Stefan Schulz

Medical University of Graz (Austria)

purl.org/steschu

Advanced Interoperability of Health Information Systems

Terminologies / Ontologies / Information Models for Semantic Interoperability

Workshop organised by Bernd Blobel

Semantic Interoperability

"*... integrating resources that were developed using different **vocabularies** and different **perspectives** on the data. To achieve semantic interoperability, systems must be able to exchange data in such a way that the precise meaning of the data is readily accessible and the data itself can be translated by any system into a form that it understands.*"

Jeff Heflin and James Hendler (2000) Semantic Interoperability on the Web
http://www.cs.umd.edu/projects/plus/SHOE/pubs/extreme2000.pdf

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"Formal Ontology": Ontologies Terminologies

"Epistemology": Information Models

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Plurality of equivalent encodings

The same meaning is represented by…

"*Suspected heart failure caused by ischaemic heart disease*"

… single codes in ontologies

"*Finding with explicit context*" and
DueTo some "*Ischaemic heart disease*" and
FindingContext some "*Suspected*"

… complex expressions in ontologies

Diagnosis: "Heart Failure"
Certainty: "Suspected"
Aetiology: "Ischaemic heart disease"

combinations between ontologies and information models

SemanticHealthNet Approach

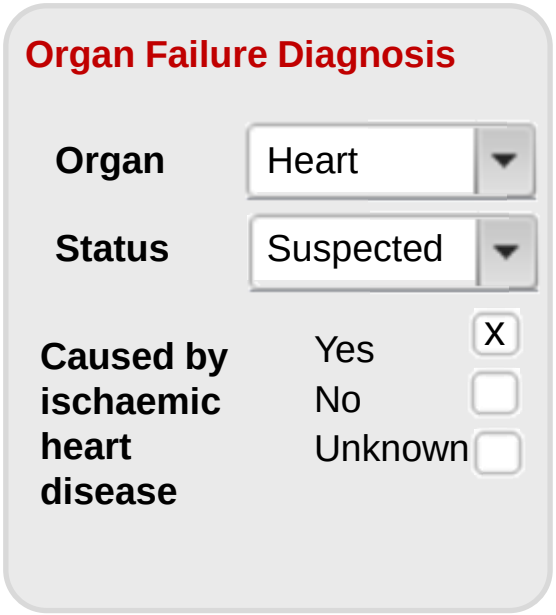
Expressing the very meaning of complex clinical statements in the most abstract way

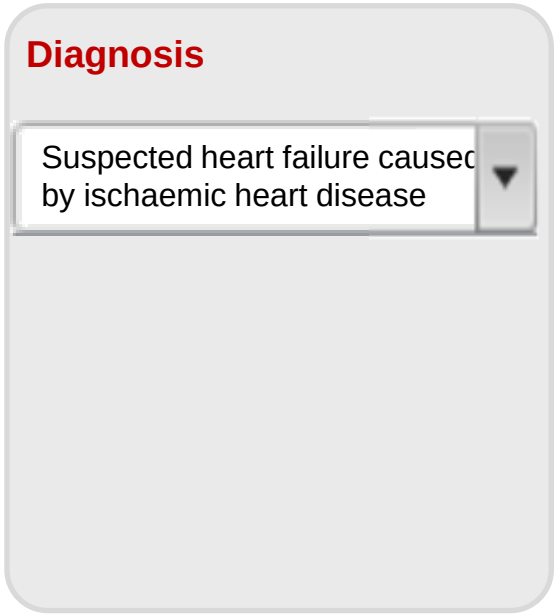
→ formal ontology, rooted in a highly constrained upper level

