



Expressions and Context Patterns

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Compositional grammar (1)

- Simplest expression is a single conceptid
 - For example
 - 71620000
- Optionally conceptid may be followed by a term enclosed in pipe delimiters
 - For example
 - 71620000|fracture of femur|
- Concepts can be combined with a plus sign that means logical “and” (conjunction)
 - For example
 - 31978002|fracture of tibia| +75591007|fracture of fibula|





Compositional grammar (2)

- Refinements can be added after a colon

For example

125605004: 363698007=29627003

- Refinements can be nested in parentheses

For example

53057004|hand pain|:

363698007|finding site|=(76505004|thumb structure|:

272741003|laterality| =7771000|left|)

- Refinements can be grouped in braces

For example

71388002|procedure|:

{260686004|method| =129304002|excision - action|,

363704007|procedure site| =66754008|appendix structure|}

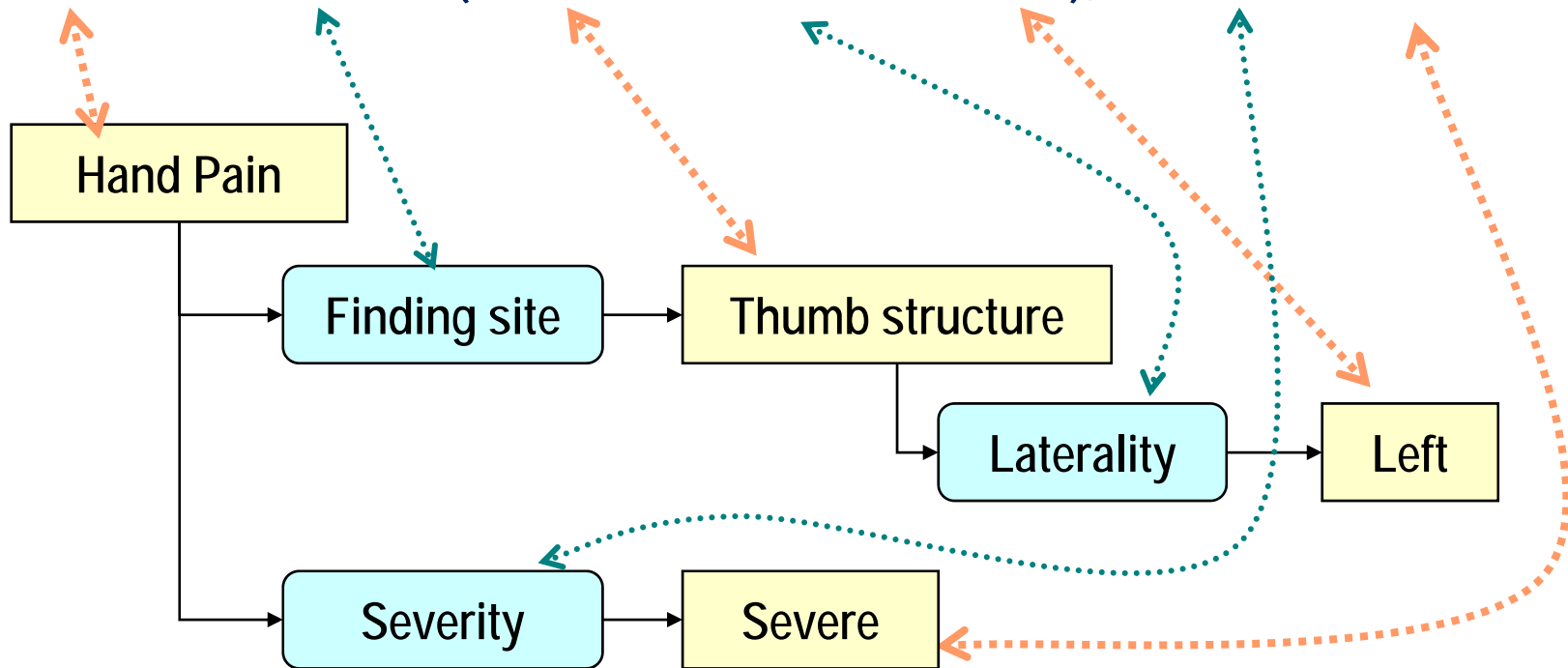
Note: the comma also means logical “and” in this expression

Expression example

“Severe pain the left thumb”

Compositional grammar mapped to diagrammatic representation

53057004:363698007=(76505004:272741003=7771000),272141005=24484000





Compositional Grammar BNF syntax

- expression = concept *("+" concept) [":" ws refinements]
- concept = ws conceptId ws ["|" ws term ws "|" ws]
- conceptId = sctId
- term = 1*nonwsnonpipe *(1*SP 1*nonwsnonpipe)
- refinements = (attributeSet *attributeGroup) / 1*attributeGroup
- attributeGroup = "{" attributeSet "}" ws
- attributeSet = attribute *("," attribute)
- attribute = attributeName "=" attributeValue
- attributeName = ws attributeNameld ws ["|" ws term ws "|" ws]
- attributeValue = concept / (ws "(" expression ")" ws)
- attributeNameld = sctId
- sctId = digitNonZero 5*17(digit)
- ws = *(SP / HTAB / CR / LF) ; white space



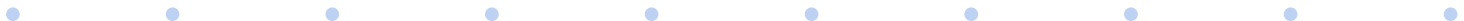


HL7 representation of SNOMED CT expressions

- Example of (old) Concept Descriptor (CD) datatype

```
<code codeSystem="2.16.840.1.113883.6.96" code="71620000"
  displayName="fracture of femur">
  <qualifier>
    <name code="272741003" displayName="laterality"/>
    <value code="7771000" displayName="left"/>
  </qualifier>
</code>
```
- Same expression in compositional grammar

```
71620000|fracture of femur|:272741003||laterality| =7771000|left|
```



