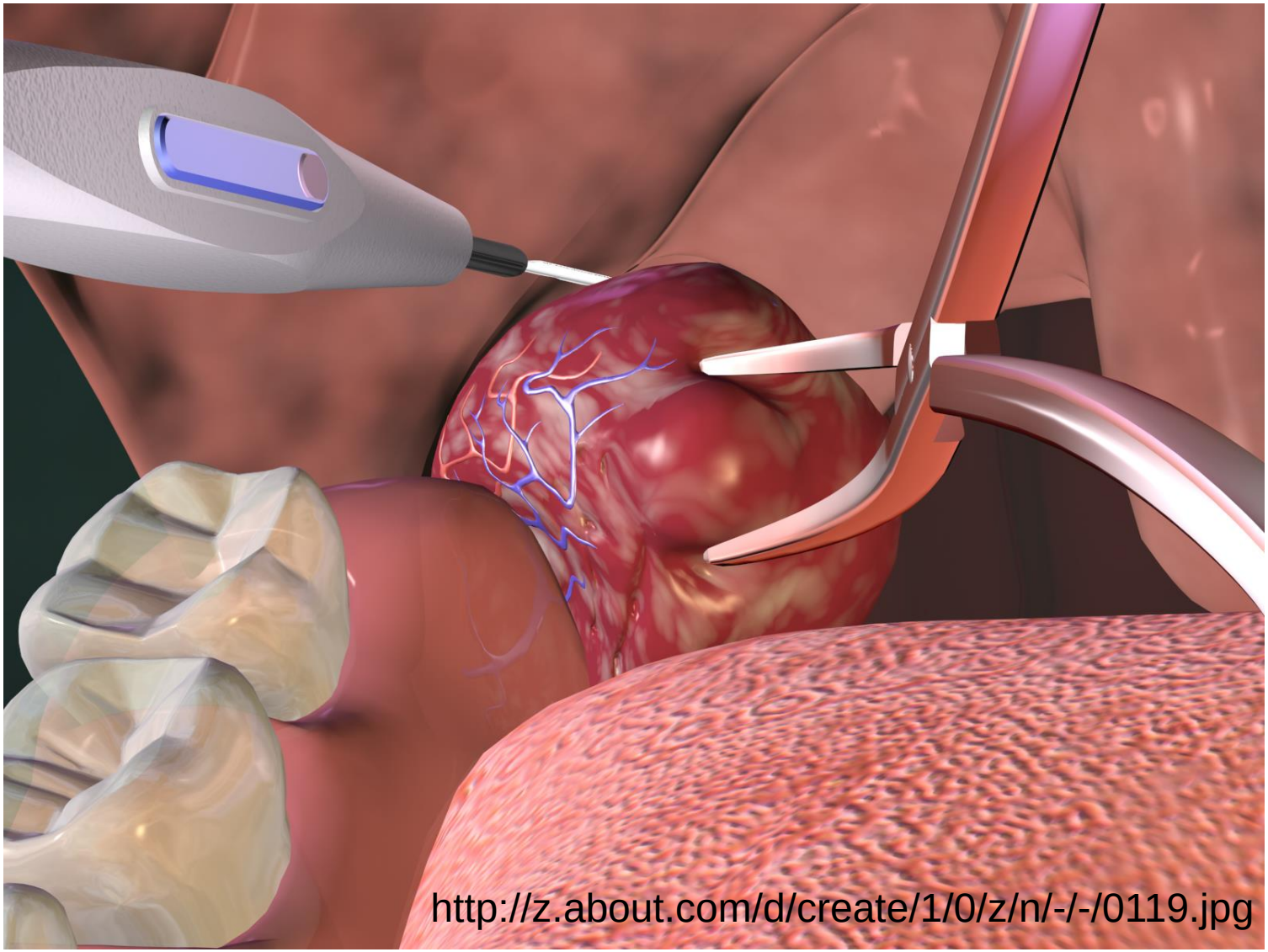
G-A231	Acute
M-40000	Inflammation
G-C006	In
T-59200	Appendix, NOS

- Unterschiedliche Beschreibungen desselben Sachverhalts sind nicht aufeinander abbildbar
- Aneinanderreihung von Konzepten und Relationen nicht eindeutig interpretierbar

Ontological commitment

- "Agreement about the ontological nature of the entities being referred to by the representational units in an ontology" (modified definition following Gruber 93)
- Formal ontologies: subsumption and equivalence statements are either true or false
- Problem: change of truth-value of axioms and sentences according to resulting competing interpretations

