# Clinical documents and their parts


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# Part I

# The mereology of documents

# The variety of clinical documents

Ontologies can analyze and disambiguate clinical documents that could enable better data sharing:

- drug prescriptions
- drug dispensing reports written by pharmacists
- laboratory test prescriptions and laboratory test reporting documents
- questionnaires and surveys
- consent forms
- diagnosis sheets

# Information Artifact Ontology (IAO)

- Included in the OBO Foundry, founded on the upper ontology BFO (Basic Formal Ontology)
- Introduces Information content entity (ICE)
- An ICE *is about* some "portion of reality".

# The parts of a document

- How to represent ontologically the mereological structure of a document?

- The semantics of a document is constrained by the semantics of its parts

→ important to represent those parts and those parthood relations in a first step

# Classical Extensional Mereology

- Parthood is a (partial) ordering relation:
  - Reflexive
  - Antisymmetric
  - Transitive
- Strong (and Weak) Supplementation Principle

# A non-classical mereology for ICEs

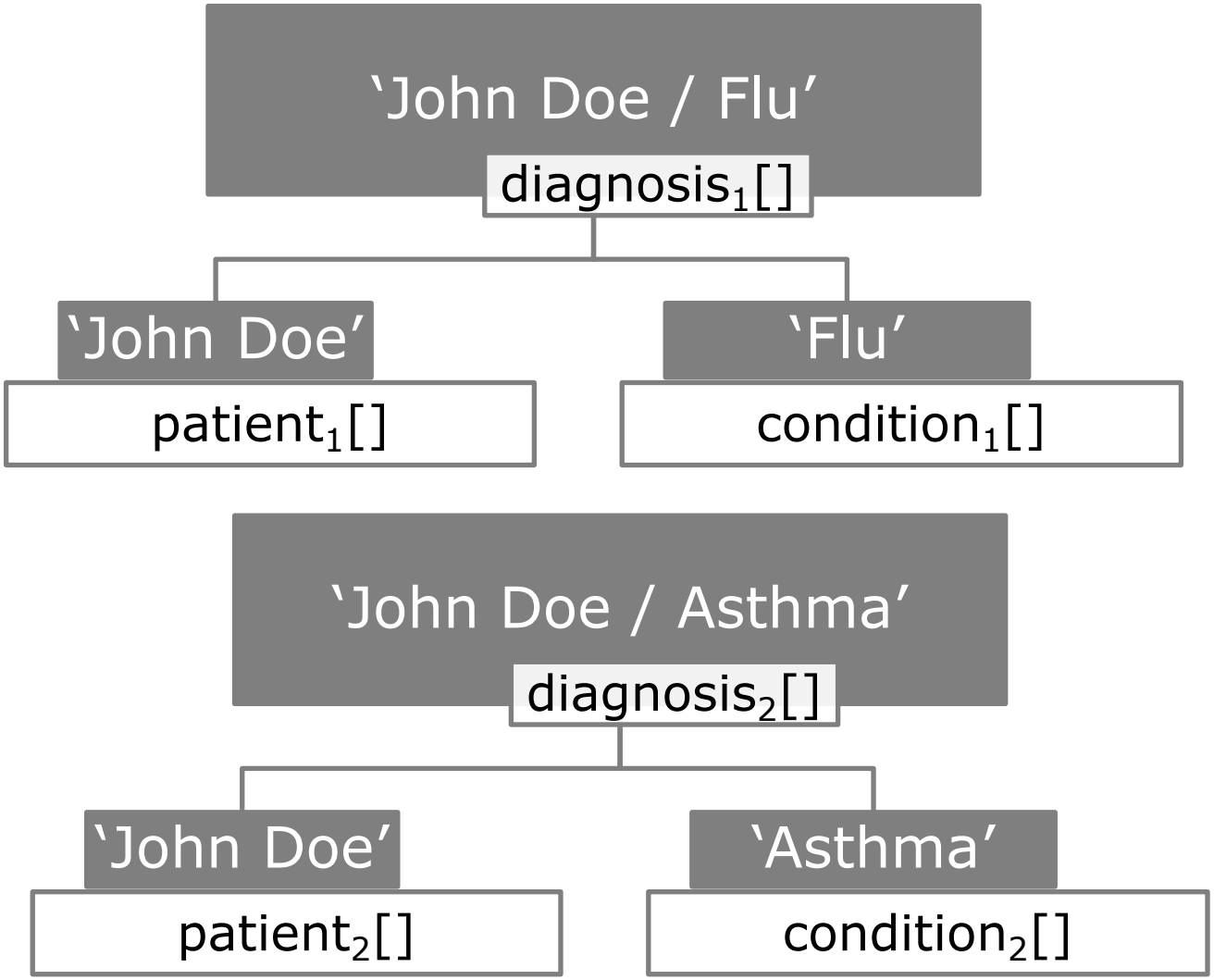
- Formal analysis of parthood between informational entities, based on