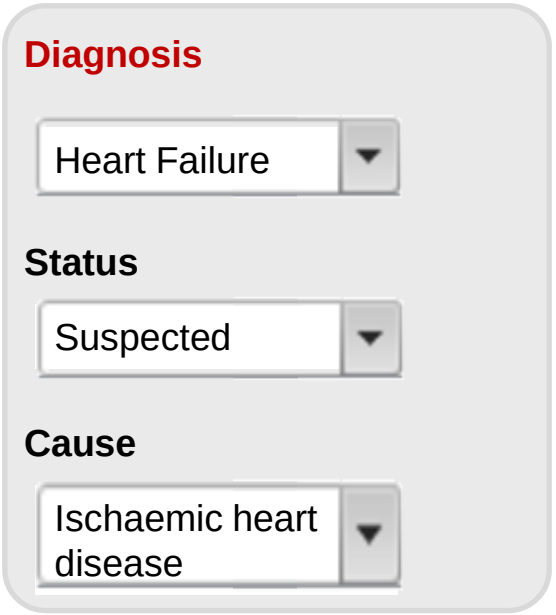
http://www.semantichealthnet.eu

SemanticHealthNet Network of Excellence

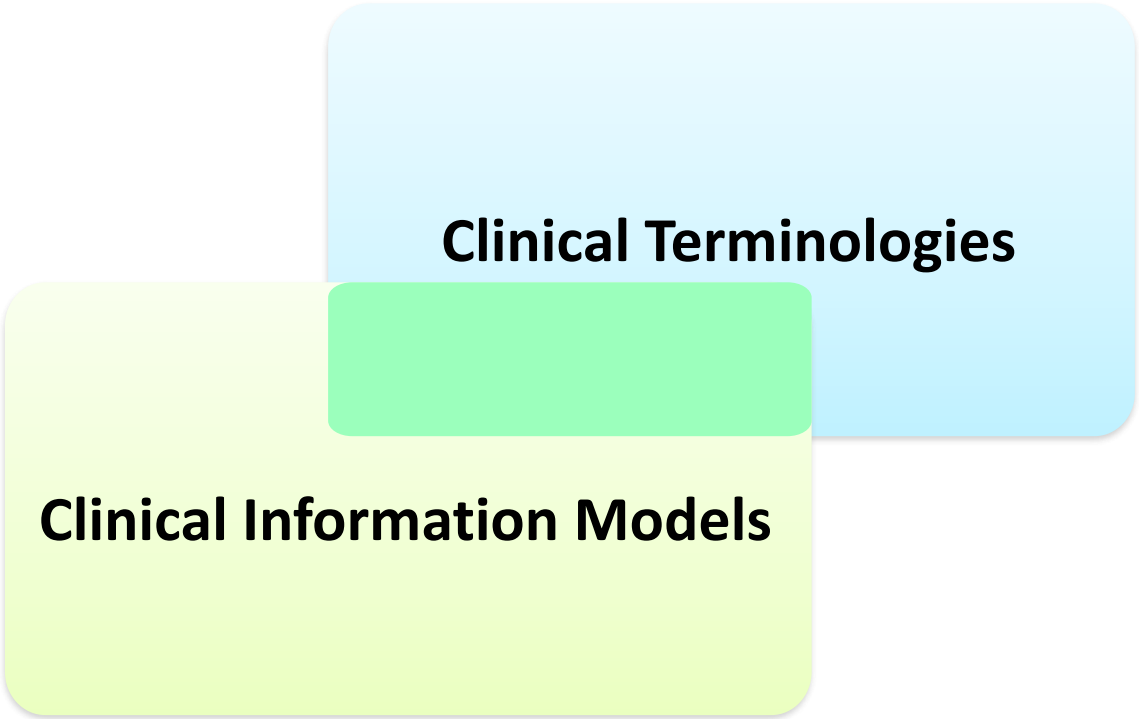
- Mission: To create interoperability between equivalent but heterogeneous representations of structured clinical content
- Target: To optimize clinical queries and exchange of data
- Methods: Formal ontology and description logics (OWL DL)







Can formal ontology represent both information and clinical information?



Example:

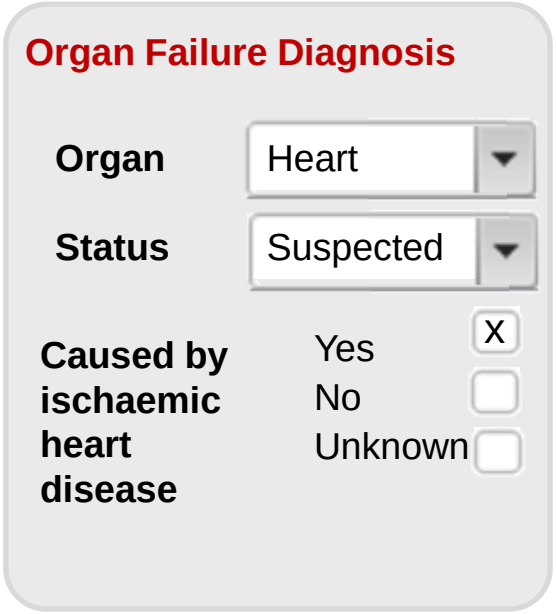
"Suspected heart failure caused by ischaemic heart disease"