Tonsillectomy



SNOMED CT Examples

1. ***Tonsillectomy planned*** $\equiv$

   $\exists$ *rg.(* $\exists$ *associatedProcedure.Tonsillectomy* $\sqcap$

   $\exists$ *procedureContext.Planned* $\sqcap$

   $\exists$ *subjectRelationshipContext.SubjectOfRecord* $\sqcap$

   $\exists$ *temporalContext.CurrentOrSpecifiedTime)*

SNOMED CT Examples

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SNOMED CT Examples

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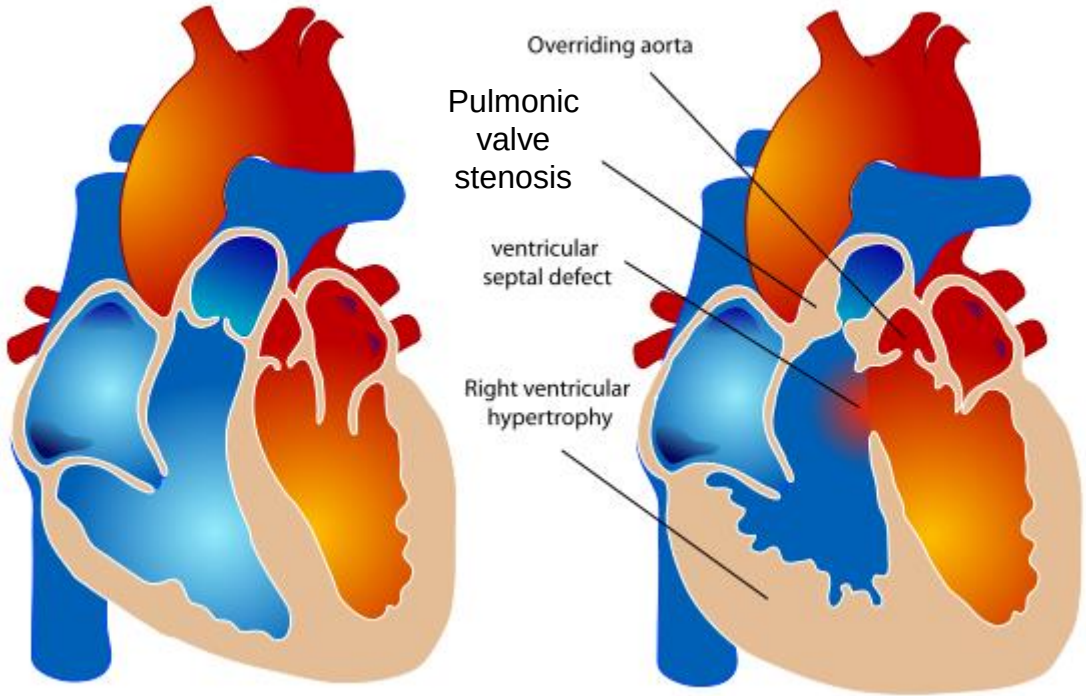
   $\exists subjectRelationshipContext.SubjectOfRecord \sqcap$