K. Bennett, Having a part twice over, *Australasian Journal of Philosophy* **91** (2013), 83–103.

- First work:

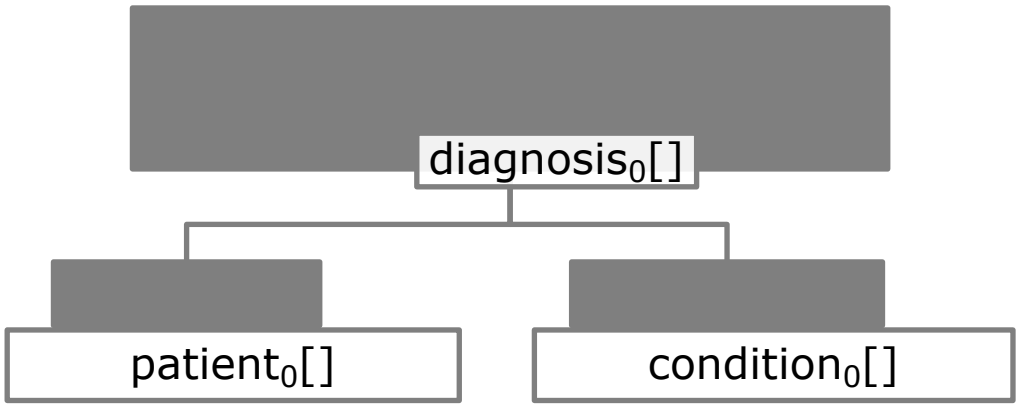
Barton, A., Toyoshima, F., Vieu, L., Fabry, P., Ethier, J.-F. The mereological structure of informational entities. In B. Brodaric, F. Neuhaus & M. Katsumi (Eds.), *Formal Ontology in Information Systems. Proceedings of the 11th International Conference (FOIS 2020)*. IOS Press.

# The same information filler can fill several information slots

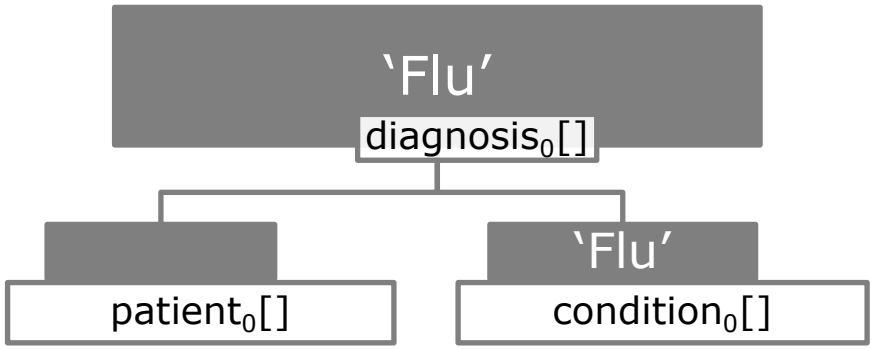


# Slots can be unfilled

- Our theory integrate unfilled slots, in order to describe:
  - templates




  - partially filled documents



# Two additional issues

- How to account that some slots can be inadequately filled?
- How to account for the layered structure of some documents?