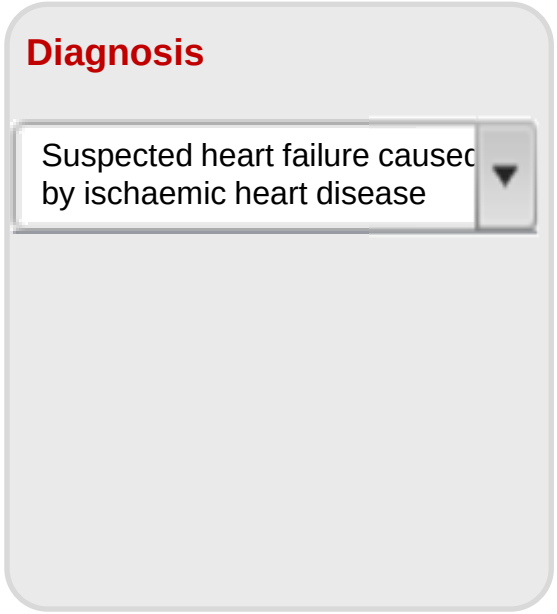
- One code or complex (postcoordinated) expression in SNOMED CT
- Reference to two kinds of disorders (**ontological** types / concepts)
- Relation between both ("caused by")
- **Epistemic** context: represents belief ("suspected")
- Not clear whether there is really some heart failure at all!

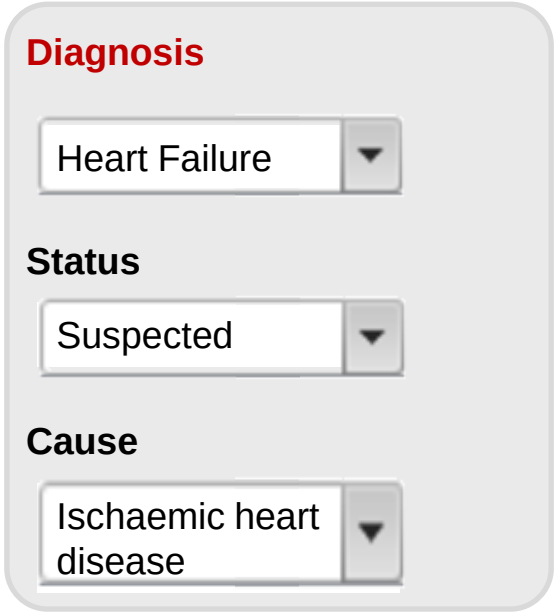
- Many entries in EHRs must not be interpreted as factual statements
- Blending of ontological and epistemic information in one code is characteristic for many clinical terminologies

“Suspected heart failure caused by ischaemic heart disease”

- Three heterogeneous representations of the same statement
- Three different atomic information entities