   $\exists temporalContext.CurrentOrSpecifiedTime)$

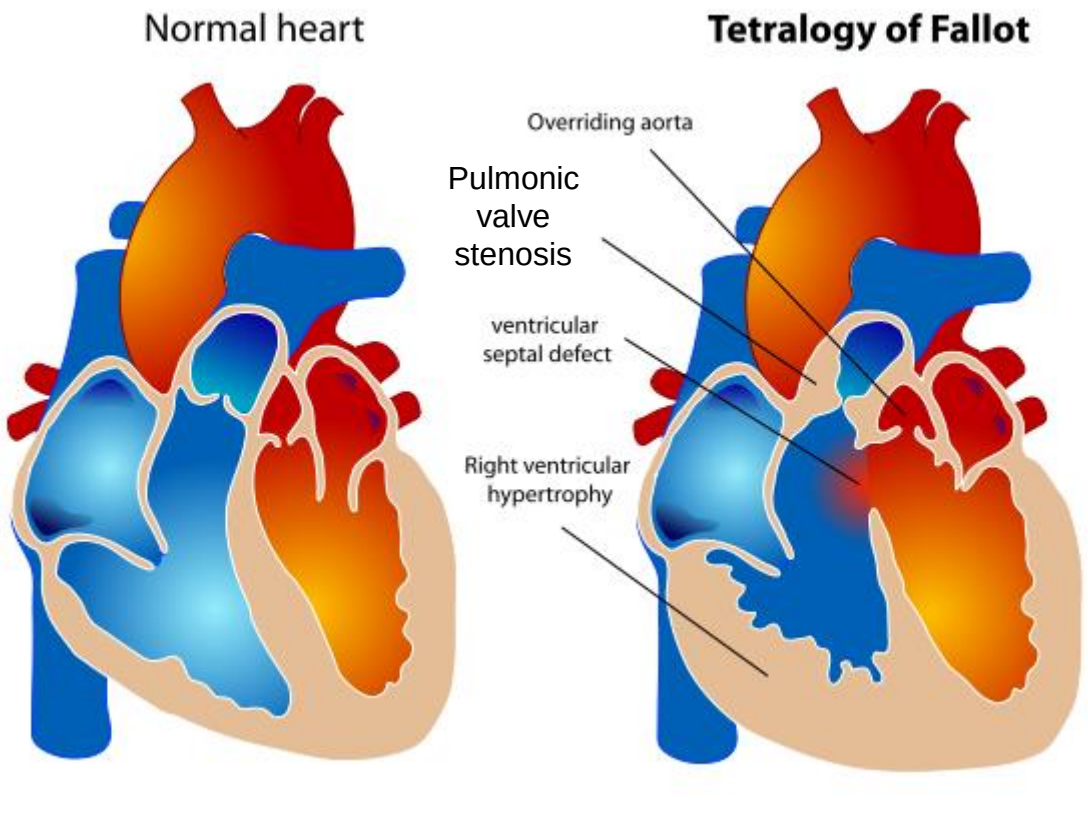
2. ***Denied tonsillectomy*** ≡

   $Tonsillectomy \sqcap \exists Priority.Denied$



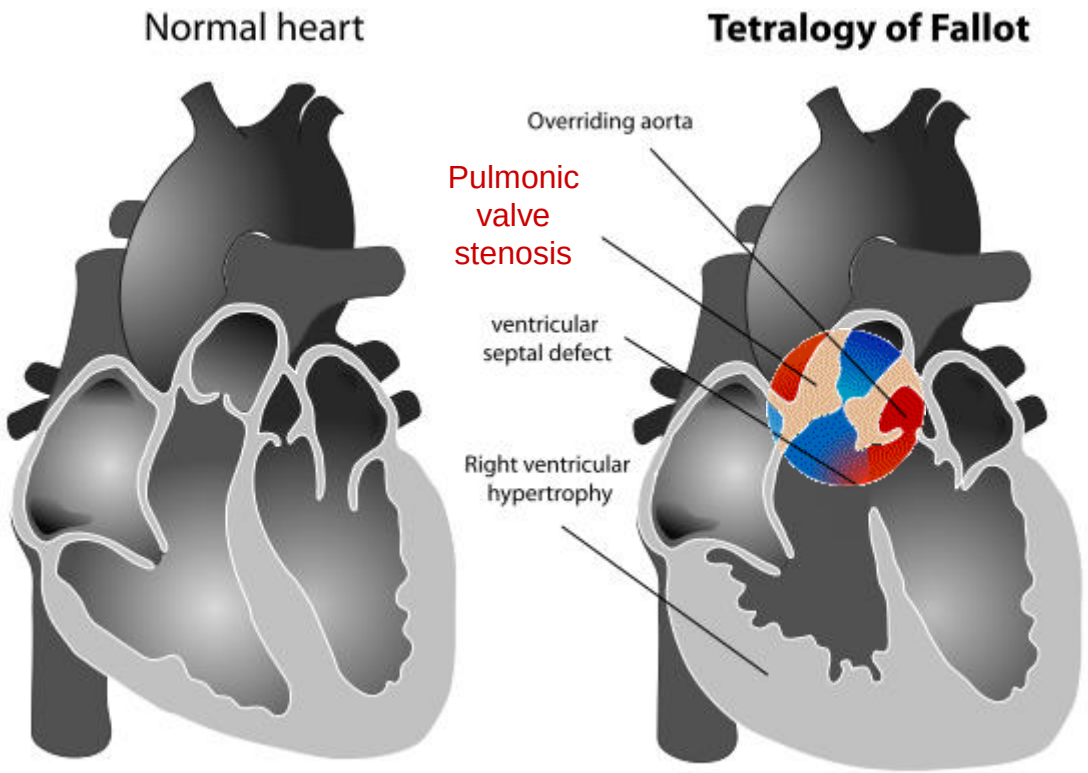
http://iwannabeadr.com/

Tetralogy of Fallot



http://iwannabeadr.com/

Tetralogy of Fallot



http://iwannabeadr.com/

SNOMED CT Examples

1. ***Tonsillectomy planned*** ≡

   $\exists$ *rg.(* $\exists$ *associatedProcedure.Tonsillectomy* $\sqcap$

   $\exists$ *procedureContext.Planned* $\sqcap$

   $\exists$ *subjectRelationshipContext. SubjectOfRecord* $\sqcap$

   $\exists$ *temporalContext.CurrentOrSpecifiedTime)*

2. ***Denied tonsillectomy*** ≡

   Tonsillectomy $\sqcap$ $\exists$ *Priority.Denied*

3. ***Tetralogy of Fallot*** ≡

   PulmonicValveStenosis $\sqcap$ *VentricularSeptalDefect* $\sqcap$

   OverridingAorta $\sqcap$ *RightVentricular hypertrophy*

SNOMED CT Examples

1. ***Tonsillectomy planned*** ≡

   $\exists$ rg.($\exists$ associatedProcedure.Tonsillectomy ⊓

   $\exists$ procedureContext.Planned ⊓

   $\exists$ subjectRelationshipContext. SubjectOfRecord ⊓

   $\exists$ temporalContext.CurrentOrSpeci

2. ***Denied tonsillectomy*** ≡

   Tonsillectomy ⊓ ∃ Priority.Denied

3. ***Tetralogy of Fallot*** ≡

   PulmonicValveStenosis ⊓ VentricularSeptalDefect ⊓

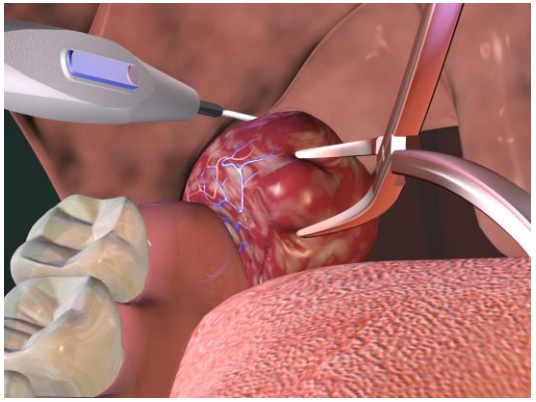
   OverridingAorta ⊓ RightVentricular hypertrophy

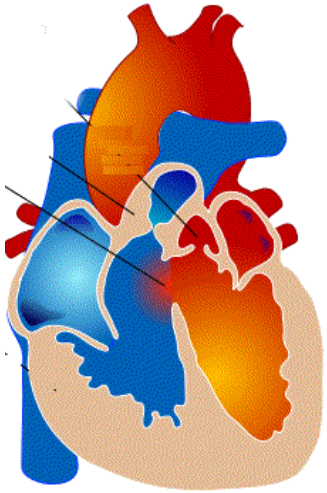
"every instance of "Tonsillectomy planned" implies some tonsillectomy"

"every denied tonsillectomy is a tonsillectomy"

"every Fallot is also a Pulmonic Valve Stenosis"