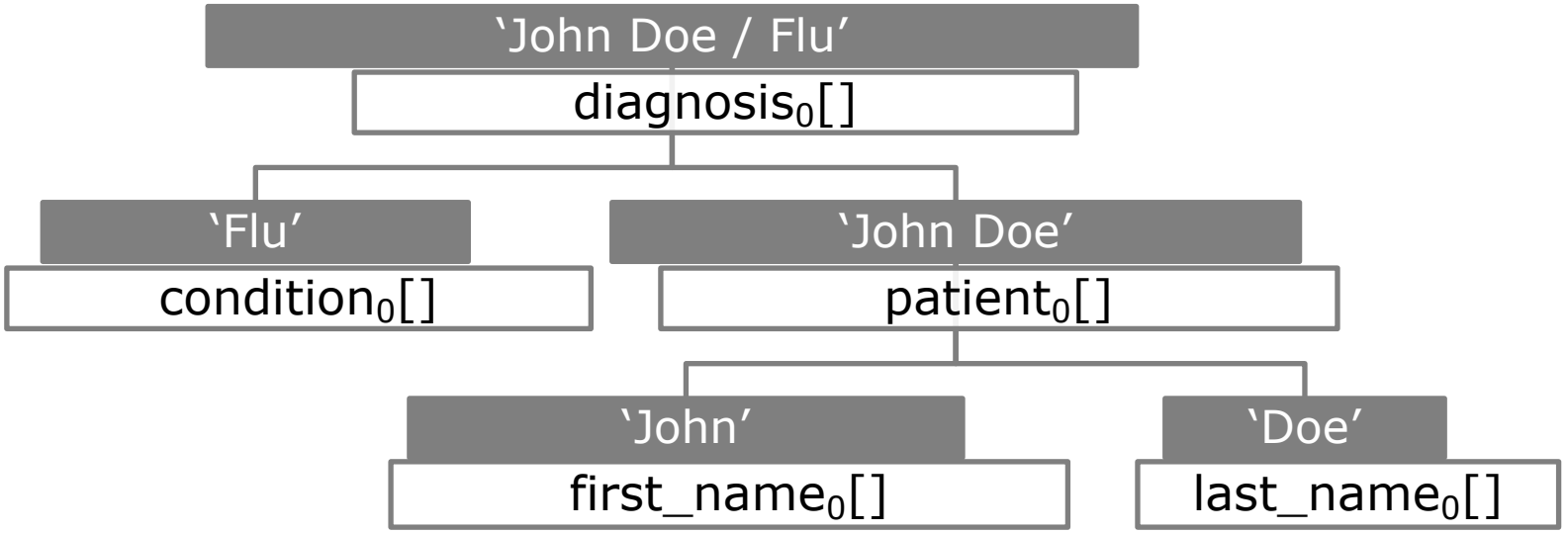
# Part II

# Adequate vs. generalized filling

# Adequate vs. generalized filling

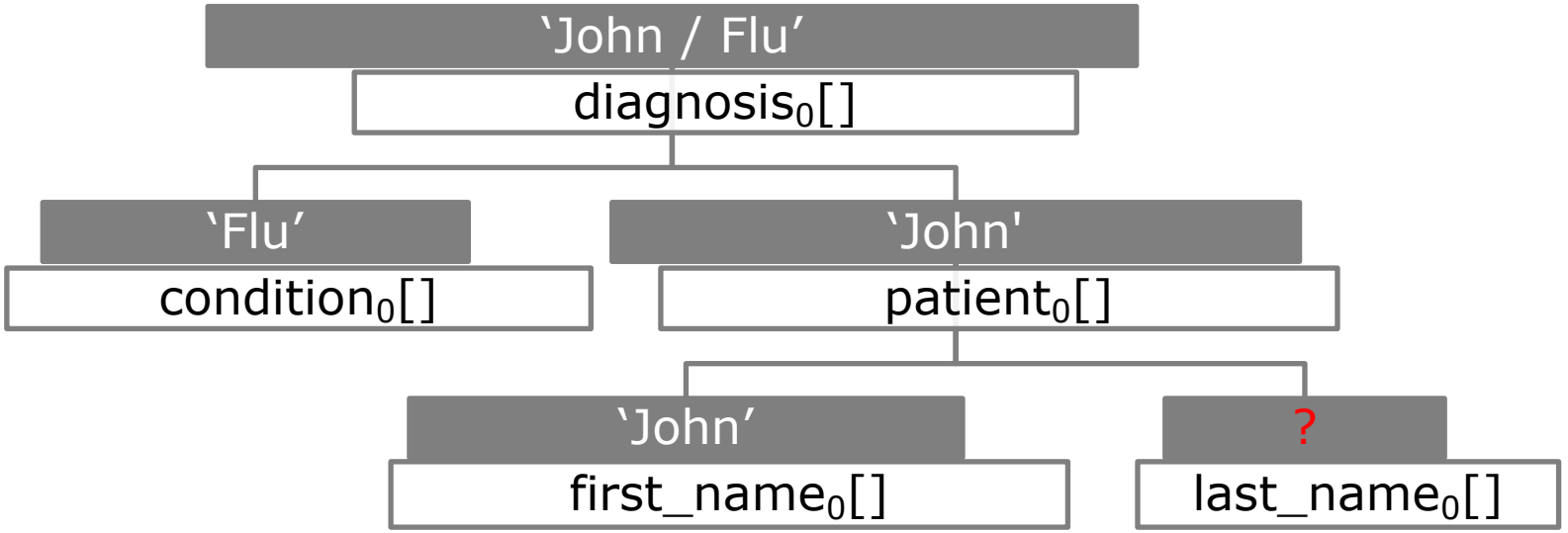
- Documents can be incorrectly filled.
- We need to be able to represent any (part of) document, even if it deviates from the norms.
- We introduce two relations of filling:
  - "adequate filling" for filling a slot in a normatively correct way
  - "generalized filling" for filling a slot in any kind of way (normatively correct or not)
- What are those norms?

# Three kinds of filling inadequacies




- Three possible kinds of inadequacies when filling it:
  - **structural** inadequacy
  - **semantic** inadequacy
  - **descriptive** inadequacy