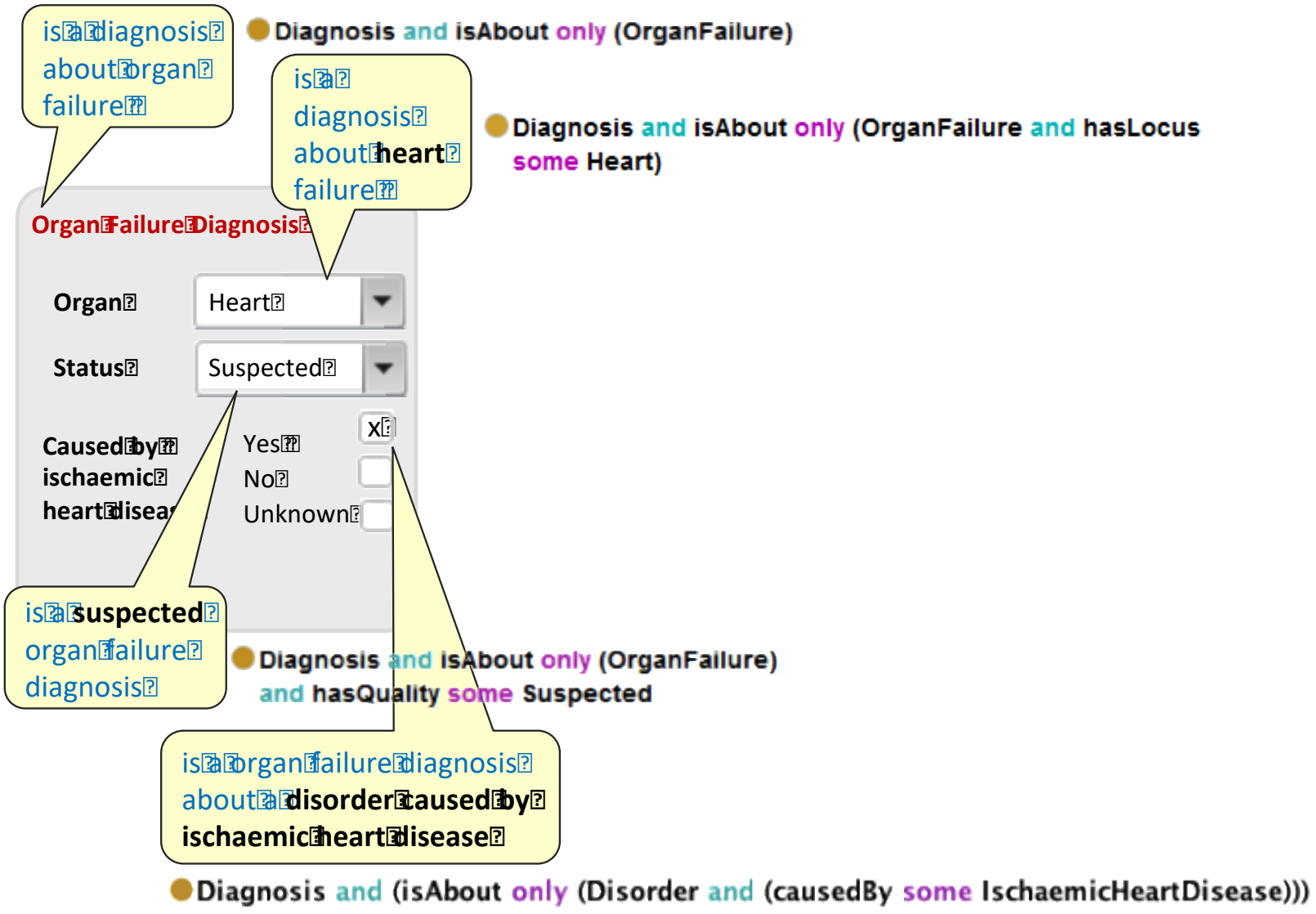




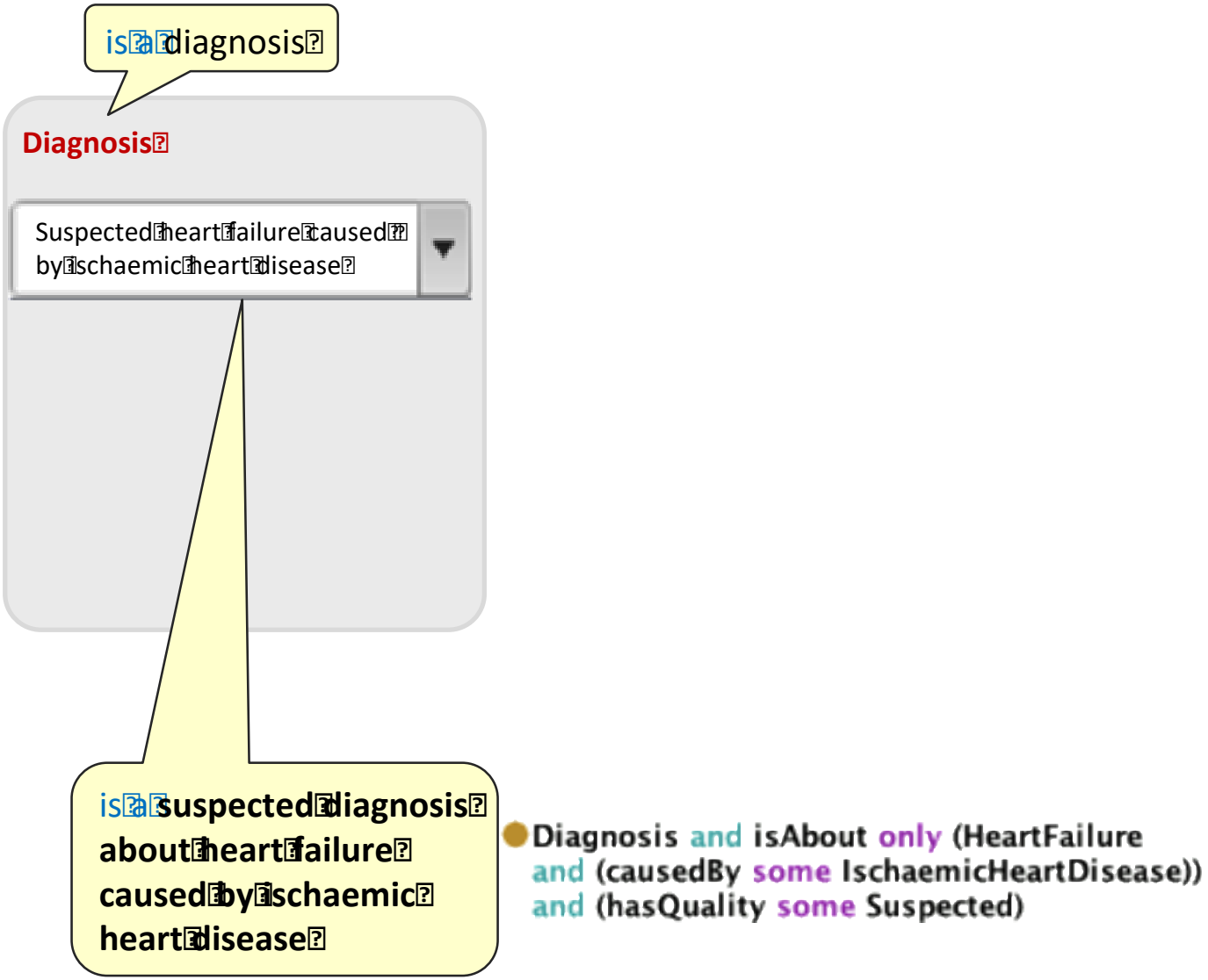


“Suspected heart failure caused by ischaemic heart disease”