General form of expressions

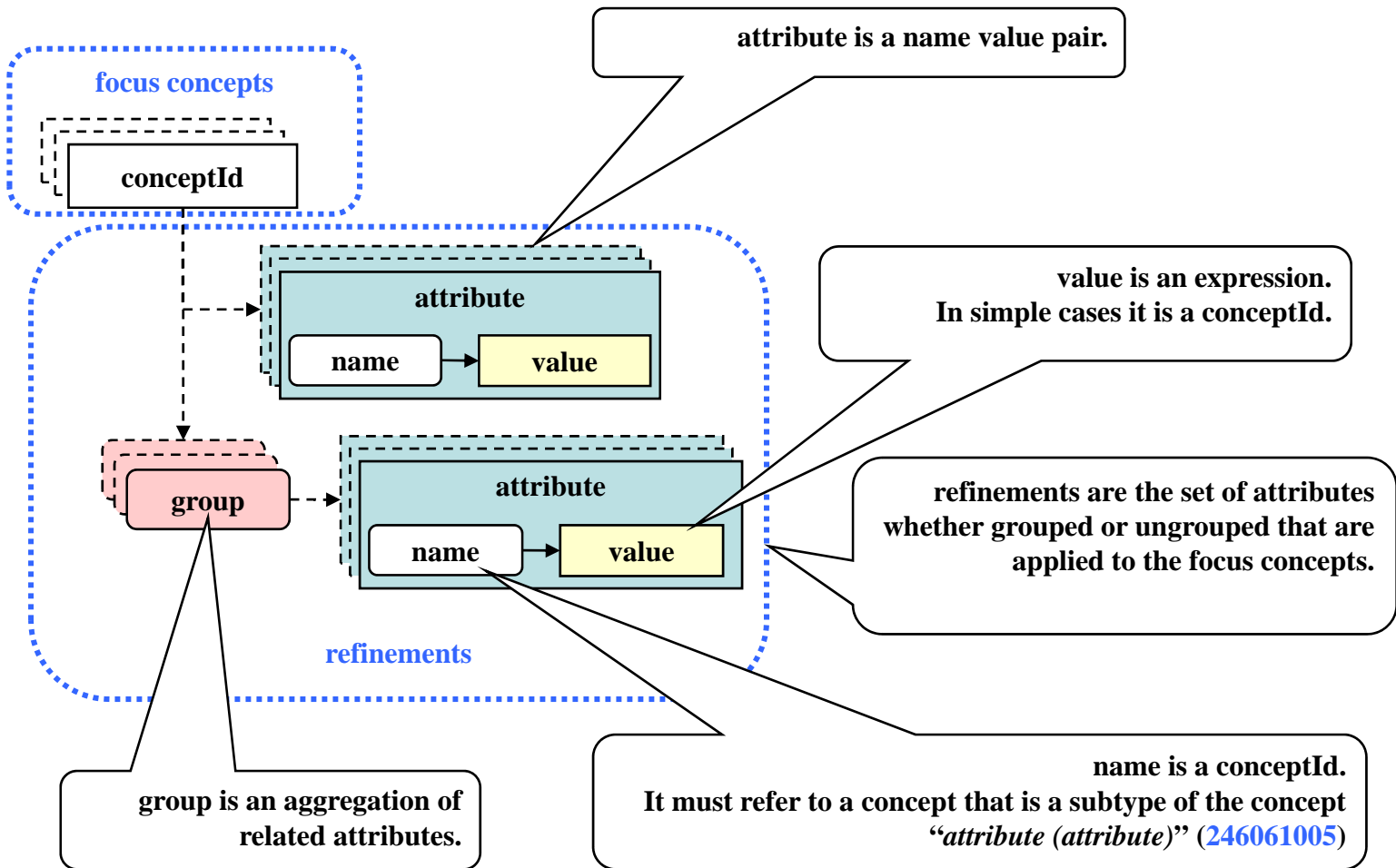


Illustration of a nested expression