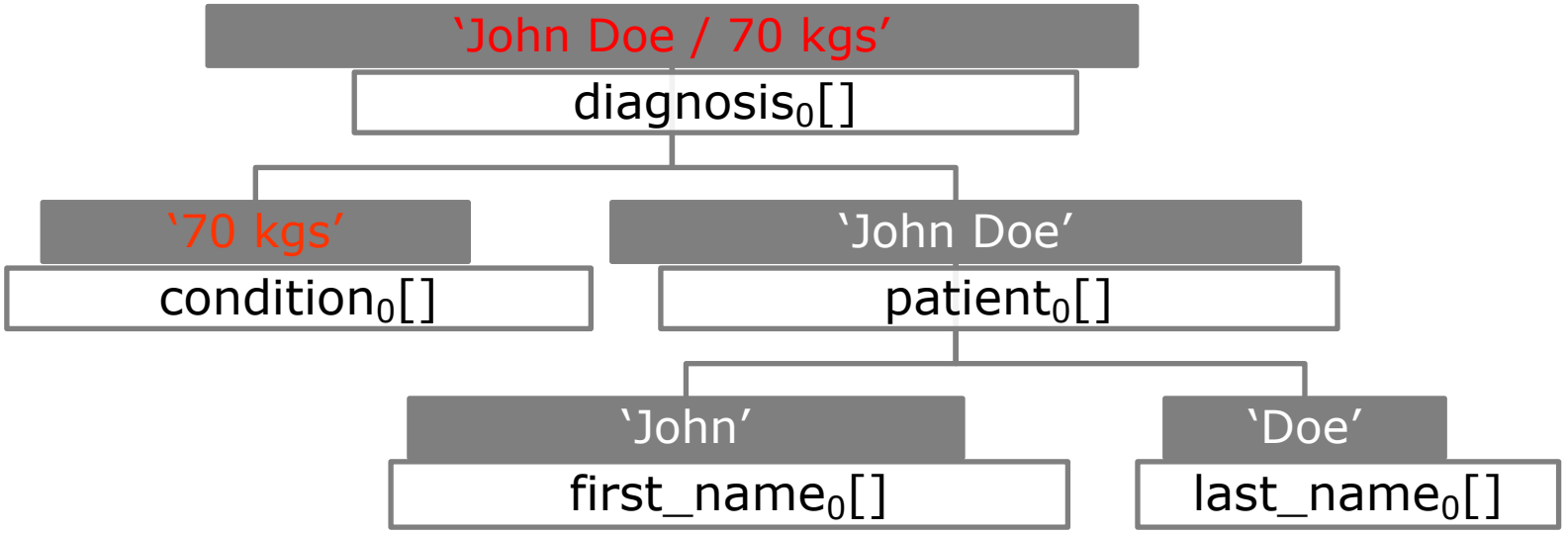
# 1. Structural inadequacy




/ last_name[]$_0$ is not filled.

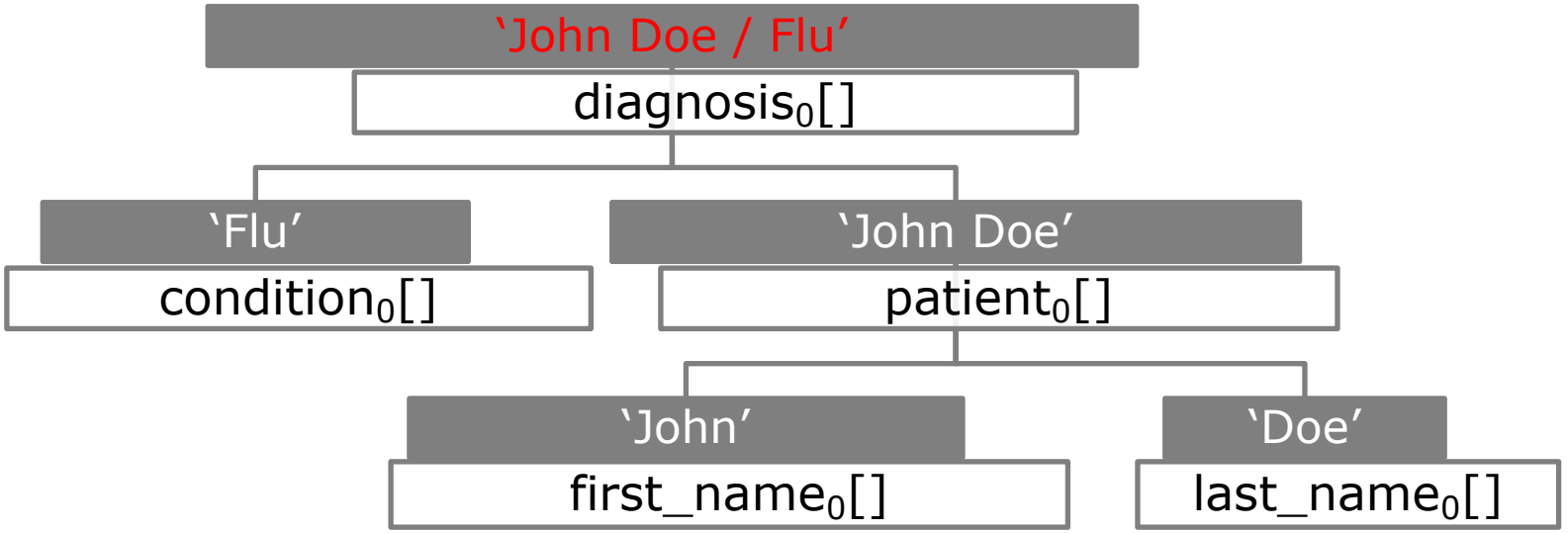
- This is the easiest kind of inadequacy to control with electronic documents.