Annotation 1

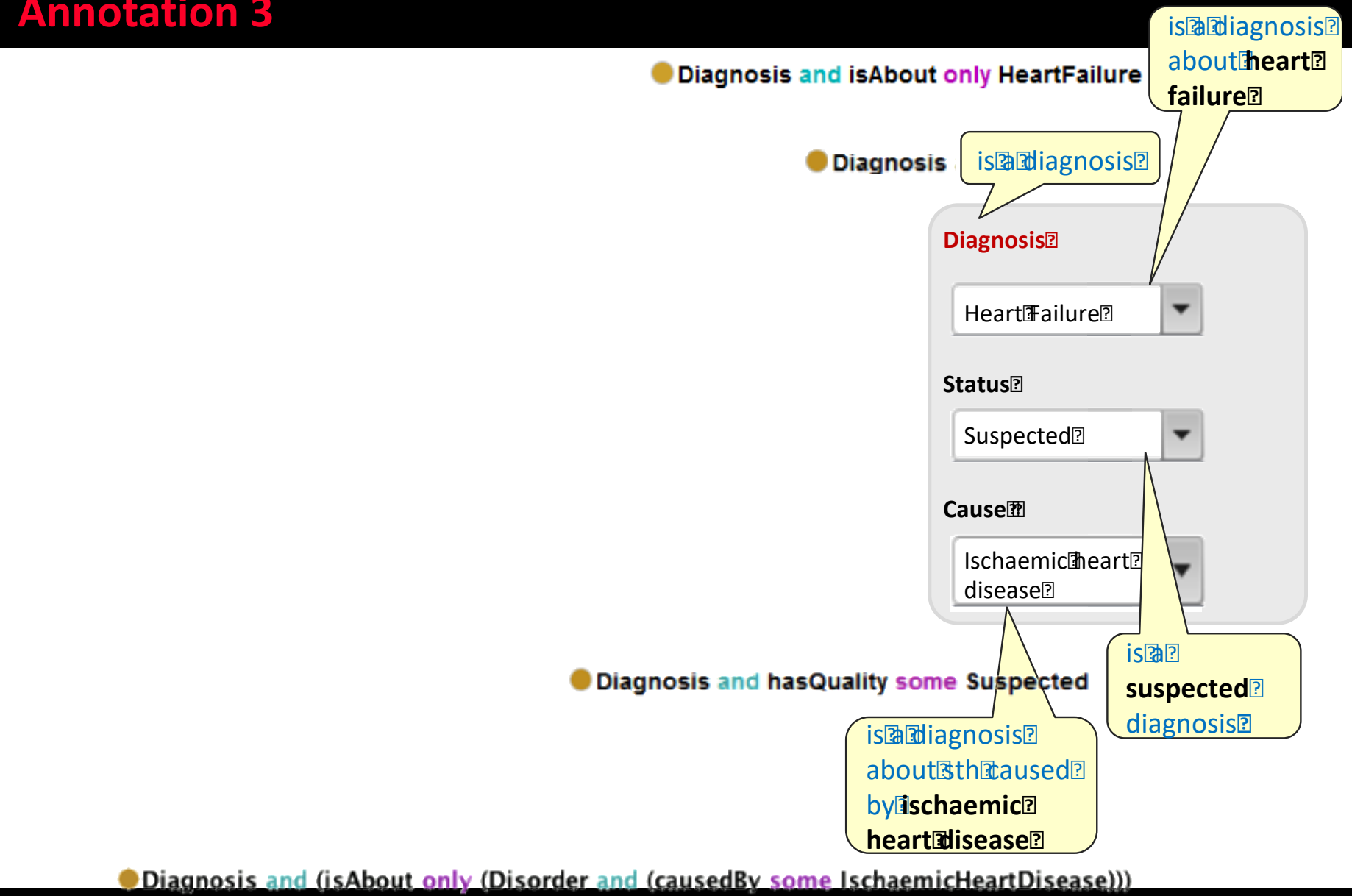


“Suspected heart failure caused by ischaemic heart disease”
Annotation 2



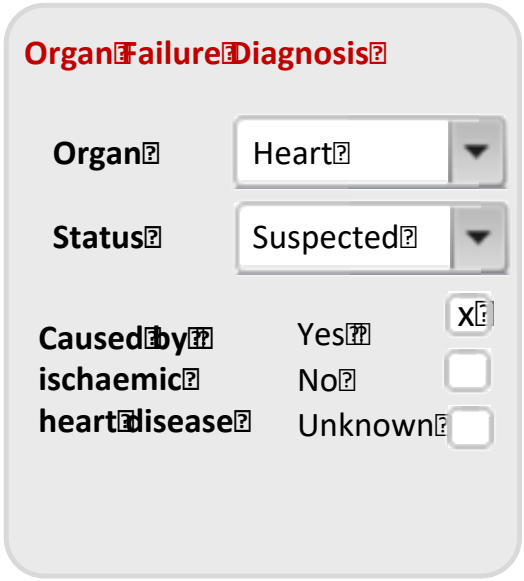
“Suspected heart failure caused by ischaemic heart disease”

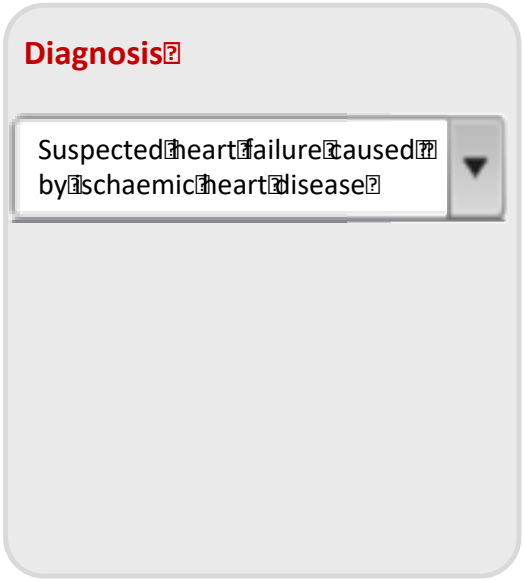
Annotation 3

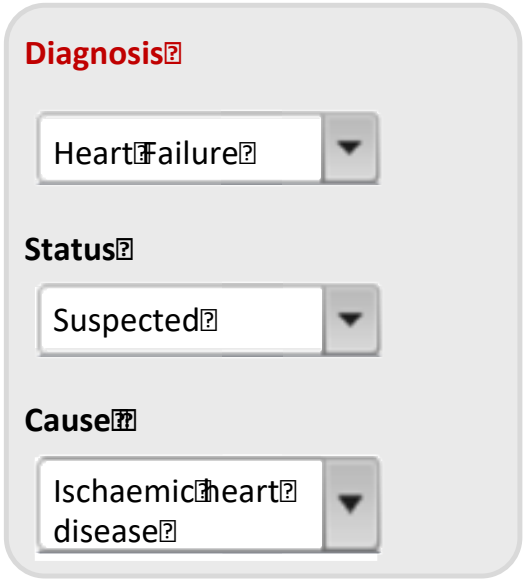


One diagnosis instance for each model

- Diagnosis_2 Type Diagnosis
- Diagnosis_2 Type Diagnosis and (hasQuality some Suspected) and (isAbout only (HeartFailure and (causedBy some IschaemicHeartDisease)))