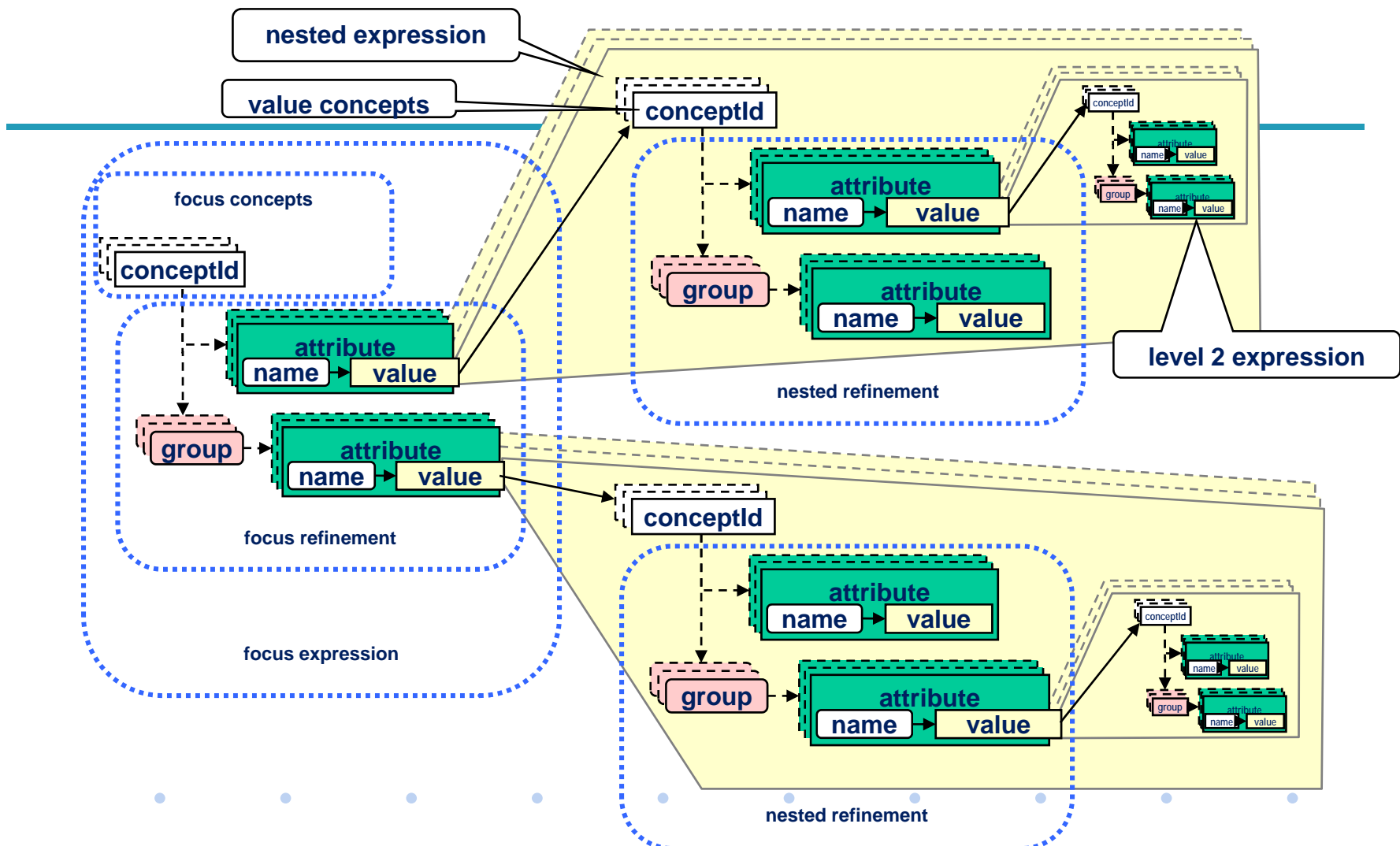
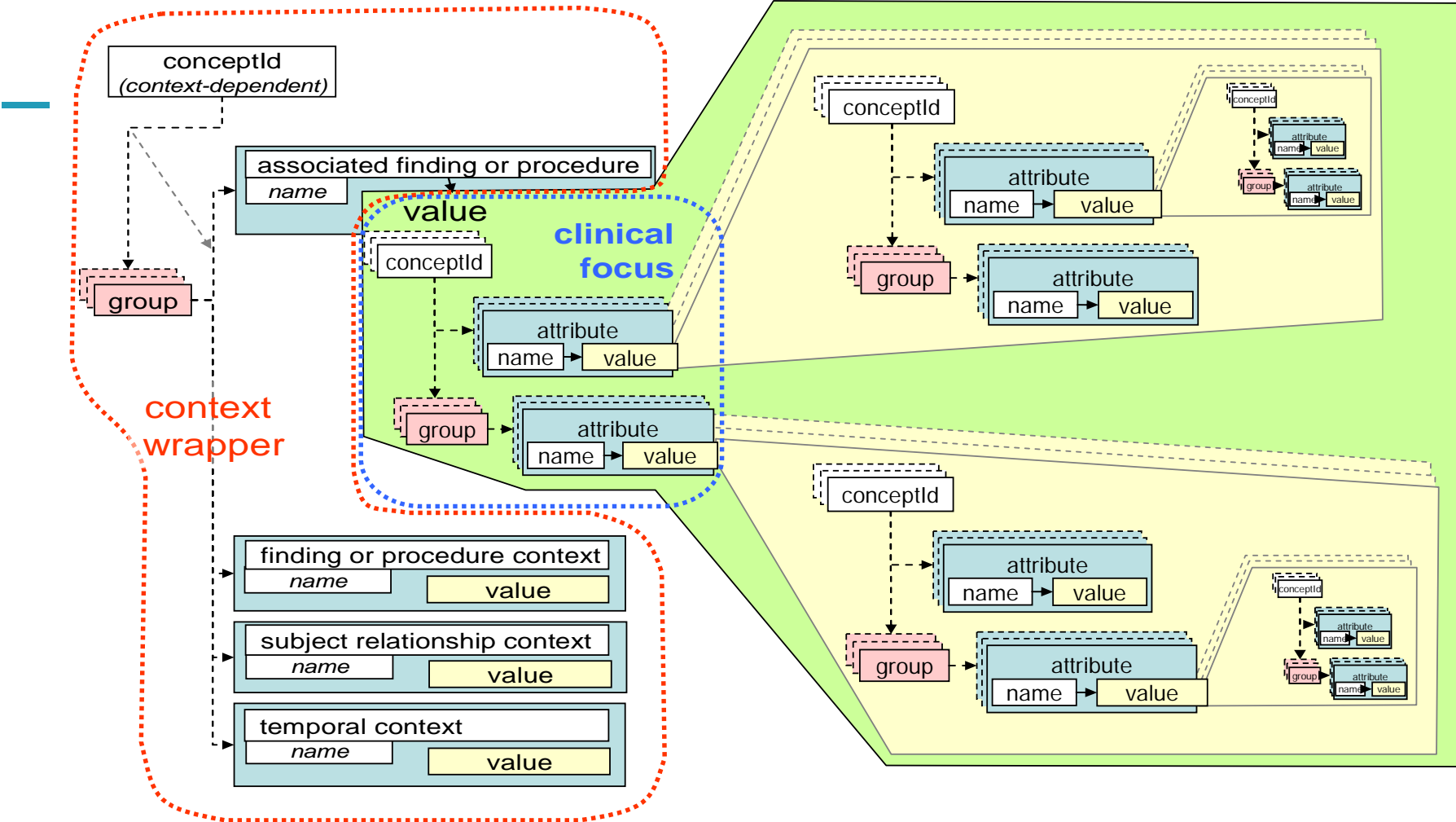
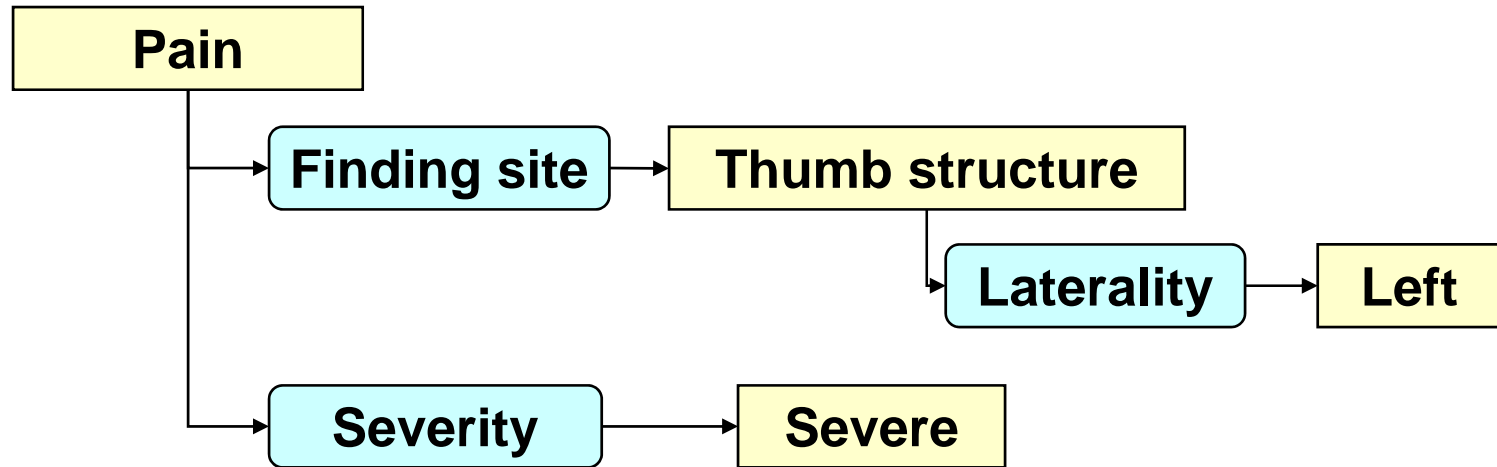


