

Retrieval of Clinical Information using the SNOMED CT Relationship Network - Possibilities and Pitfalls

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Use of (clinical) data ?

- *Observe*: Some of the content in the following presentation might seem overtly oversimplified or even naive*)
- *Warning*: it also contains a few reflections over human verbal logic and **set logic**
- ... and I will try to say as little as possible about information models
 - *) showing a lack of experience, wisdom, or judgment

Current relevance in Denmark?

- Two (of five) regions are going to implement Epic's EHR system (at least partly) ...
- ... and the current decision is *somehow* to use SNOMED CT in that framework
- The population in The Capital Region and Region Zealand is 2.2 mill. (of 5.5 mill. in Denmark)

What is SNOMED CT?

- ... actually – and what are the advantages?
- SNOMED CT possesses two major important features (as you all know)
 - Terms that represent the lexical description of each concept
 - The relationship network that represent the logical characteristics of each of the concepts
 - i.e. how the concepts (might) be related

What is SNOMED CT?

- The relationship network is constructed as a **unidirectional graph** (and I'll come back to that)
 - This is also accountable for some limitations
 - It is among other things difficult to handle negations
 - e.g. Not pregnant (finding)
 - is a: Finding related to pregnancy (finding) (!)
 - many negations in SNOMED has, however, been handled
 - negations should be handled in the information model !
- If you want to use SNOMED for logic (!)- you will have to use pure **set logic**: $\forall \exists \neg \subset$

What is SNOMED CT?

- The concepts is represented by at least two terms
 - fully specified
 - preferred
 - (synonym(s))
- often constructed as *motivated terms*
 - (mini definitions)
- not more about terms . . . but remember that language can trick you !
- not more - except some examples . . .

What is SNOMED CT?

- Provides care **without** prejudicial behaviour (procedure)
- Hypertension **without** albuminuria **AND without** oedema in the obstetric context
- Nutritional edema **without** dyspigmentation of skin **AND/OR** hair (disorder)
- Severe manic bipolar I disorder **without** psychotic features (disorder)
- (this is also SNOMED ...)

SNOMED CT - relationships

just mentioning . . .

Appendectomy

is-a *Operation on appendix*

is-a *Partiel excision of large intestine*

procedure-site *Appendix structure*

method *Excision - Action*

Bacterial meningitis

is-a *Infective meningitis*

is-a *Bacterial infection of central nervous system*

finding-site *Meninges structure*

associated-morphology *Inflammation*

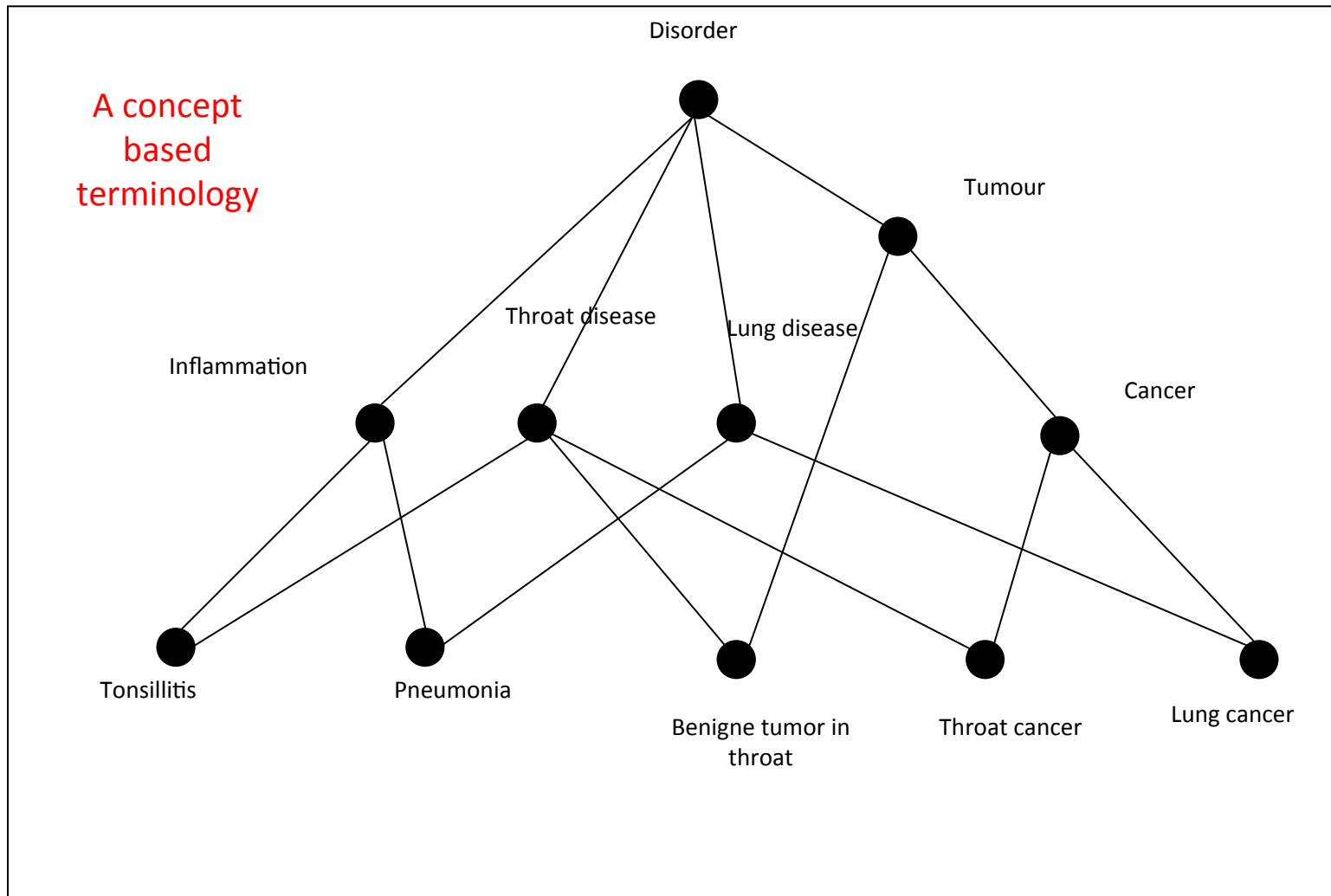
pathological process *Infectious disease*