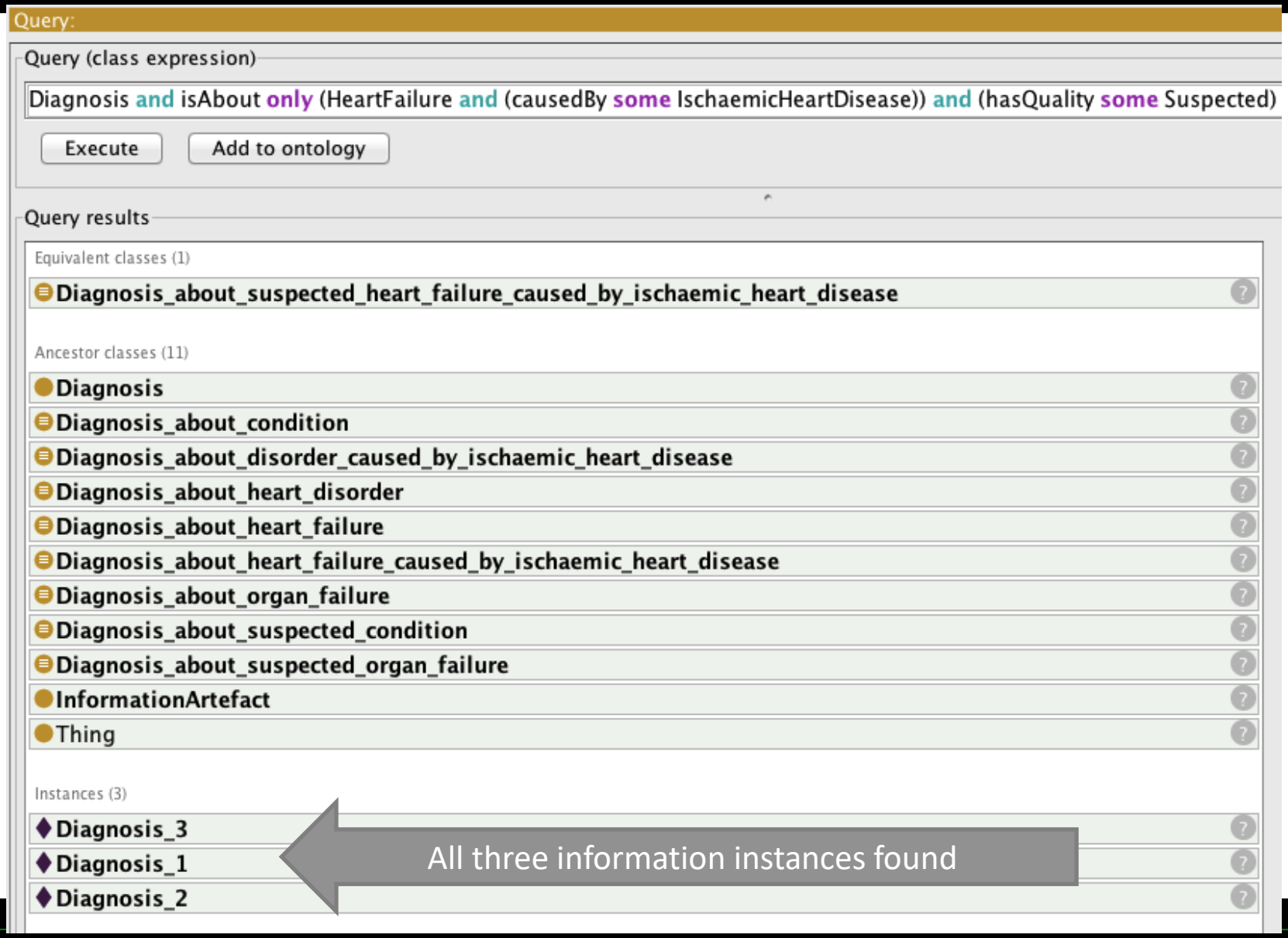




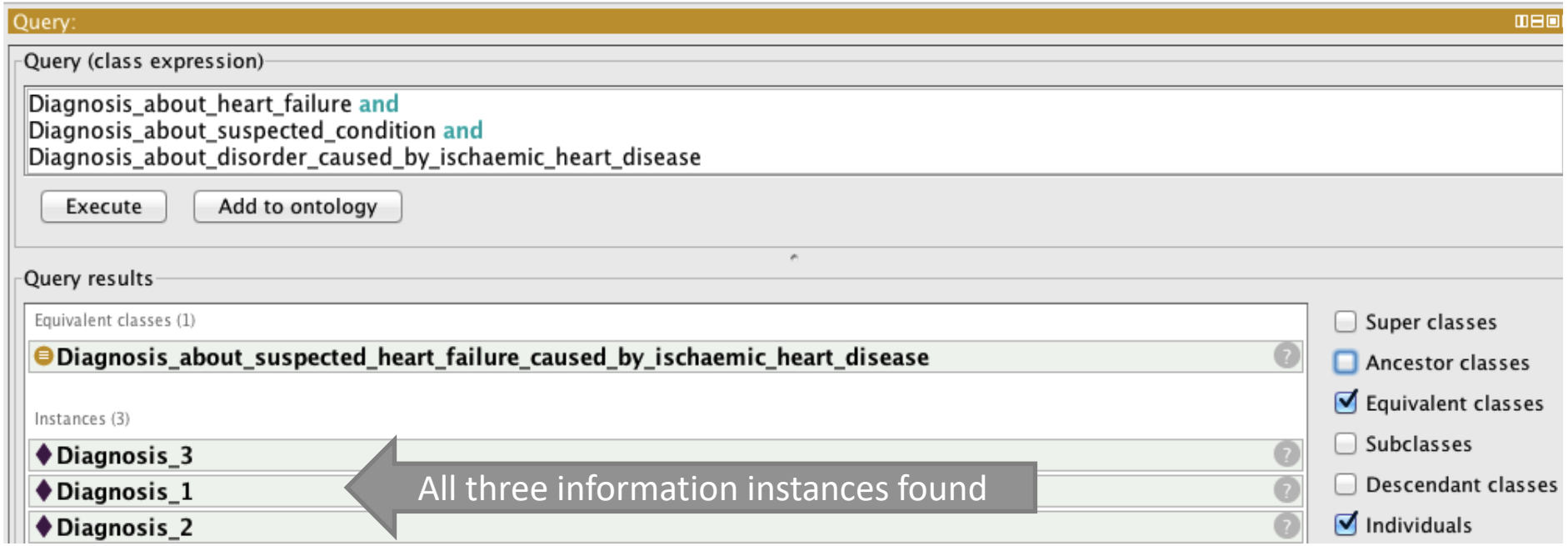
- Diagnosis_1 Type Diagnosis and (isAbout only (Disorder and (causedBy some IschaemicHeartDisease)))
- Diagnosis_1 Type Diagnosis and (isAbout only OrganFailure)
- Diagnosis_1 Type Diagnosis and (hasQuality some Suspected)
- Diagnosis_1 Type Diagnosis and (isAbout only (OrganFailure and (hasLocus some Heart)))
- Diagnosis_1 Type Diagnosis

- Diagnosis_3 Type Diagnosis and (isAbout only HeartFailure)
- Diagnosis_3 Type Diagnosis and (hasQuality some Suspected)
- Diagnosis_3 Type Diagnosis and (isAbout only (Disorder and (causedBy some IschaemicHeartDisease)))
- Diagnosis_3 Type Diagnosis

Query 1


Query:
Query (class expression)
Diagnosis and isAbout only (HeartFailure and (causedBy some IschaemicHeartDisease)) and (hasQuality some Suspected)
Execute
Add to ontology
Query results
Equivalent classes (1)
Diagnosis_about_suspected_heart_failure_caused_by_ischaemic_heart_disease
Ancestor classes (11)
Diagnosis
Diagnosis_about_condition
Diagnosis_about_disorder_caused_by_ischaemic_heart_disease
Diagnosis_about_heart_disorder
Diagnosis_about_heart_failure
Diagnosis_about_heart_failure_caused_by_ischaemic_heart_disease
Diagnosis_about_organ_failure
Diagnosis_about_suspected_condition
Diagnosis_about_suspected_organ_failure
InformationArtefact
Thing
Instances (3)
Diagnosis_3
Diagnosis_1
Diagnosis_2
All three information instances found

Query 2


Query:
Query (class expression)
Diagnosis_about_heart_failure and
Diagnosis_about_suspected_condition and
Diagnosis_about_disorder_caused_by_ischaemic_heart_disease
Execute
Add to ontology
Query results
Equivalent classes (1)
Diagnosis_about_suspected_heart_failure_caused_by_ischaemic_heart_disease
Instances (3)
Diagnosis_3
Diagnosis_1
Diagnosis_2
All three information instances found
Super classes
Ancestor classes
Equivalent classes
Subclasses
Descendant classes
Individuals