Illustration of a context rich expression



Severe pain, left thumb



22253000|pain|:

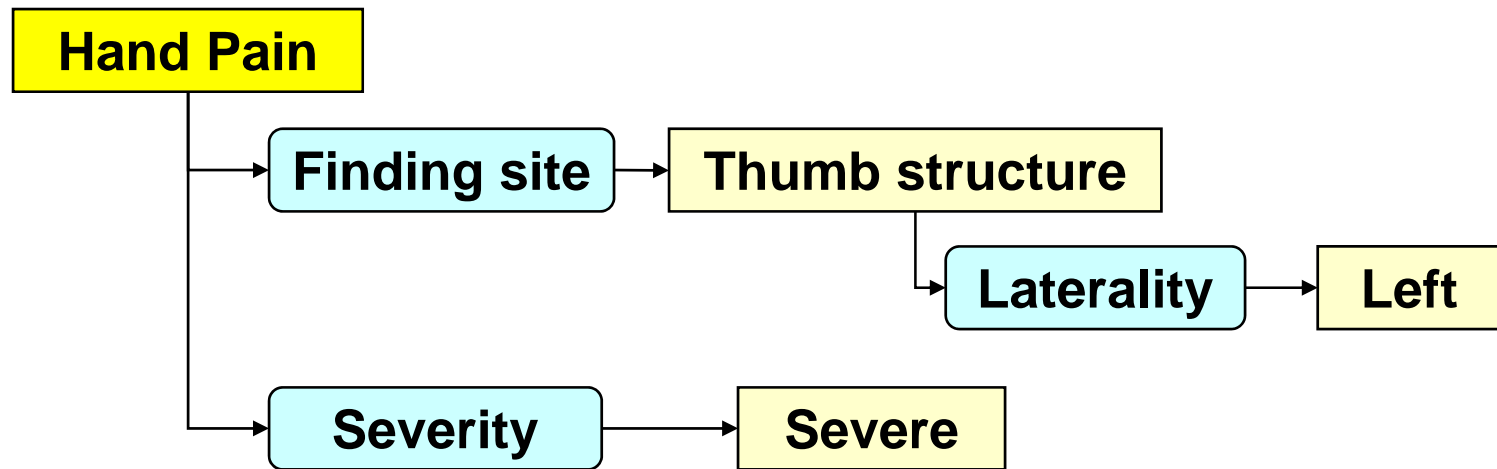
363698007|finding site|=

(76505004|thumb structure|:

272741003|laterality|=7771000|left|),

246112005|severity|=24484000|severe|

Severe pain, left thumb



53057004|hand pain|:

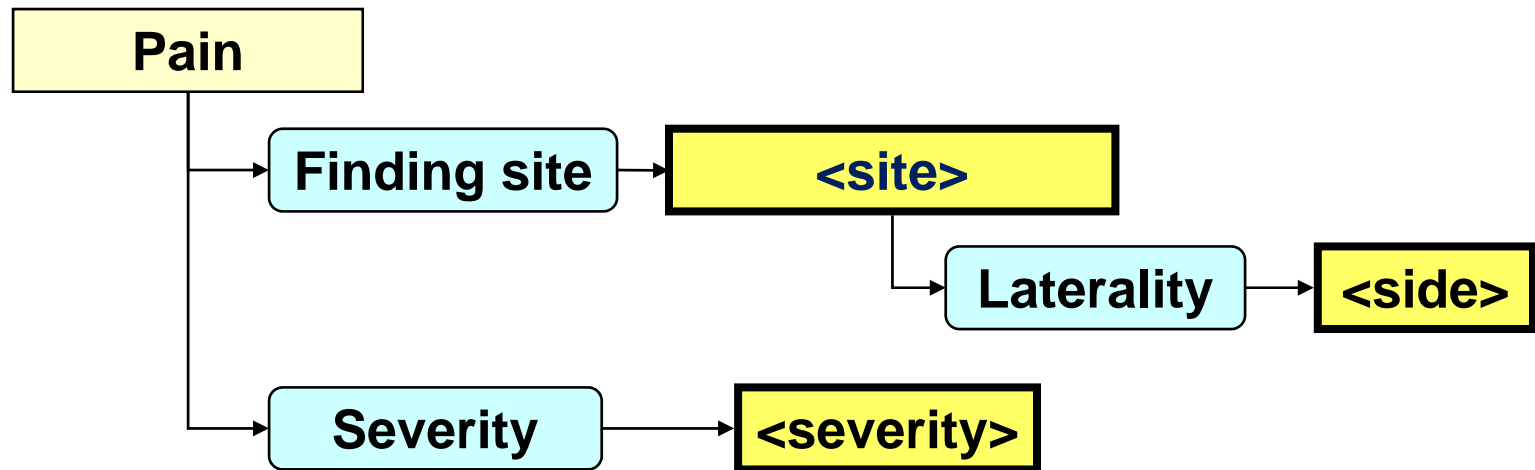
363698007|finding site|=

(76505004|thumb structure|:

272741003|laterality|=7771000|left|),

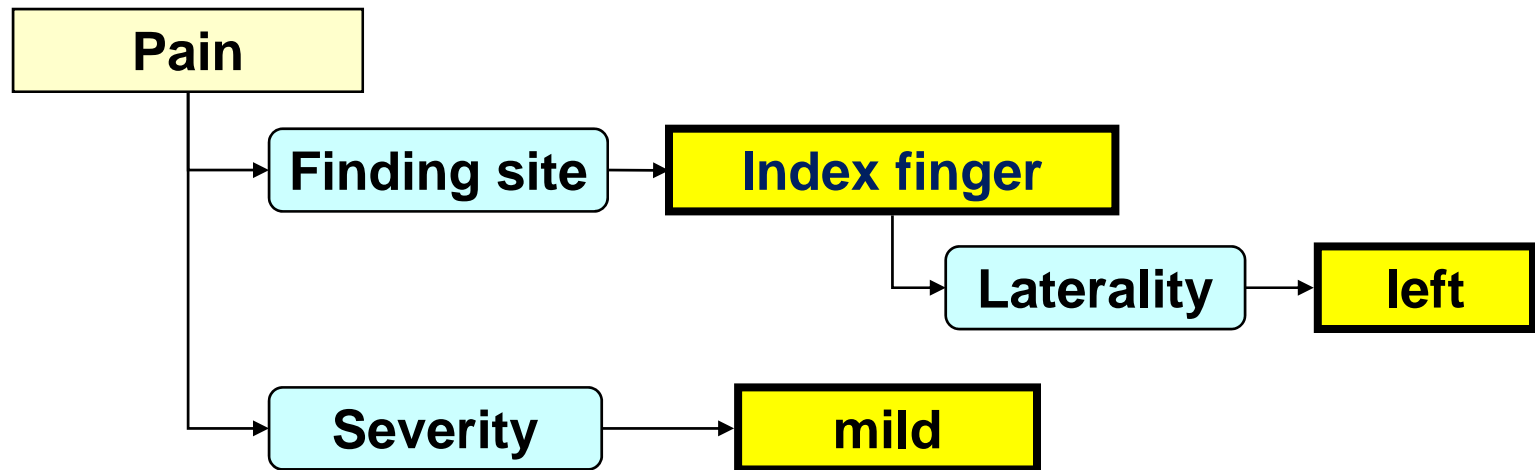
246112005|severity|=24484000|severe|

Generic Pattern: Pain of any site, any severity



my-pain-pattern (<site>,<side>,<severity>)

Using the pattern:
Mild pain in left index finger

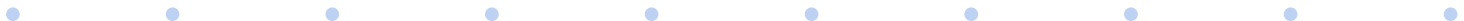


my-pain-pattern (index finger, left, mild)



Simple close-to-user post-coordination

- my-pain-pattern (<site>,<side>,<severity>)
- my-pain-pattern (index finger, left, mild)
- my-pain-pattern (arm, right, moderate)
- my-pain-pattern (ear, left, severe)
- etc



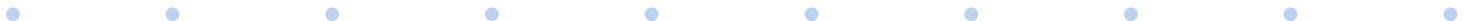
Each row in the table can easily be transformed into a SNOMED CT Normal Form expression, in the form of the Compositional grammar, or HL7 CD datatype, or other syntax

Pattern identifier	First variable	Second variable	Third variable
my-pain-pattern	<site>	<side>	<severity>
my-pain-pattern	83738005: index finger structure (body structure)	7771000: left (qualifier value)	255604002: mild (qualifier value)
my-pain-pattern	53120007: upper limb structure (body structure)	24028007: right (qualifier value)	6736007: moderate (severity modifier) (qualifier value)
my-pain-pattern	117590005: ear structure (body structure)	7771000: left (qualifier value)	24484000: severe (severity modifier) (qualifier value)



Common patterns

- Caveat: these are intended for illustrative purposes only, as examples of ways that system builders might simplify post-coordination for their clinical experts
- They are full logical models for which the meaning can be represented in the interface and in storage with more than one split between the information model and terminology model