Causative-agent *Bacterium*

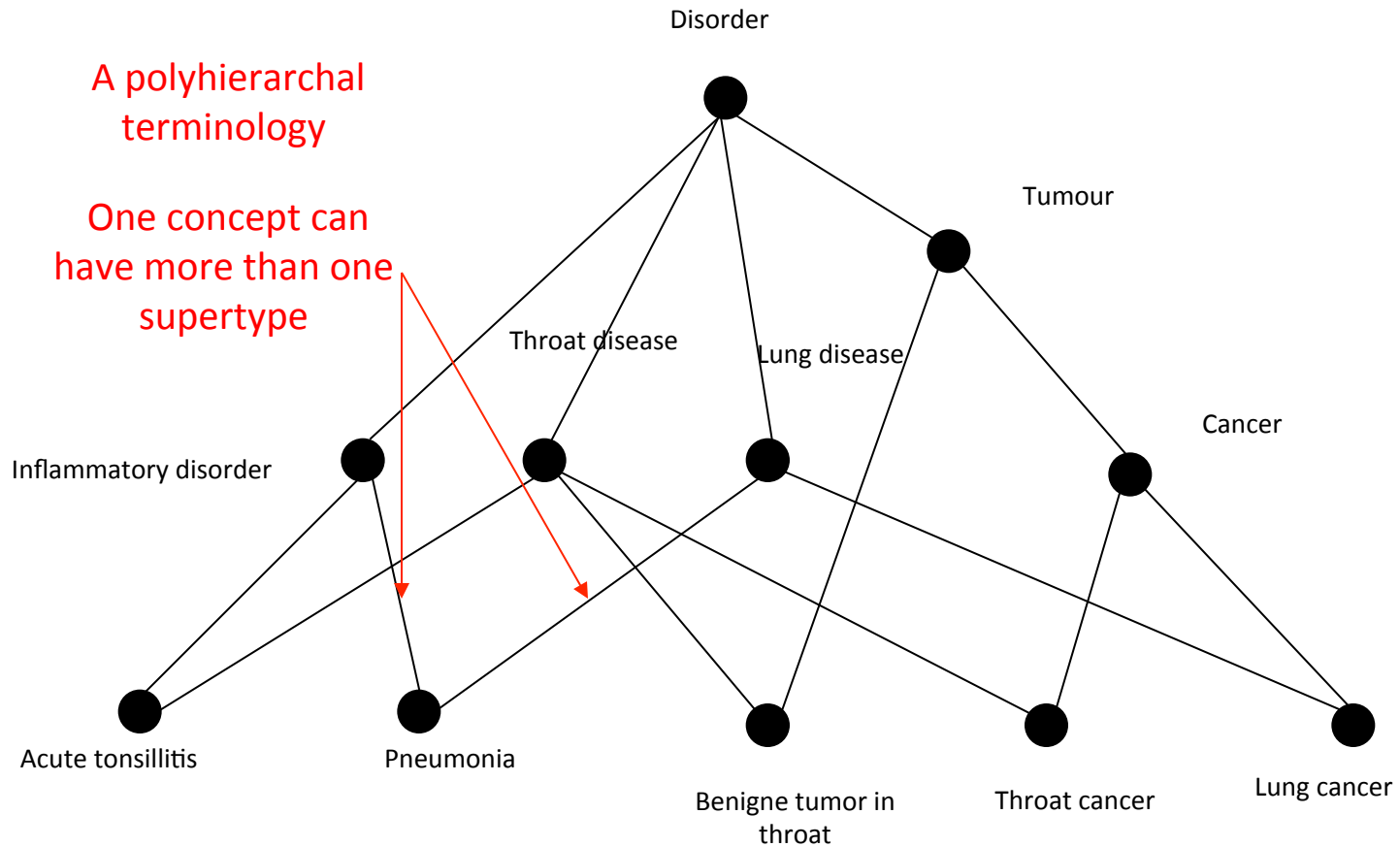
(fully defined)

The use of attribute relations follow specific rules (description logics)

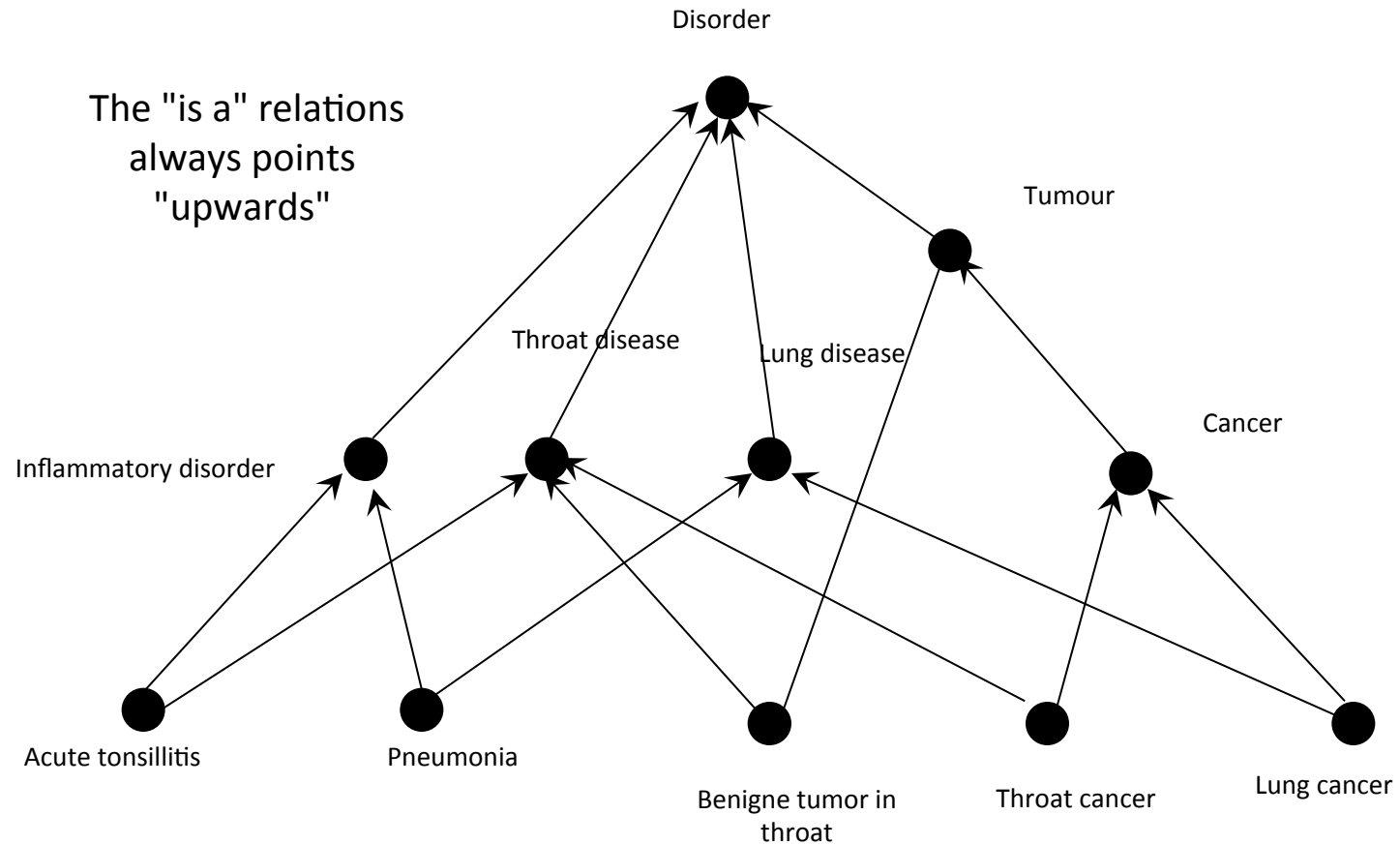
The architecture of a concept based terminology