Problems

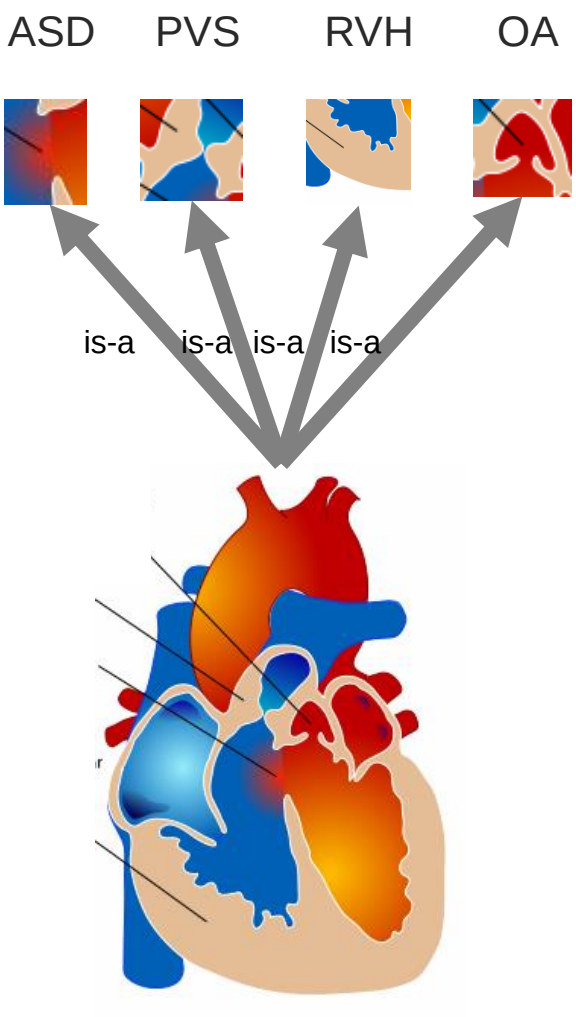




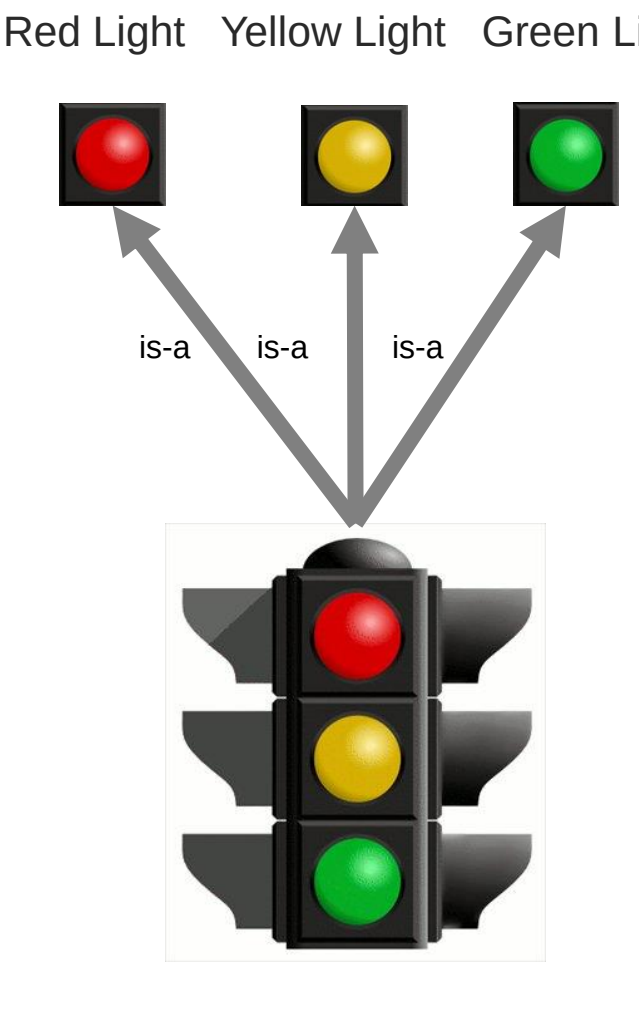
- The negation of a process is a specialization of this process
- A plan is defined such as its realization is implied
- A (definitional) proper part of a compound entity is its taxonomic parent

Proper parts of taxonomic parents ?