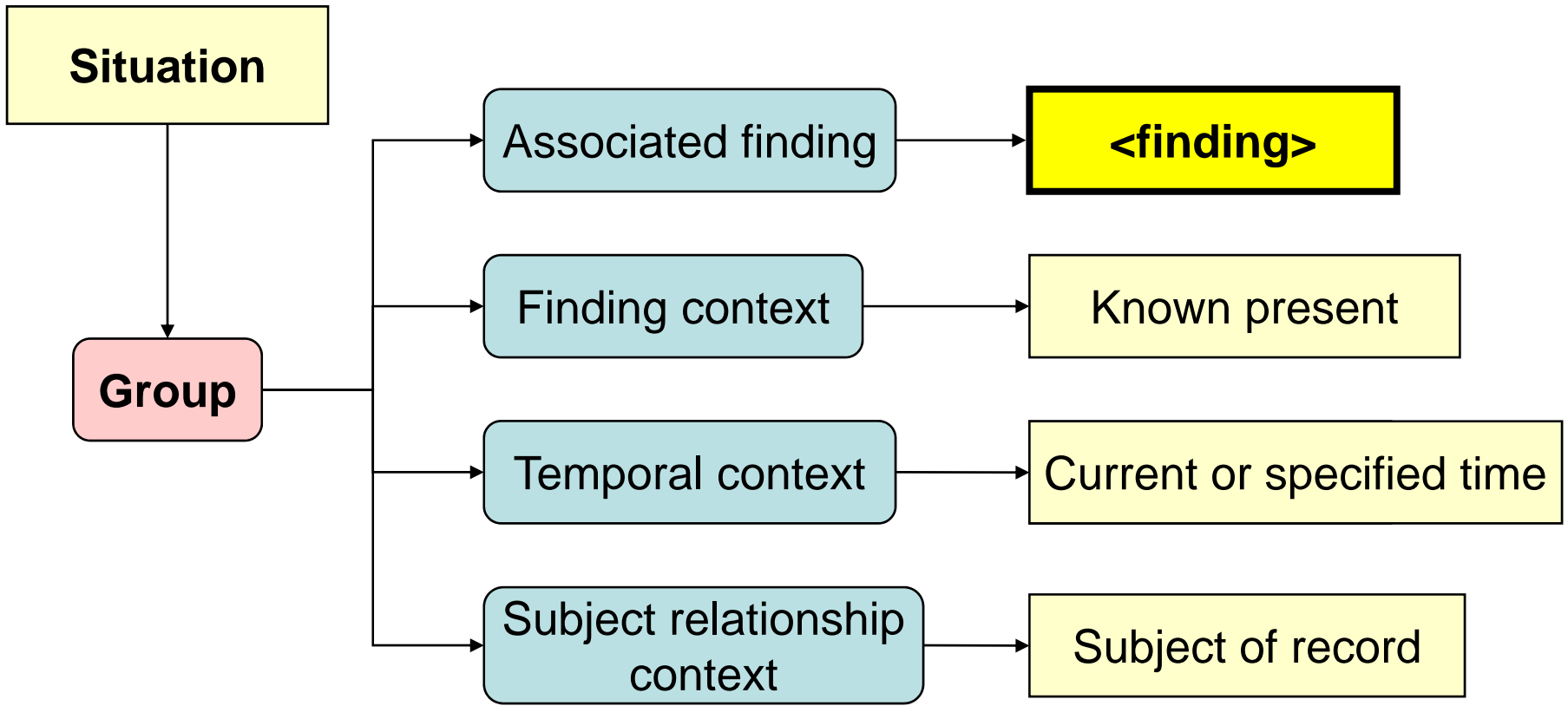
Common patterns

- Clinical finding present
- Clinical finding absent
- Clinical finding unknown
- History of
- No history of
- Family history of
- No family history of
- Observable + value
- Procedure done
- Procedure not done
- (Drug or procedure) contraindicated