The architecture of SNOMED CT !

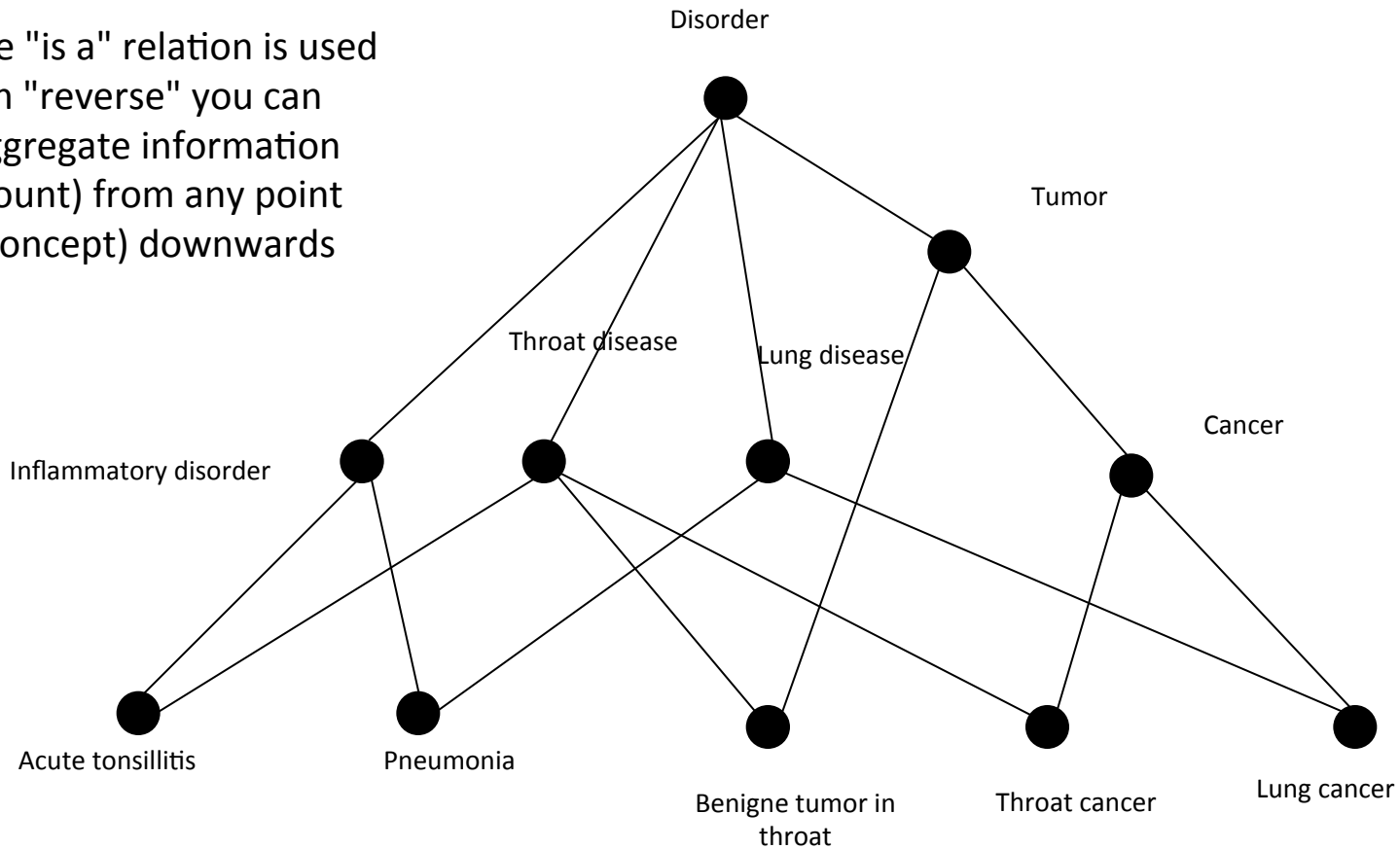


The architecture of SNOMED CT !