Example from Harold Solbrig



Tetralogy of Fallot



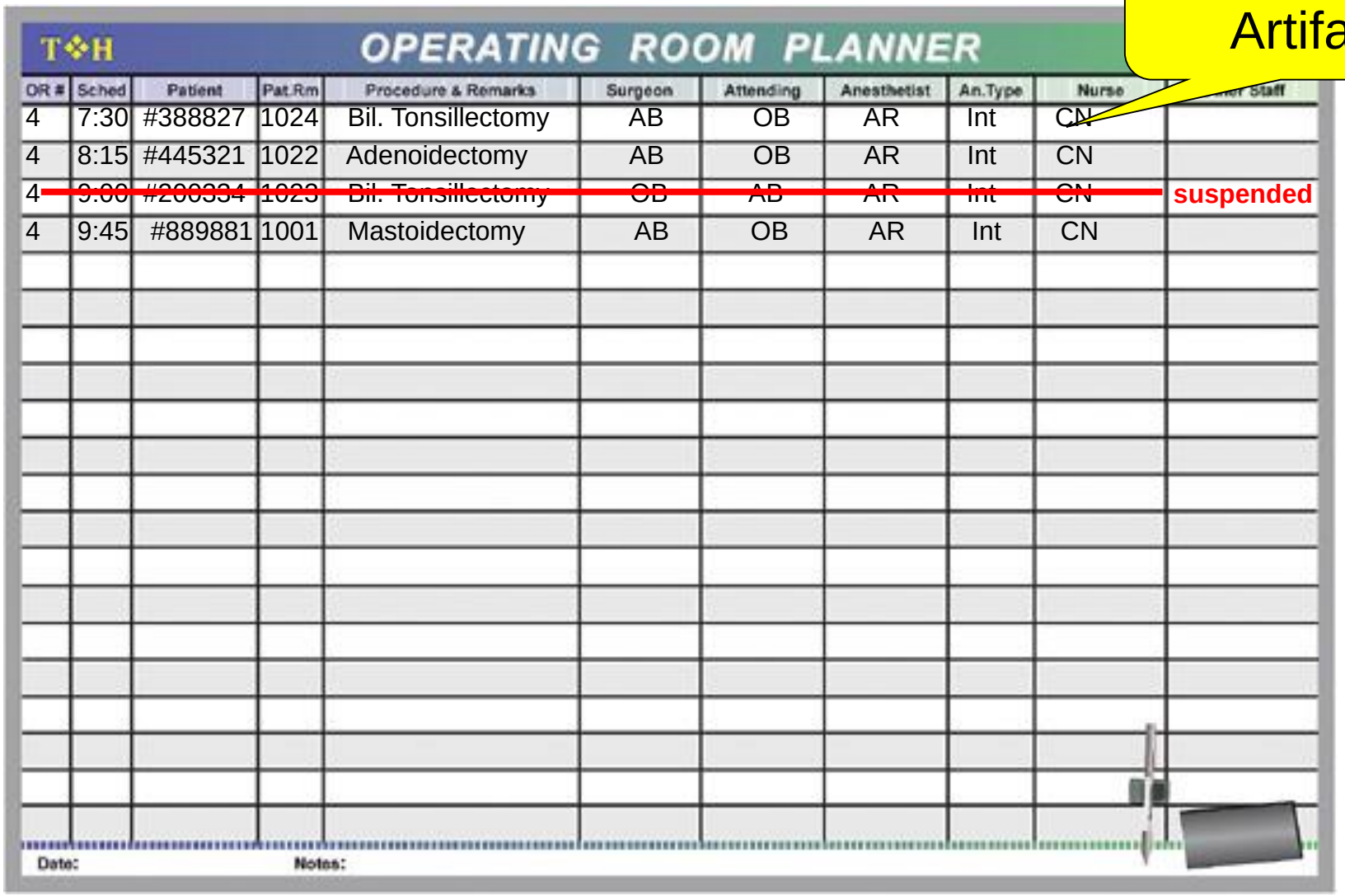
Traffic Light

Relevance

- The three examples are not accidental errors – they represent systematic architectural patterns of SNOMED CT
  - for 50,000 procedure concepts, "denied" subconcepts can be created
  - hundreds of concepts have properties like "planned", "suspected" or "known absent" in their definition
  - 77,000 "procedure" or "finding" concepts have their constituent parts as parent concepts (side effect of role group constructor)
- Hypothesis: they represent different and competing ontological commitments strongly influenced by the practice of clinical coding and documentation

Alternative interpretations ?

Alternative interpretation (I)



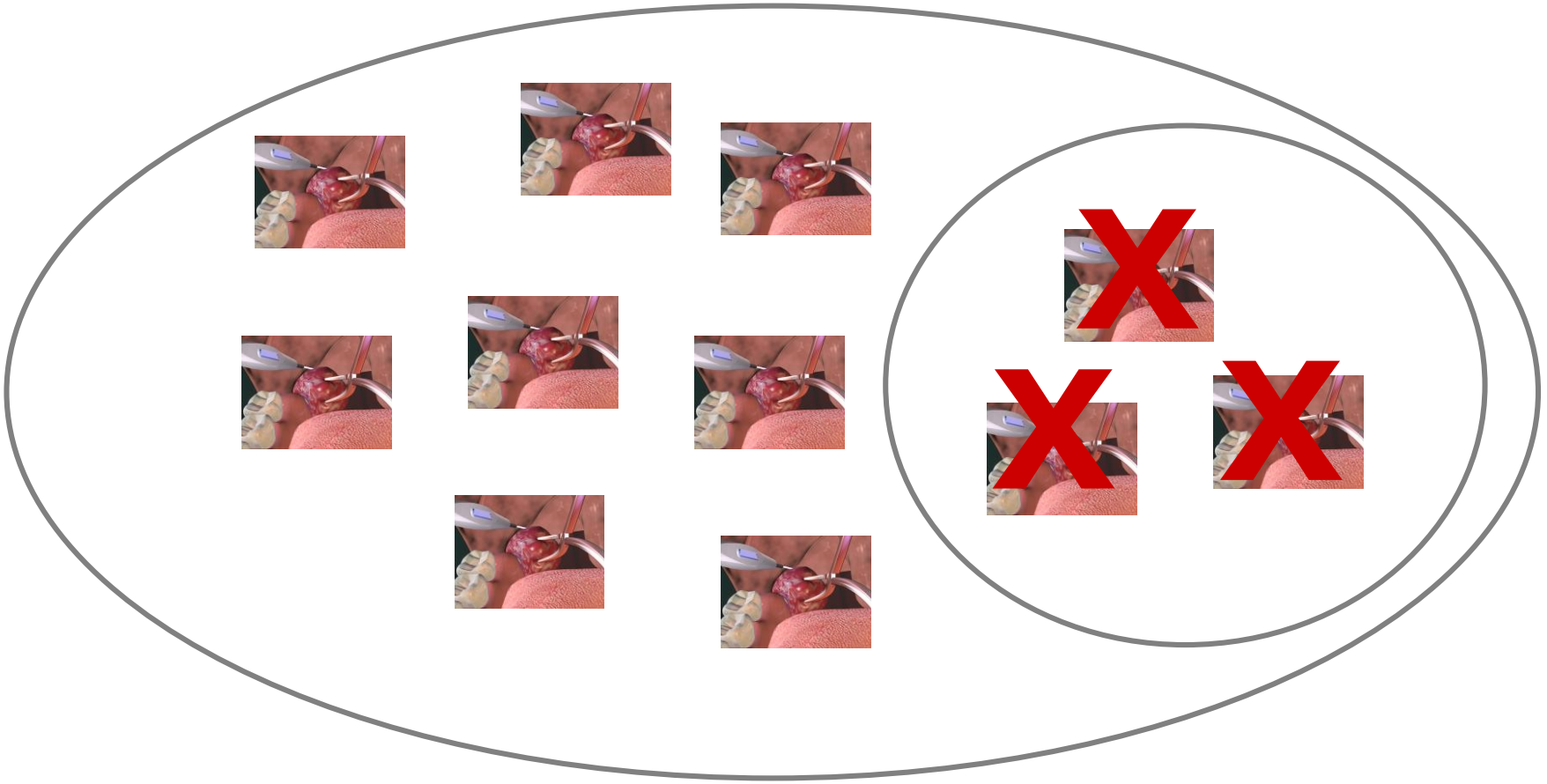
Alternative interpretation (I)

SNOMED CT concepts are instantiated by representational artifacts as contained in an electronic patient record