- Plus:
 - all the above with site, or site & laterality

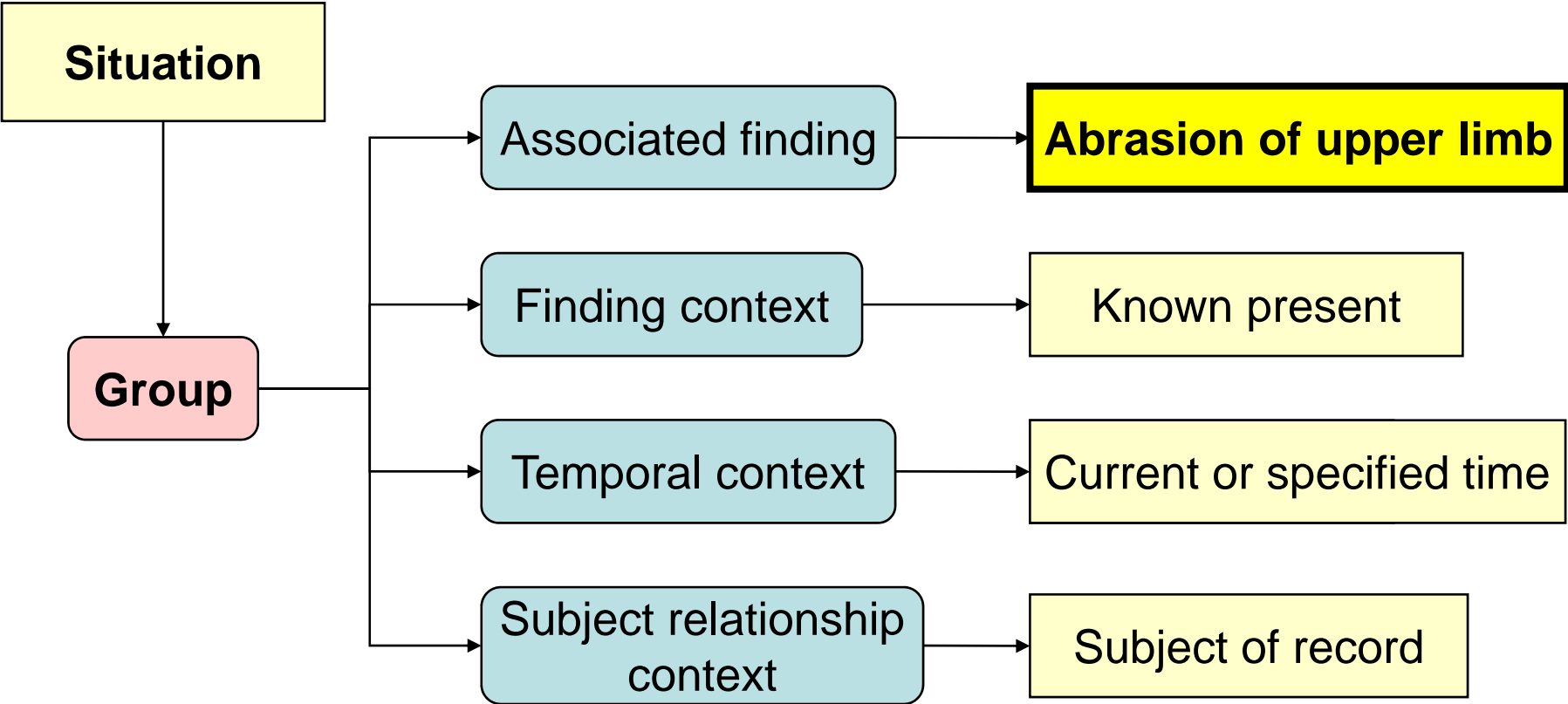


Clinical finding present



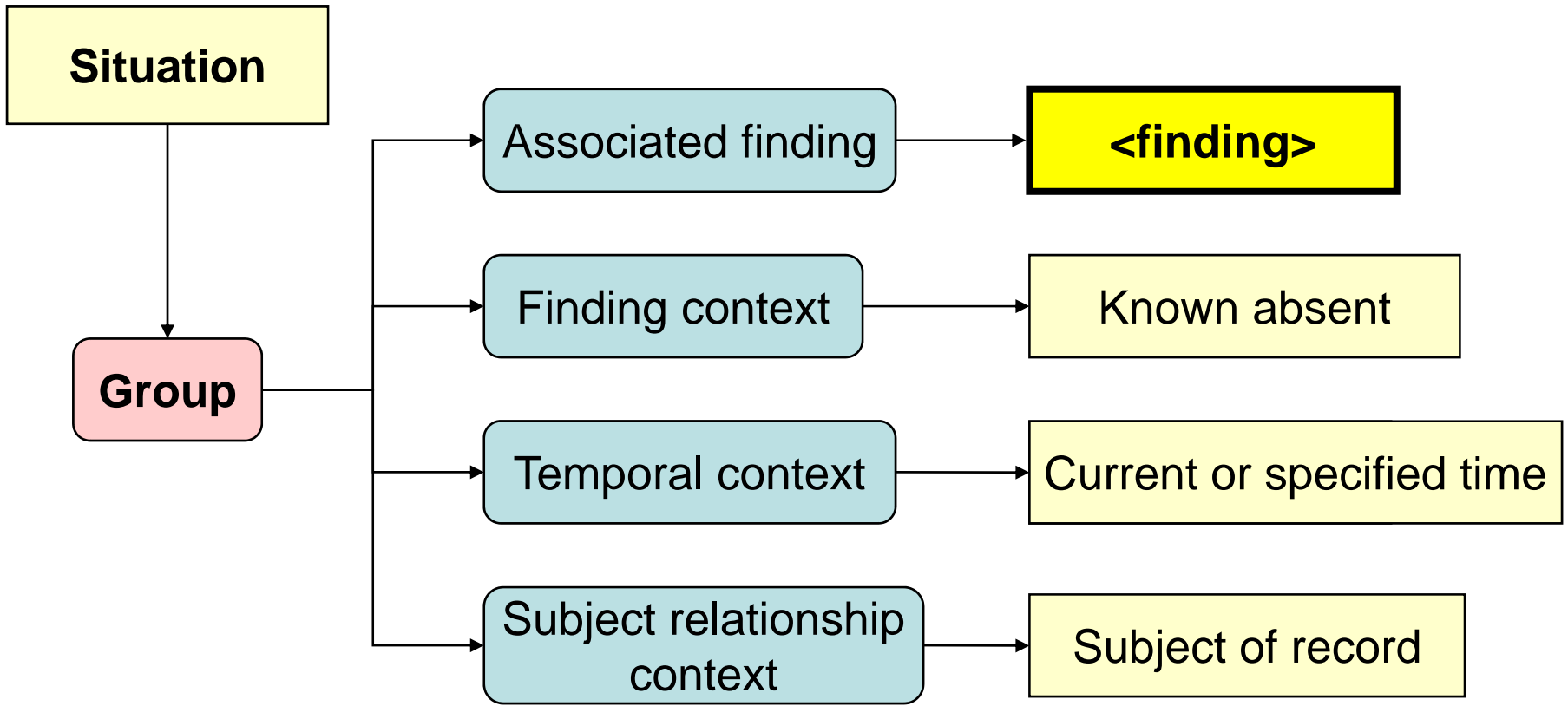
Clinical-finding-present (<finding>)