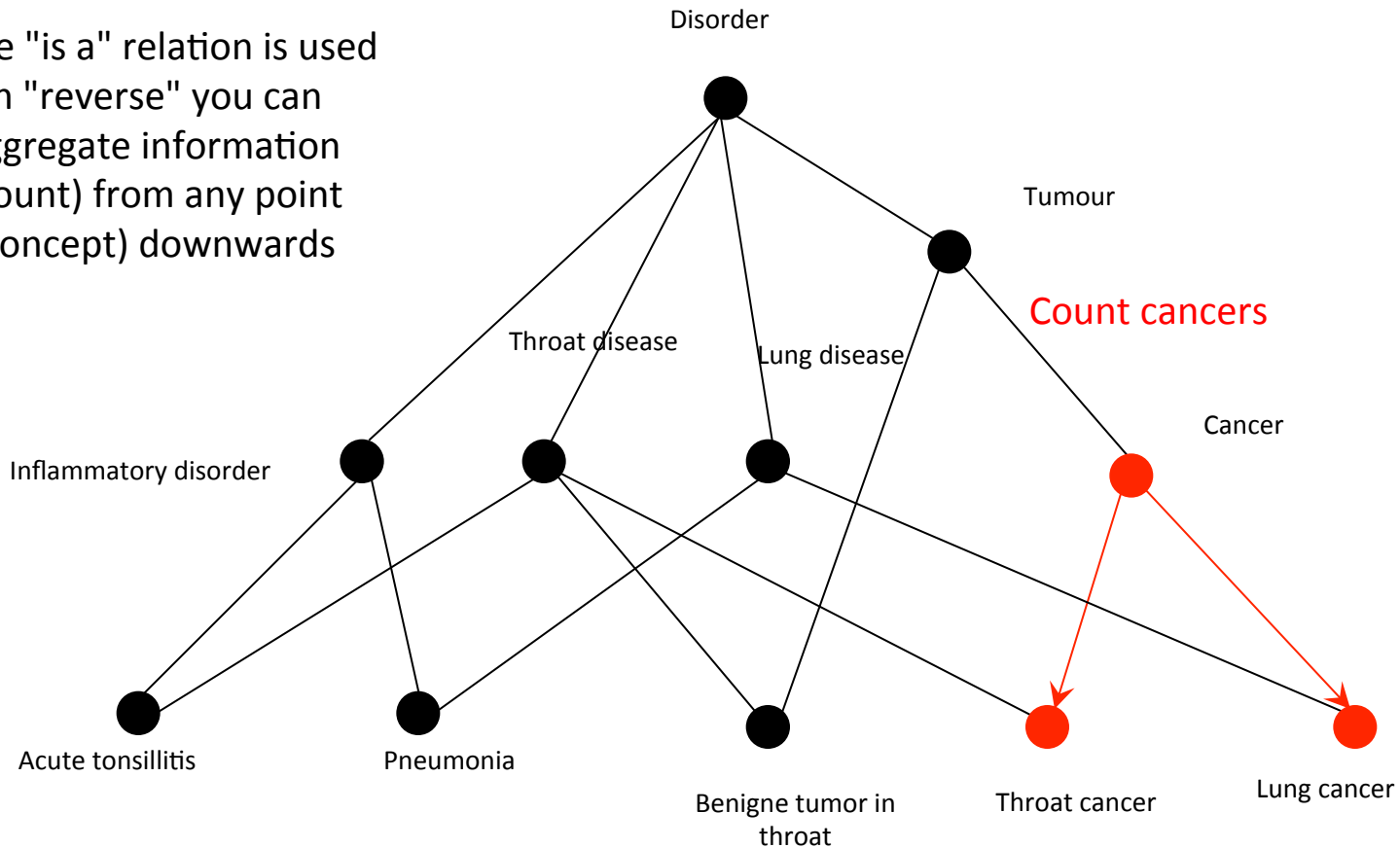
The architecture of SNOMED CT !

If the "is a" relation is used in "reverse" you can aggregate information (count) from any point (concept) downwards