- A documentation artifact of a certain kind is created for each patient scheduled for an operation
- The class of these information artifacts includes subclasses of information artifacts that include values such as “planned”, “executed”, “denied” etc.
- An expression such as $\exists$ *associatedProcedure.Tonsillectomy* can be seen representing a plan (but $\exists$ is false anyway)
- $\exists$ *Priority.Denied* refines the class of information artifacts but not the class of tonsillectomies

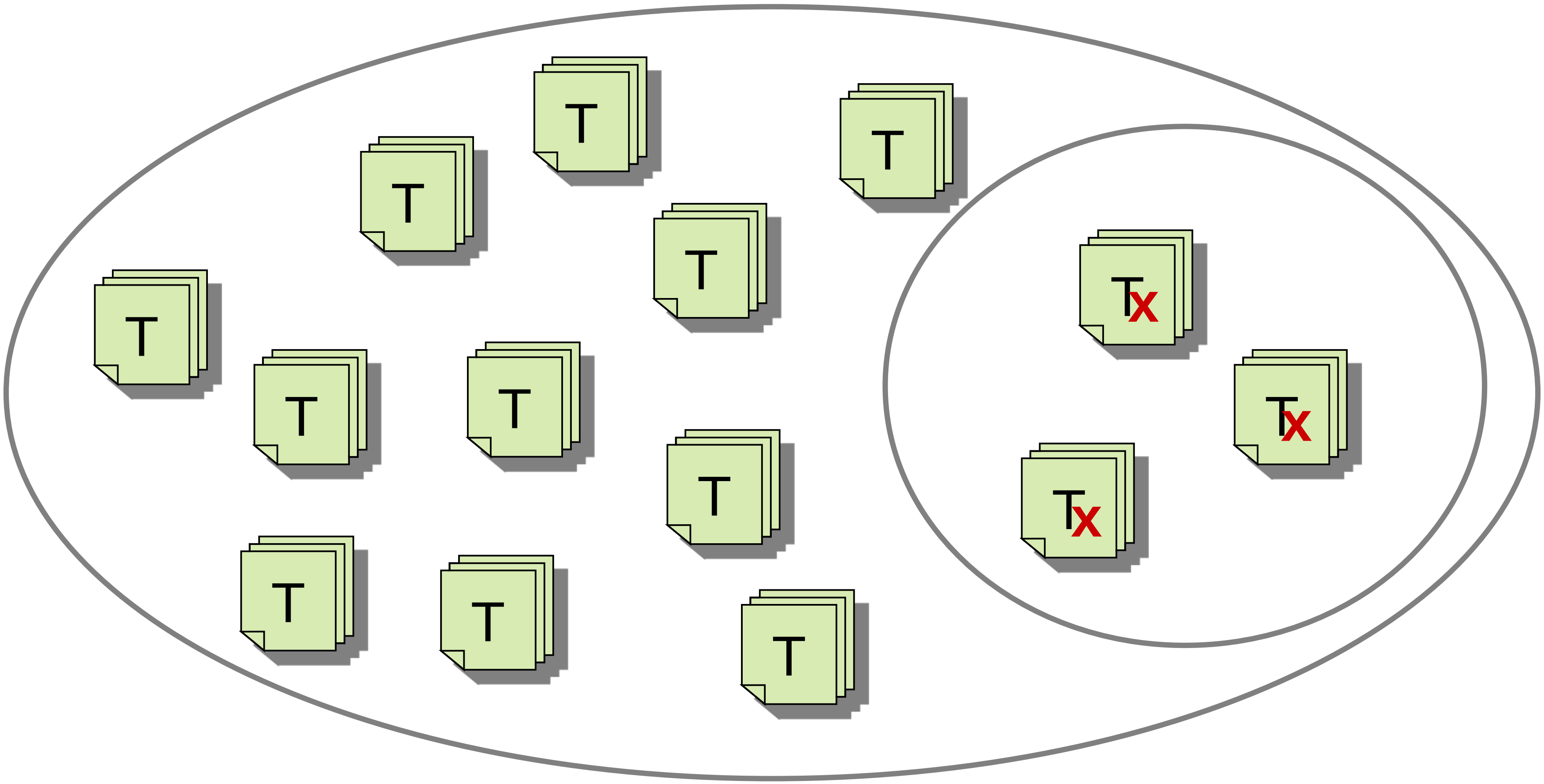
Alternative interpretation (I)

Extension of "Tonsillectomy" includes extension of "Denied Tonsillectomy": **FALSE**



Alternative interpretation (I)

Extension of “Record of Tonsillectomy” includes extension of “Record of Denied Tonsillectomy”: **TRUE**



Alternative interpretation (II)