# 2. Semantic inadequacy




/ '70 kgs' does not refer to a medical condition.

# 3. Descriptive inadequacy




/ John Doe never had the flu.

- Ontologically, descriptive inadequacy can be seen as a kind of semantic inadequacy (the filler of diagnosis$_0$[] does not refer to a state of affair that occurred).
- Epistemically, it is very different from semantic inadequacy (we cannot check it with a dictionary).

# A formalization of generalized vs. adequate filling

- Adequate filling has been formalized in the FOIS 2020 paper.
- Generalized filling has been formalized in the ICBO 2020 paper.

# Example of axioms expressing adequacy

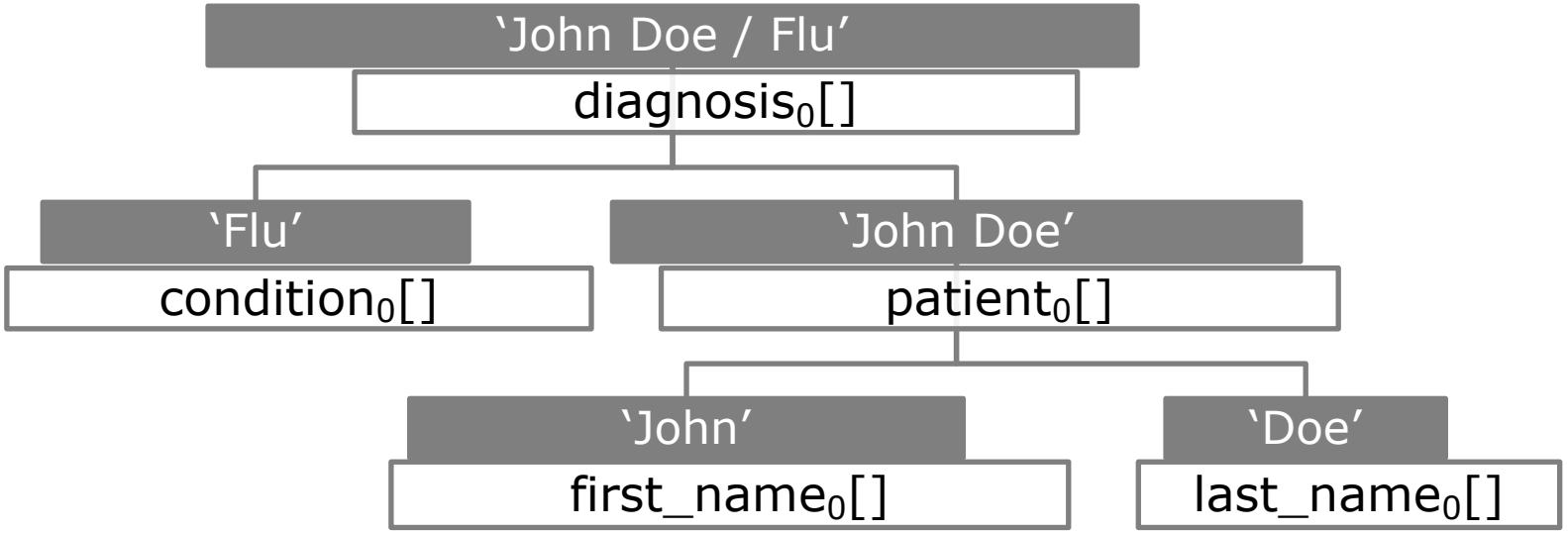
- Axiom expressing structural adequacy:
  - *Patient slot* SubClassOf **adequately_filled_by** only (**has_part** exactly 1 *First name* and **has_part** exactly 1 *Last name*)