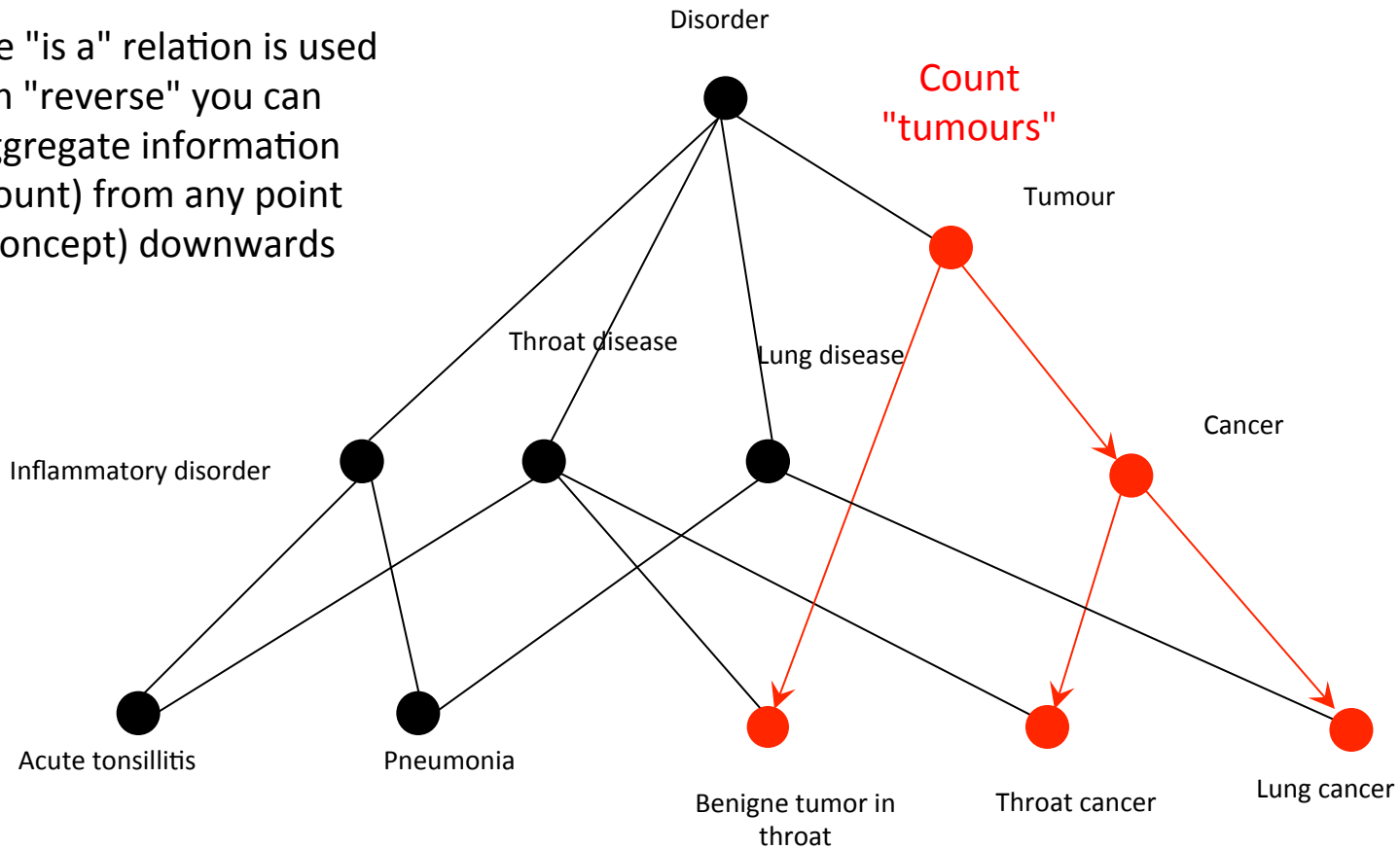
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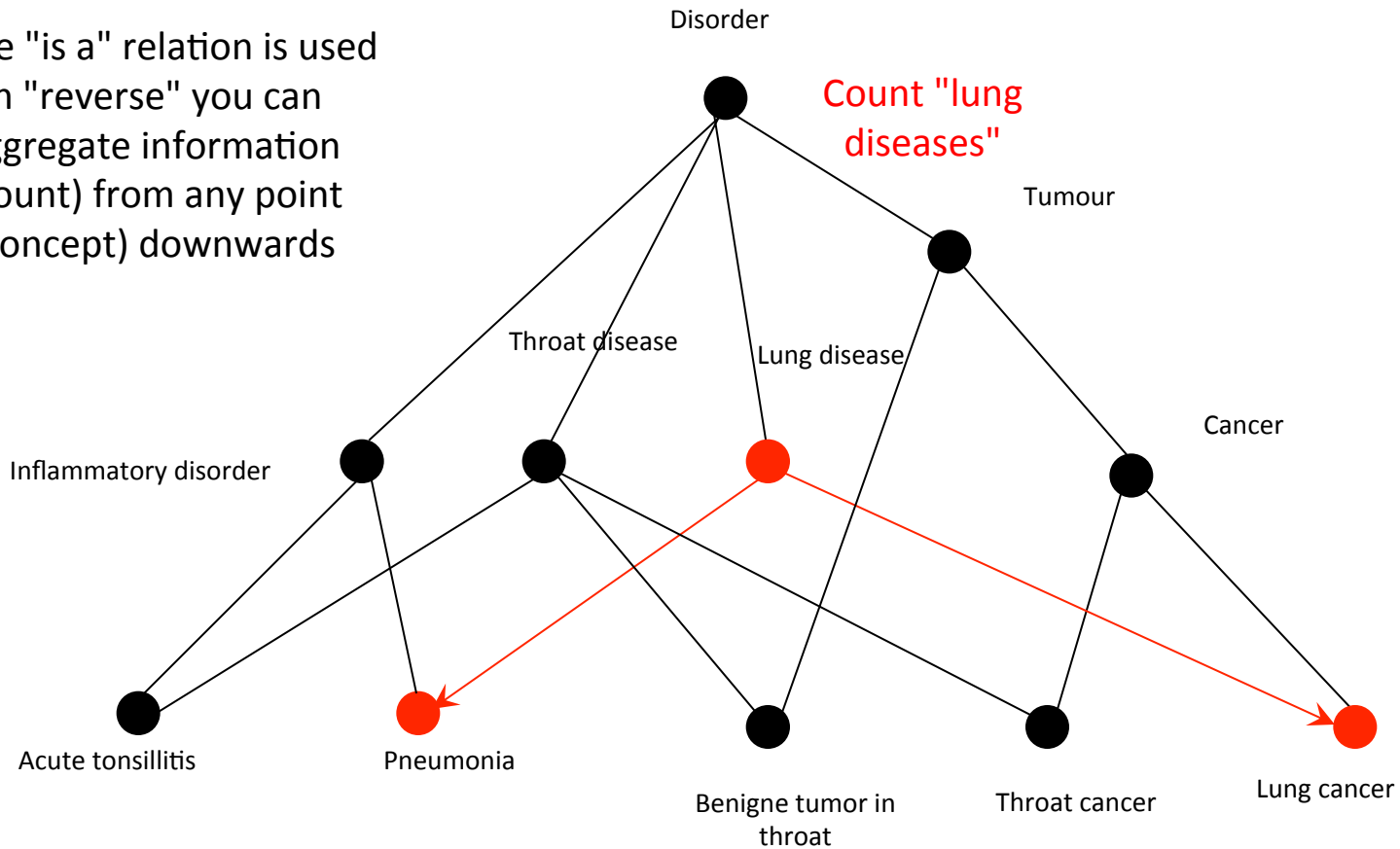
The architecture of SNOMED CT !

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The architecture of SNOMED CT !

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... decision support, audit, epidemiology...

- SNOMED CT (benefits) - represents logical semantic relationships between concepts. This allows consistent retrieval of clinical information for a wide range of purposes, including **decision support, audit, epidemiology**, research, service management, billing and statutory reporting. . . .
- Does this comply to e.g.:
 - Top level aggregations ?
 - Medium level usage ?
 - The detailed clinical (?) level ?

... decision support, audit, epidemiology...

- Top level: With some examples
- What "medium" level?
 - might correspond to e.g. clinical databases ?
- (Detailed clinical (?) level out of scope)