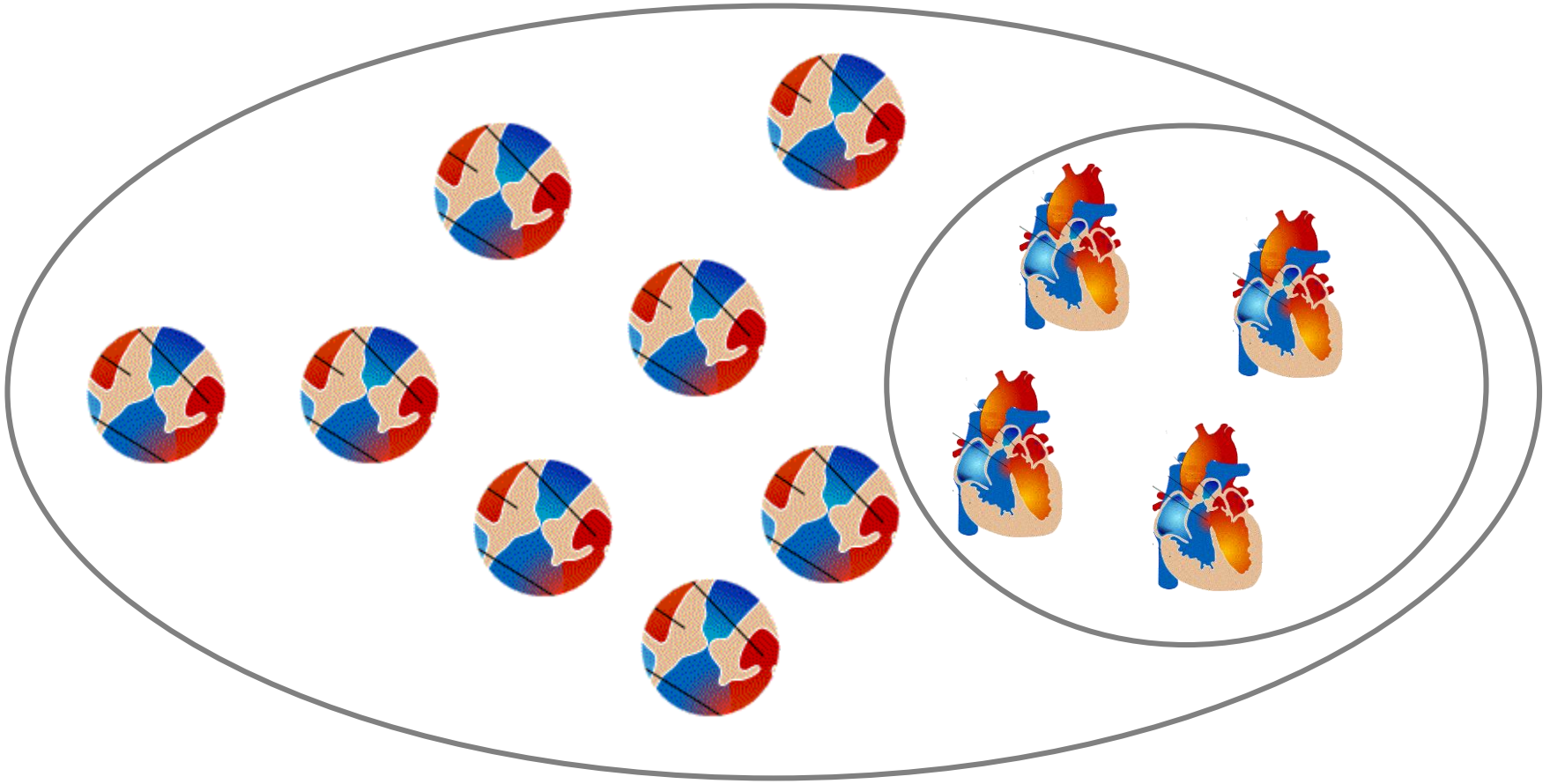
SNOMED CT concepts are instantiated by patients or clinical situations.

- *Pulmonic Valve Stenosis* stands for "Patient with a pulmonic valve stenosis"
- *Tetralogy of Fallot* stands for "Fallot Patient"
- All Fallot patients are also patients with pulmonic valve stenosis because every instance of Tetralogy of Fallot has one instance of pulmonic valve stenosis as part

- Consequence:
  - Finding and procedure concepts extend to classes of patients but not to classes of findings or procedures

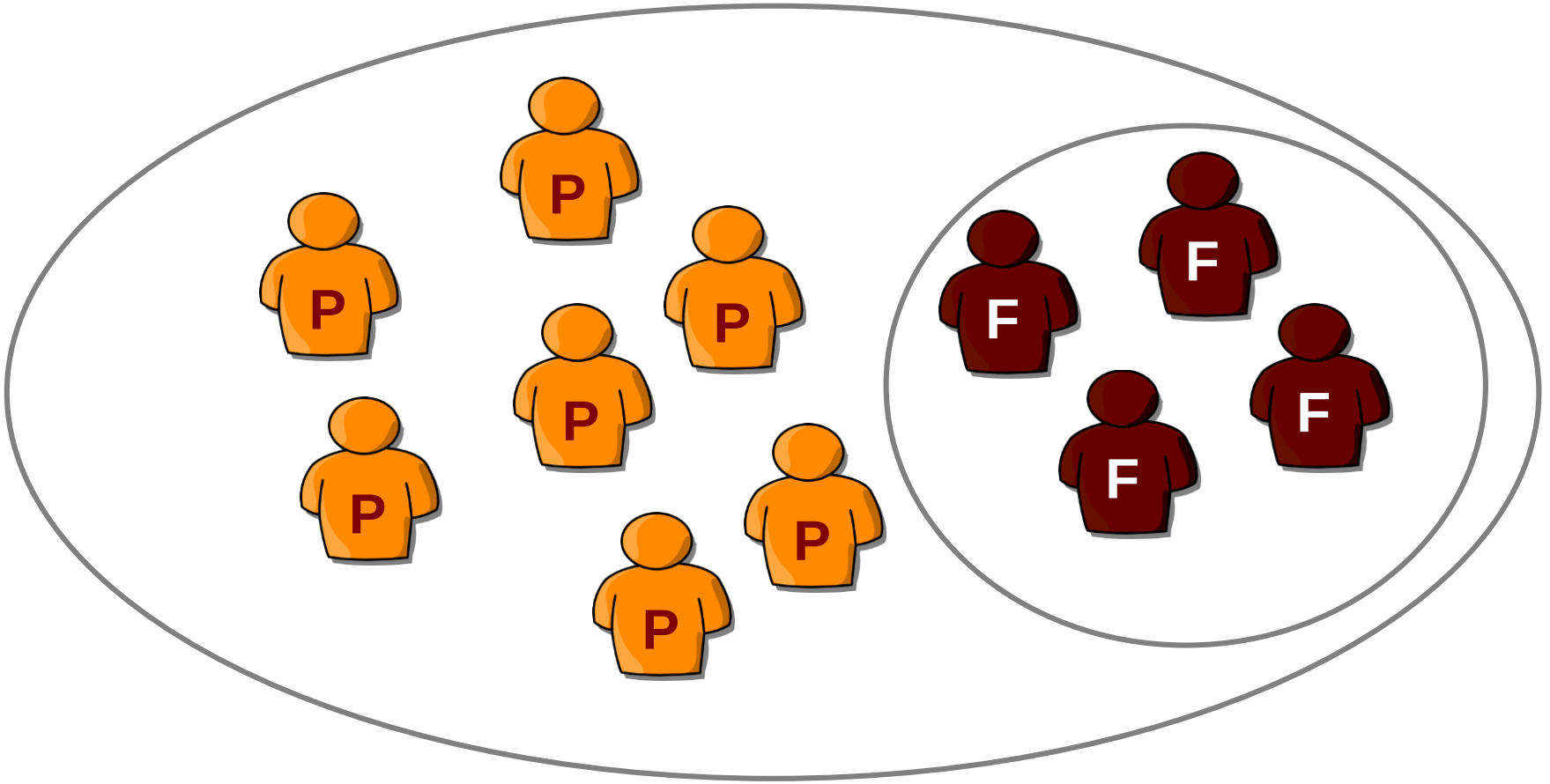
Alternative interpretation (II)