- Axioms expressing semantic adequacy:
  - *Patient slot* SubClassOf **adequately_filled_by** only *Patient name*
  - *Condition slot* SubClassOf **adequately_filled_by** only *Clinical condition name*

# Part III

# Direct slots and direct parts

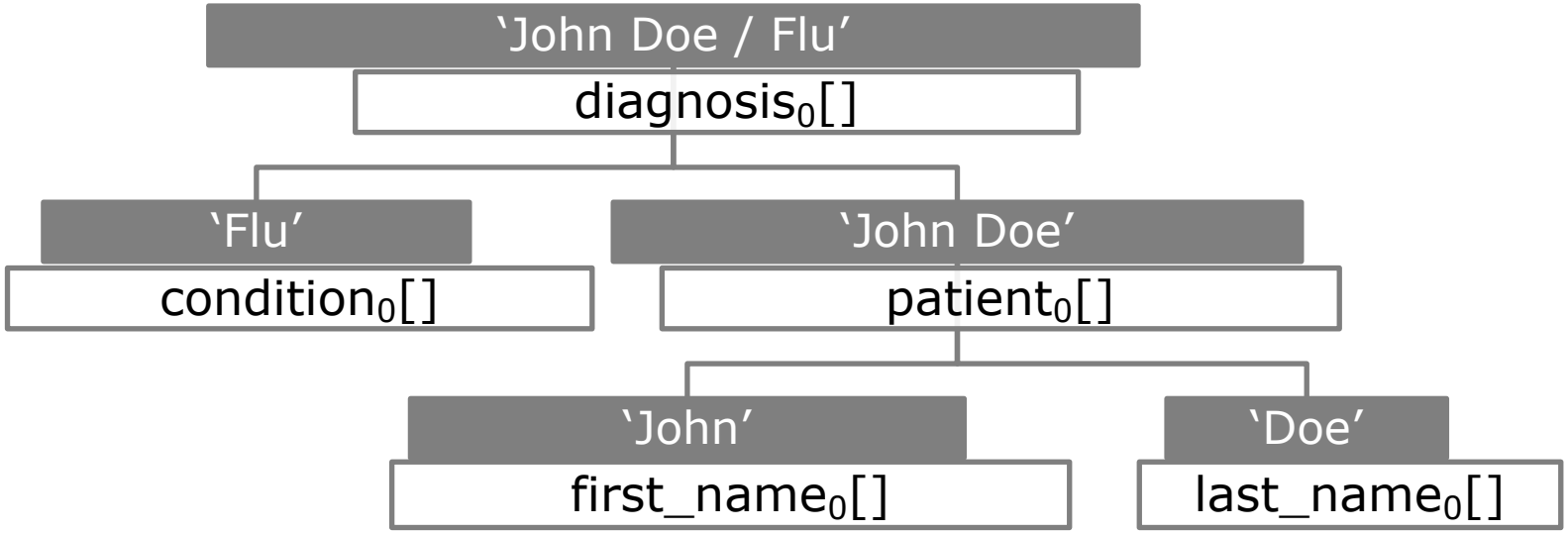
# The layered slot structure




- By slot inheritance, first_name$_0$[] is also a slot of diagnosis$_0$[]