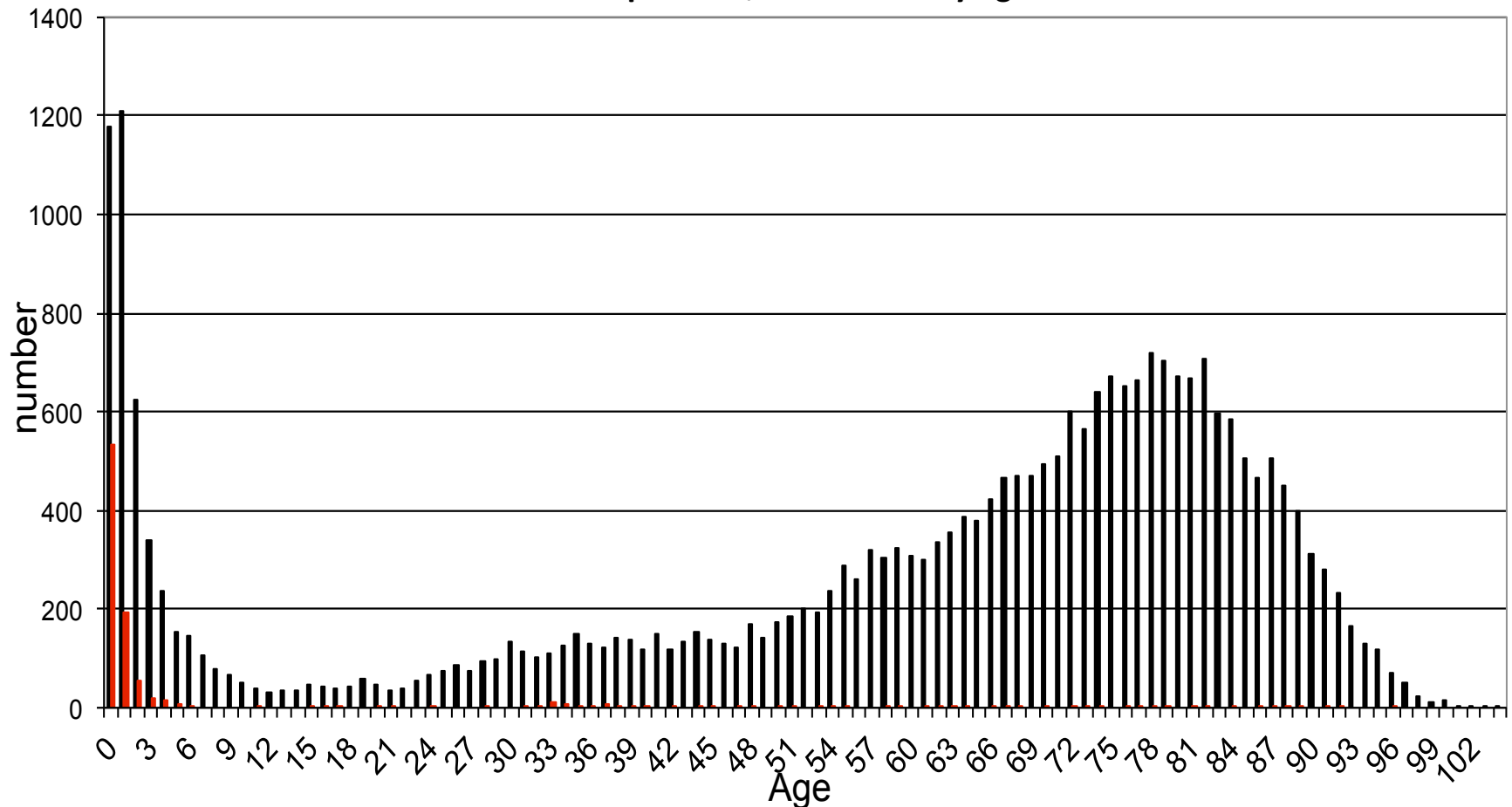
“Top level” examples from data in the National Danish Patient Register (NPR)

- The following slides shows a few examples of aggregation of coded information using SNOMED’s relationship network
- The data originate from the NPR that comprises information about outpatients and admitted patients in Denmark (11 mill. entries/year)
- The ICD-10-DK codes are mapped “in reverse” to SNOMED ...
 - The “aggregation points” are SNOMED CT concepts shown in *italics*

Data from NPR – “aggregated” with SNOMED CT

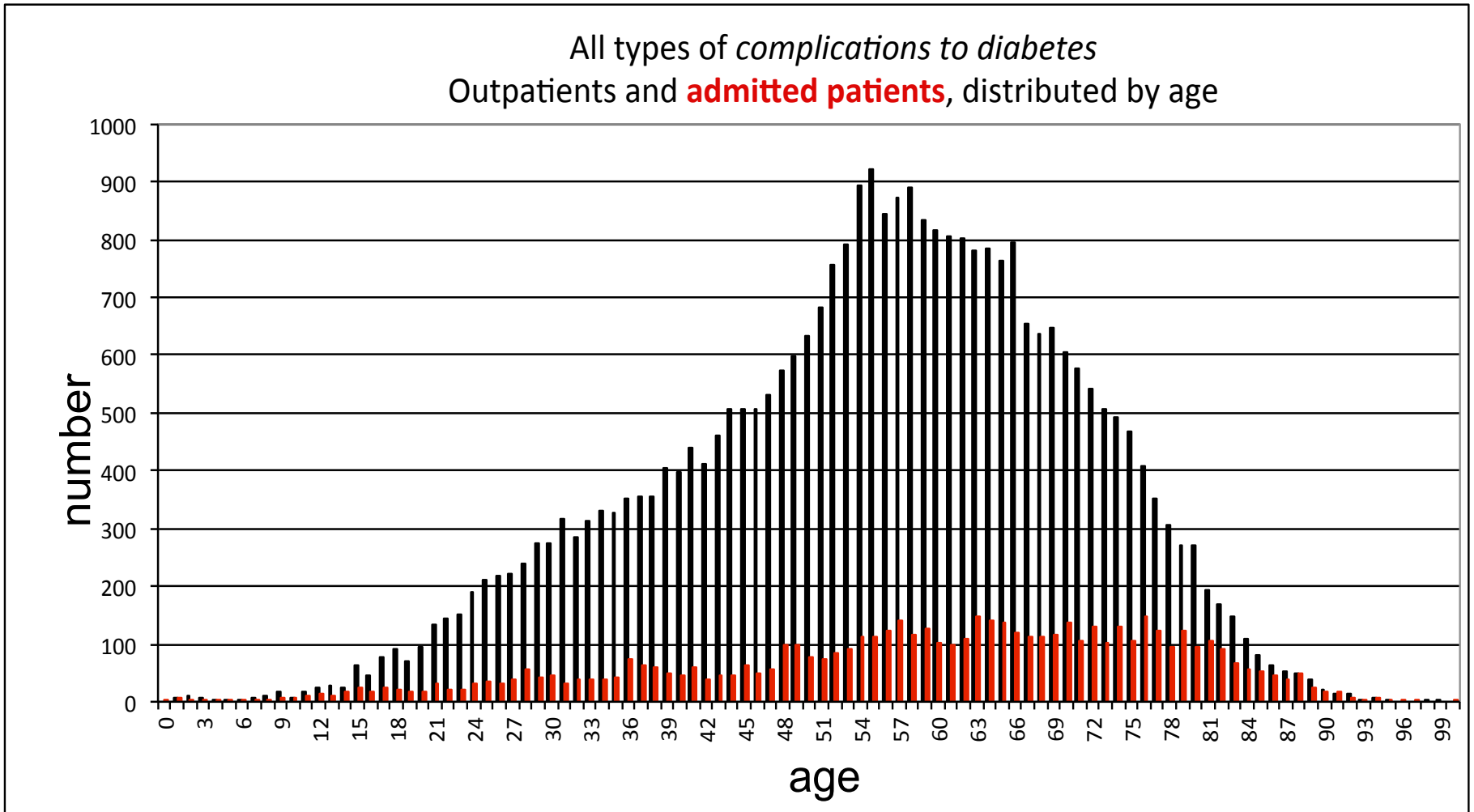
SNOMED CT concept in italics

All types of *pneumonia* and *viral pneumonia*
all admitted patients, distributed by age