Extension of "Pulmonic Valve Stenosis" includes extension of "Tetralogy of Fallot": **FALSE**



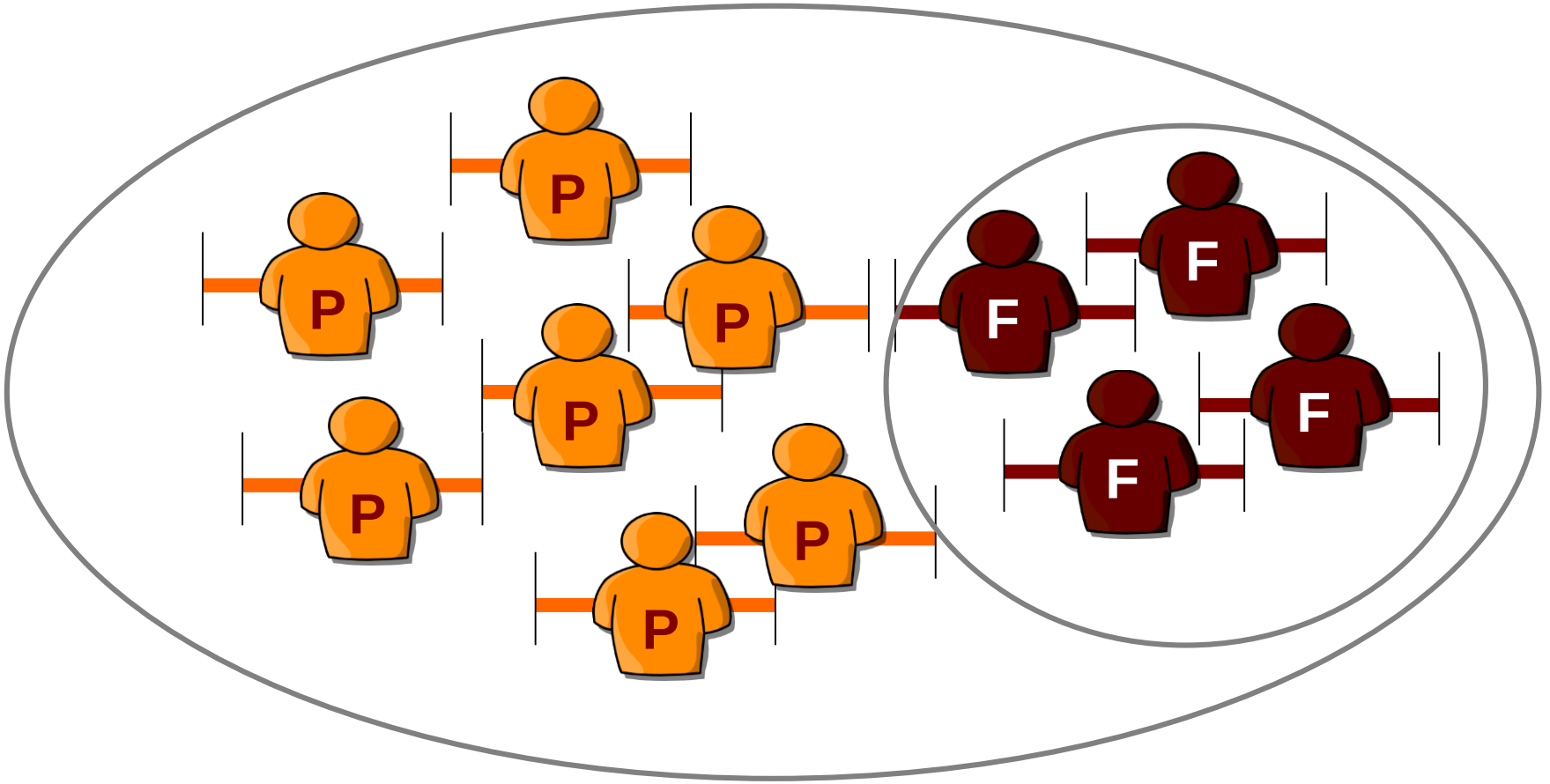
Alternative interpretation (II)

Extension of "**Patient with** Pulmonic Valve Stenosis" includes extension of "**Patient with** Tetralogy of Fallot": **TRUE**



Alternative interpretation (II)

Extension of "**Situation with** Pulmonic Valve Stenosis" includes extension of "**Situation with** Tetralogy of Fallot": **TRUE**



Conclusions

- SNOMED CT's ontological commitment is heterogeneous
- SNOMED CT's alternative interpretations are implicit, thus leaving burden of interpretation to the user.
- The alternative interpretations reflect clinicians' reasoning patterns
- SNOMED mixes elements of an ontology with elements of information models (information artifacts)
- Use of SNOMED CT as an ontology depends on agreement about its ontological commitment