

CLIF: A Method to Formalise Clinical Quality Indicators

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If you can not measure it, you can not improve it. Lord Kelvin

Problems, Goal and Requirement **Definition Quality Indicator** A quality indicator is "a measurable element of practice performance for which there is Problems evidence or consensus that it can be used to assess the quality, and hence change in the ▶ Indicators that are released in natural language are *ambiguous* quality, of care provided." ► *Increasing number* of indicators makes their manual calculation unfeasible Goal (Lawrence 1997) Ideally, indicators would be calculated automatically based on patient data that is captured during the care process. Requirement The Big Picture: Formalise indicators to calculate them automatically To derive comparable values, a *formalisation method* is needed to transform indicators from natural language into an unambiguous, machine-processable, formal representation. **Quality Indicators Example Quality Indicator** Number of examined lymph-nodes after resection A Method to Formalise Quality Indicators Numerator: Number of patients who had 10 or more lymph-nodes examined after a resection of a primary colon carcinoma. Formal Representation of Quality Indicators Denominator: Number of patients who had lymph-nodes examined after a resection of a primary colon carcinoma. input Exclusion Criteria: Patients with previous radiotherapy; recurrent colon carcinoma. Intelligent Indicator System **Example Patient** query answer patient132 admissionDate / dischargeDate / dataDeliveredToDSCA rdf:type hasProcedure hasProcedure Data Source / EHR Data Source / EHR Data Source / EHR colectomy132 2010-10-17 2010-10-19 Patient nasDisease reoperation132 procedureDate /rdf:type sociatedWith associatedWith procedureDate rdf:type 2010-10-18 Colectomy 2010-11-17 coloncancer132 Reoperation contains contains contains ype PrimaryColonCancer Raw Data Raw Data Raw Data

Method to formalise Quality Indicators into SPARQL Queries

Resulting SPARQL query (Numerator)

Step 1)

Encode relevant concepts (diagnoses and procedures) from the indicator by concepts from a terminology

?colectomy a sct:SCT_23968004 .

Step 2)

Define the information model ?patient schema:hasDisease ?coloncancer .

Step 3)

Formalise temporal constraints (FILTER - SPARQL FILTERs restrict solutions to those for which the filter expressions evaluate to true) FILTER (?lymphnodeexaminationdate > ?colectomydate)

Step 4)

Formalise numeric constraints (FILTER) FILTER (?numberexaminedlymphnodes \geq 10)

Step 5)

Formalise boolean constraints (FILTER) FILTER (?deliveredToDSCA = true)

Step 6)

Group constraints by boolean connectors (coloncancer AND colectomycode) OR (rectumcancer AND resectionrectum)

Step 7)

Mark exclusion criteria FILTER (?lymphnodeexaminationdate > ?radiotherapydate) }

Step 8)

Mark constraints that only aim at the numerator FILTER (?numberexaminedlymphnodes ≥ 10)

OWL Schema for Patient Data

Colectomy ResectionRectum Radiotherapy ExaminationLymphNodes Patient Reoperation SubClassOf SubClassOf SubClassOf \SubClassOf SubClassOf hasNumber hasProcedure dataDeliveredToDSCA PrimaryColonCancer integer hasDisease admissionDate SecondaryRectumCancer Procedure PrimaryRectumCancer SecondaryColonCancer boolean dischargeDate SubClassOf SubClassOf SubClassOf SubClassOf associatedWith procedureDate Disease dateTime

SELECT ?patient WHERE

Step 1)

?patient a sct:SCT_116154003 . ?coloncancer a sct:SCT_93761005 . ?colectomy a sct:SCT_23968004 . ?lymphnodeexamination a sct:SCT_284427004 .

Step 2)

?colectomy sct:SCT_47429007 ?coloncancer .
?patient schema:hasDisease ?coloncancer .
?patient schema:hasProcedure ?colectomy .
?colectomy schema:procedureDate ?colectomydate .
?patient schema:hasProcedure ?lymphnodeexamination .
?lymphnodeexamination schema:hasNumber ?numberexaminedlymphnodes .

Step 3)

FILTER (?lymphnodeexaminationdate > "2010-01-01T00:00:00+02:00")
FILTER (?lymphnodeexaminationdate < "2011-01-01T00:00:00+02:00")
FILTER (?lymphnodeexaminationdate > ?colectomydate)

Step 4); needs to be removed to construct the denominator (# Step 8)) FILTER (?numberexaminedlymphnodes \geq 10)

Step 7)

FILTER NOT EXISTS ?radiotherapy a sct:SCT_108290001 . ?patient schema:hasProcedure ?radiotherapy . ?radiotherapy schema:procedureDate ?radiotherapydate . FILTER (?lymphnodeexaminationdate > ?radiotherapydate)