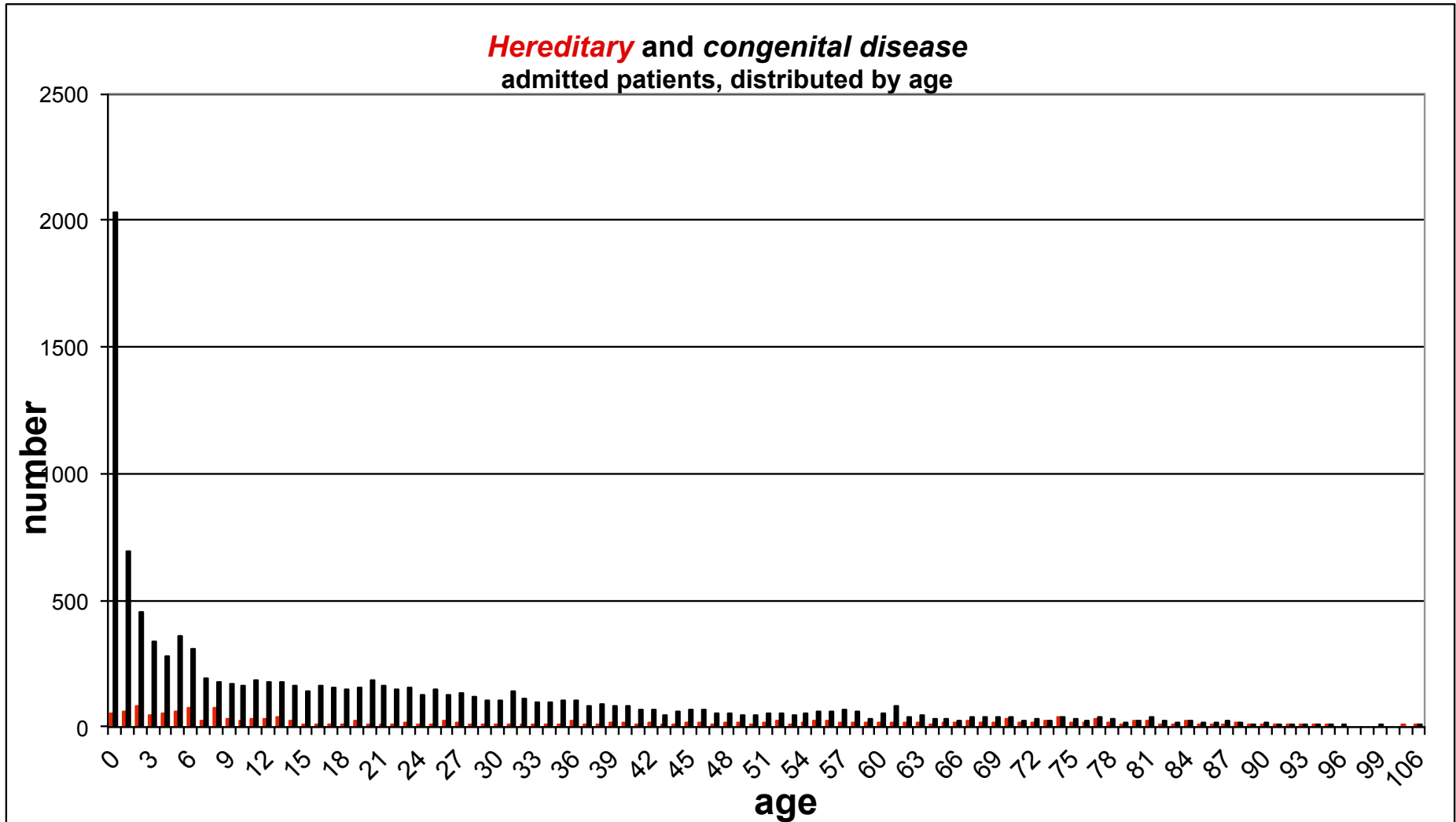
Data from NPR – “aggregated” with SNOMED CT

SNOMED CT concept in italics



Data from NPR – “aggregated” with SNOMED CT

SNOMED CT concepts in italics



Top level ...

- Quite advanced “top level” aggregations seems to work ...
- ... and could replace the national statistical reporting to WHO ...
- ... who (!) only receives calculated statistics from nations or Classification Centers ...
- ... based on ICD – used as a tool ...
- ... so – why map from SNOMED to ICD when you can use SNOMED “directly” – as a tool ??

What "medium" level?

- Are SNOMED “useful” in e.g. clinical quality databases?
- Objective: We wanted to extend the methods mentioned above for analysis of data from individual databases and maybe across databases (contains lots of data !) – Could we take it to a lower level?
- Denmark: 60+ nationwide clinical databases (including cancer) some for 10+ years
- many (most) of the indicators are the same in other countries
- SNOMED could be tested in cancer databases because of their importance and because SNOMED could be expected to be “perfect” in the relevant areas ...

What "medium" level?

- We started out with colon cancer and gynaecological cancers ...
- In the questionnaire for colon cancer the first entry was: is the tumour situated in colon or rectum
- The conceptual intent is to discriminate between
- **Primary adenocarcinoma of colon**
- ... and ...
- **Primary adenocarcinoma of rectum**

What "medium" level?

- We found (in 2009) the following in SNOMED:
- Adenocarcinoma of large intestine (disorder)
 - Adenocarcinoma of appendix (disorder)
 - Adenocarcinoma of cecum (disorder)
 - Adenocarcinoma of sigmoid colon (disorder)
 - Adenocarcinoma of rectum (disorder)
 - Adenocarcinoma of rectosigmoid junction (disorder)
- But not colon ! and no “primary”

What "medium" level?