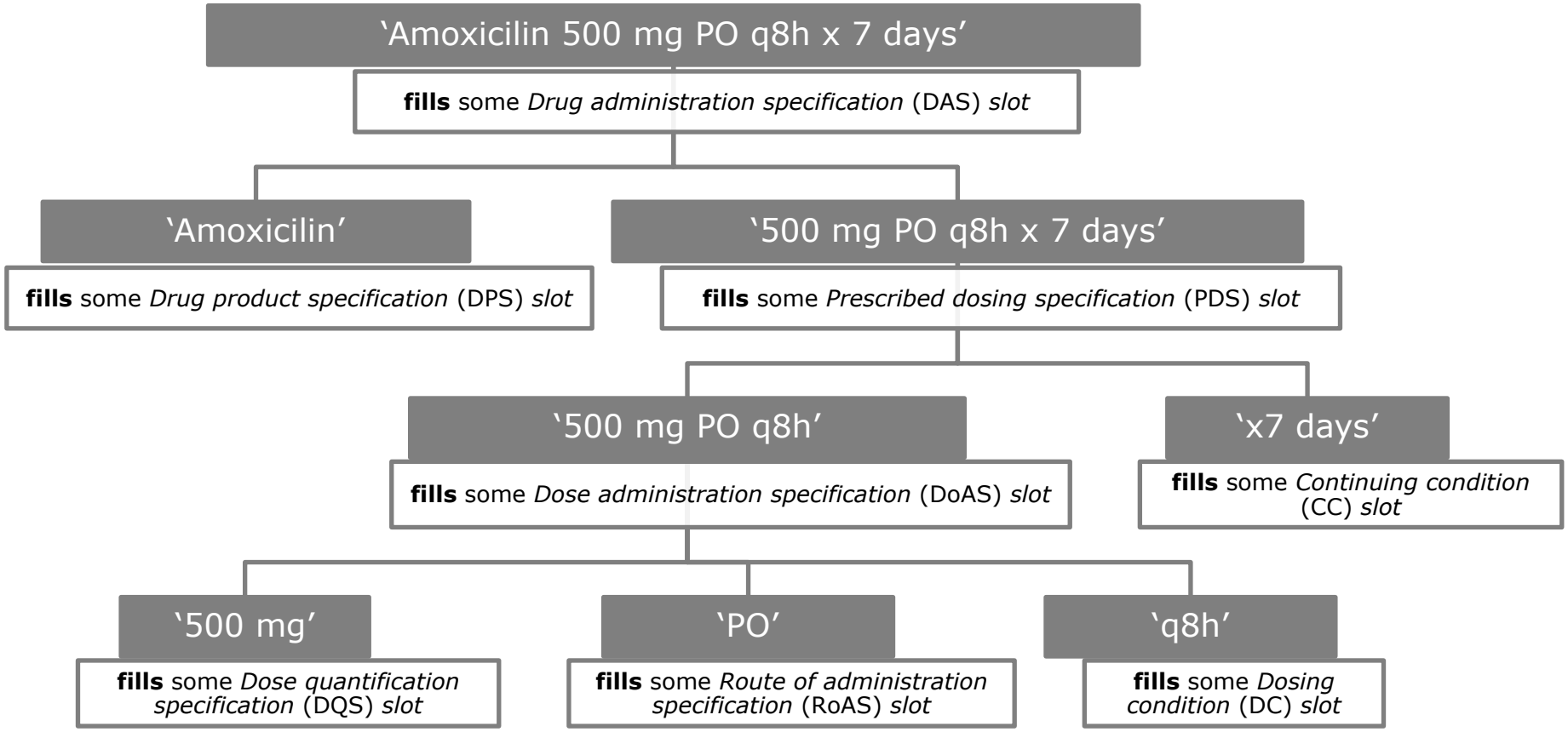
/ intuitively, it is not a direct slot.

# Axiomatization of a specific slot structure




- *Diagnosis document* SubClassOf
  **has_direct_slot** exactly 1 *Patient slot*
  and **has_direct_slot** exactly 1 *Condition slot*
  and **has_direct_slot** only (*Patient slot* OR *Condition slot*)
- But it can have other (non-direct) slots (e.g. 'last_name$_0$[]').
- Axiomatization of **has_direct_slot** and **has_direct_proper_part** in the ICBO2020 paper.

# The layered slot structure of a drug prescription



# Conclusion

- We can represent:
  - the same filler filling various slots (in the same document, or in different documents)
  - templates or partially filled documents
  - adequately and inadequately filled slots
  - the layered structure of a document.

# Thank you for your attention!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