- Primary adenocarcinoma of colon is one of the most common cancers and a major "killer"

Subdivisions

Cecum

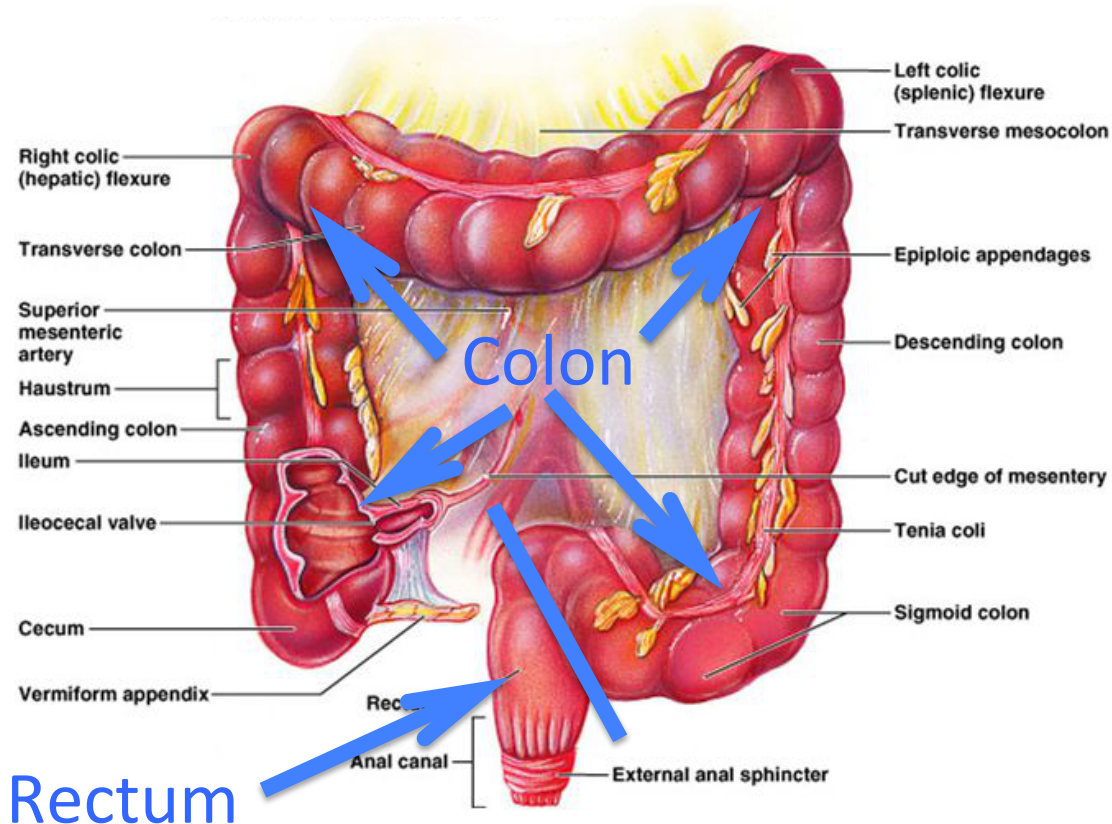
Appendix



Colon

Rectum

Anal canal



What "medium" level?

- Pragmatism often wins and we could live without “primary” – but not without “colon” ...
- ... and we found comparable “flaws” for gynaecological cancers ...
- ... and approximately (only) 1/3 of the concepts we needed in the databases
- I even modelled the colon cancer area in Protégé Owl – and had the intend to submit it to NRC – but other priorities came up
- and - frankly - it was easier to continue **business as usual** ...

What "medium" level?

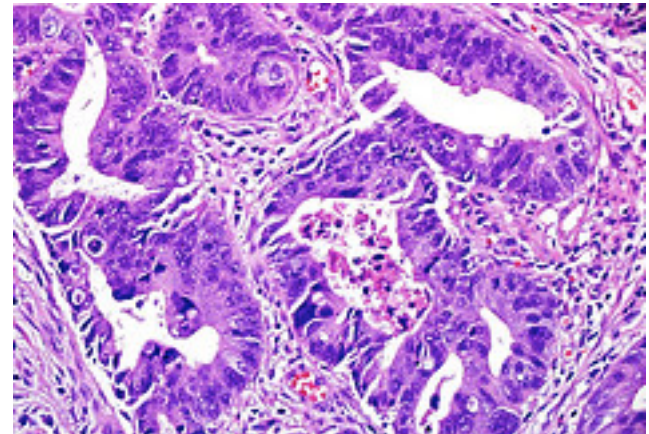
- ... then the following year (SNOMED evolves) the following turned up:
- Adenocarcinoma of large intestine (disorder)
 - Adenocarcinoma of appendix (disorder)
 - Adenocarcinoma of cecum (disorder)
 - **Primary** adenocarcinoma of **colon** (disorder)
 - Adenocarcinoma of sigmoid colon (disorder)
 - Adenocarcinoma of rectum (disorder)
 - Adenocarcinoma of rectosigmoid junction (disorder)
- Suddenly a “primary” and “colon” ...
- ... but not “primary” for rectum (?)

What "medium" level?

- Out of curiosity I then looked at the “associated morphology” for the adenocarcinomas in the mentioned concepts
- expecting: **Adenocarcinoma, no subtype (morphologic abnormality)**
- with the legacy code: M-81403
- ordinarily used by surgical pathologists

What "medium" level?

- ... but found three concepts (of 140 adenocarcinomas):
 - Adenocarcinoma, no subtype (morphologic abnormality) = M-81403
 - Malignant adenomatous neoplasm - category (morphologic abnormality)
 - Primary malignant adenomatous neoplasm (morphologic abnormality)
- which just adds to the inconsistency if you e.g. want to use the supporting axes for reasoning logic decision support etc. ...
- The common adenocarcinoma in colon and rectum looks like this:
and only one concept is needed



What "medium" level?

- The “Adenocarcinoma of large intestine (disorder)” is just an example – but it is quite common to see comparable issues in other “important” areas of SNOMED ...
- Why talk about the mentioned “flaws” ?
because data-entry is very tightly connected to retrieval and analysis !
- You will have to be pragmatic to a certain degree (as when you use e.g. ICD)

And in the end ... The Beatles, Abbey Road

- As we have heard in this conference and before: The possibilities are there ...
- ... and there are the usual pitfalls in the hierarchies and texts also known from other classifications ...
- ... and some additional related to the complexity of SNOMED
- But ...
- ... the extent of gaps (and flaws) in **the content** including relationships imposes a great deal of work before SNOMED becomes really useful and beneficial and accomplish value that cannot be achieved easier otherwise ...

Getting Better - all the time ... The Beatles, Sgt Pepper

- Another possibility: Ask for the right content – you will have to make it yourself ...
- ... and clinical quality databases is a good place to start ...
- ... keep it simple ...
- ... and remember: if you want to use SNOMED for aggregation, reasoning, decision support, research etc. use **set logic** and avoid “concepts” with negations, AND/OR etc. and use e.g. lexical exclusions etc. with care ...