Abrasion of upper limb



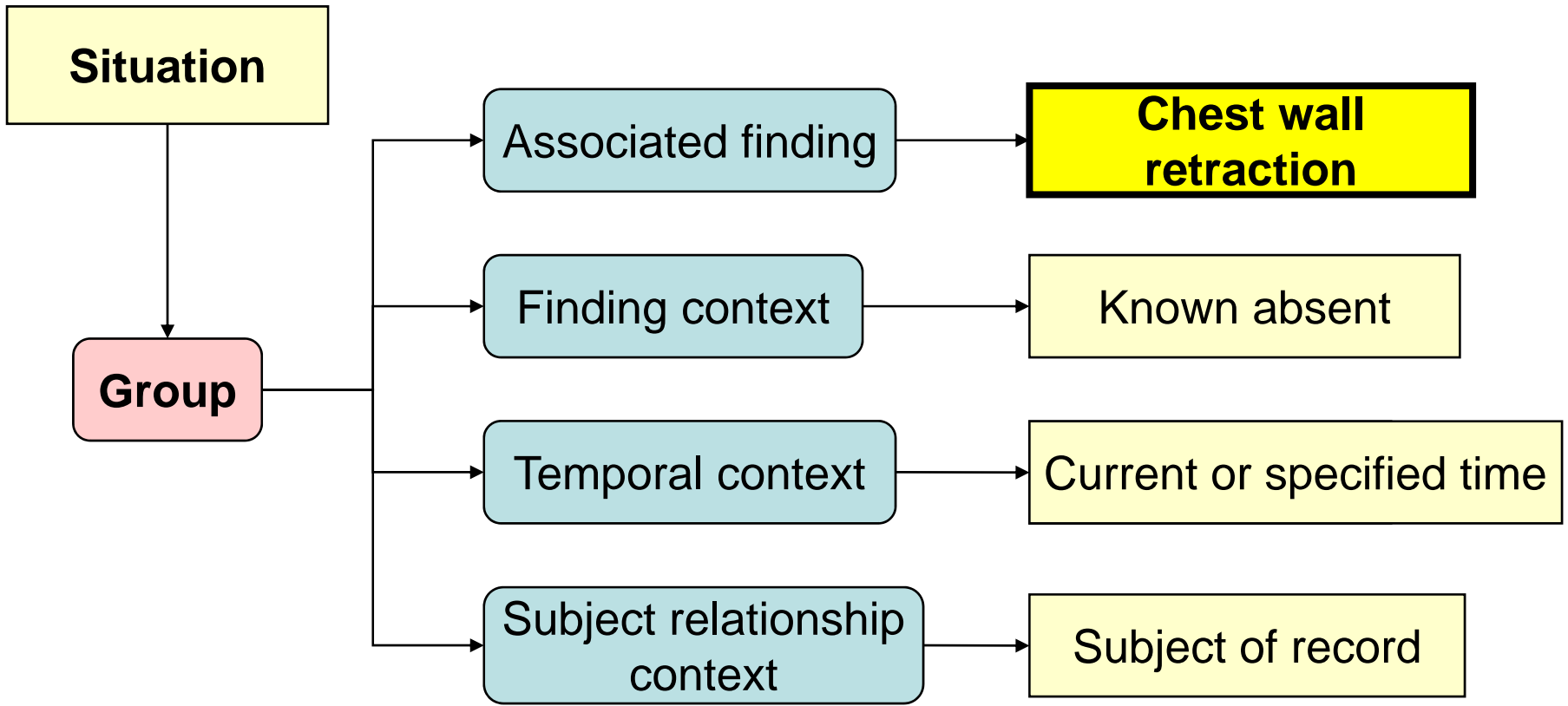
Clinical-finding-present (abrasion of upper limb)

Clinical finding absent



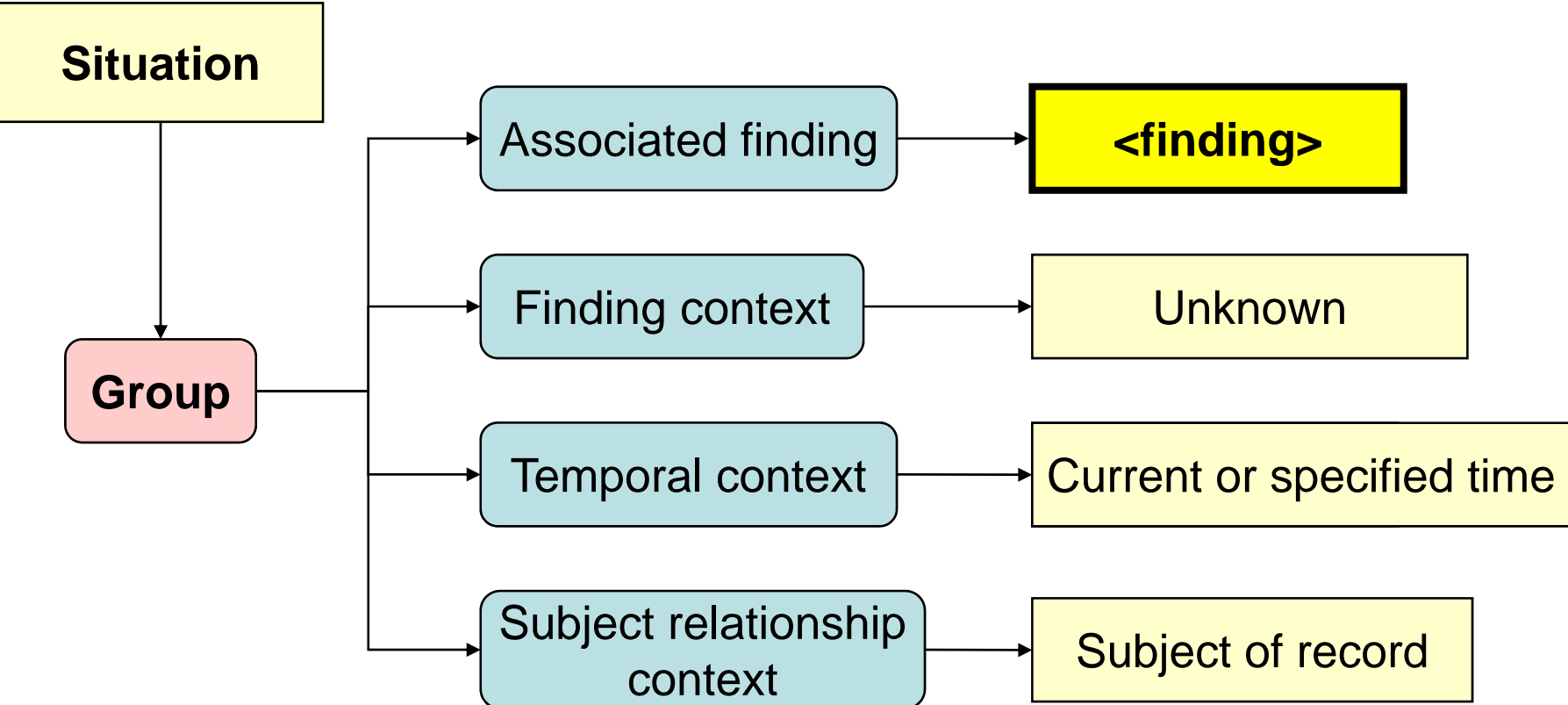
Clinical-finding-absent (<finding>)

No chest retractions



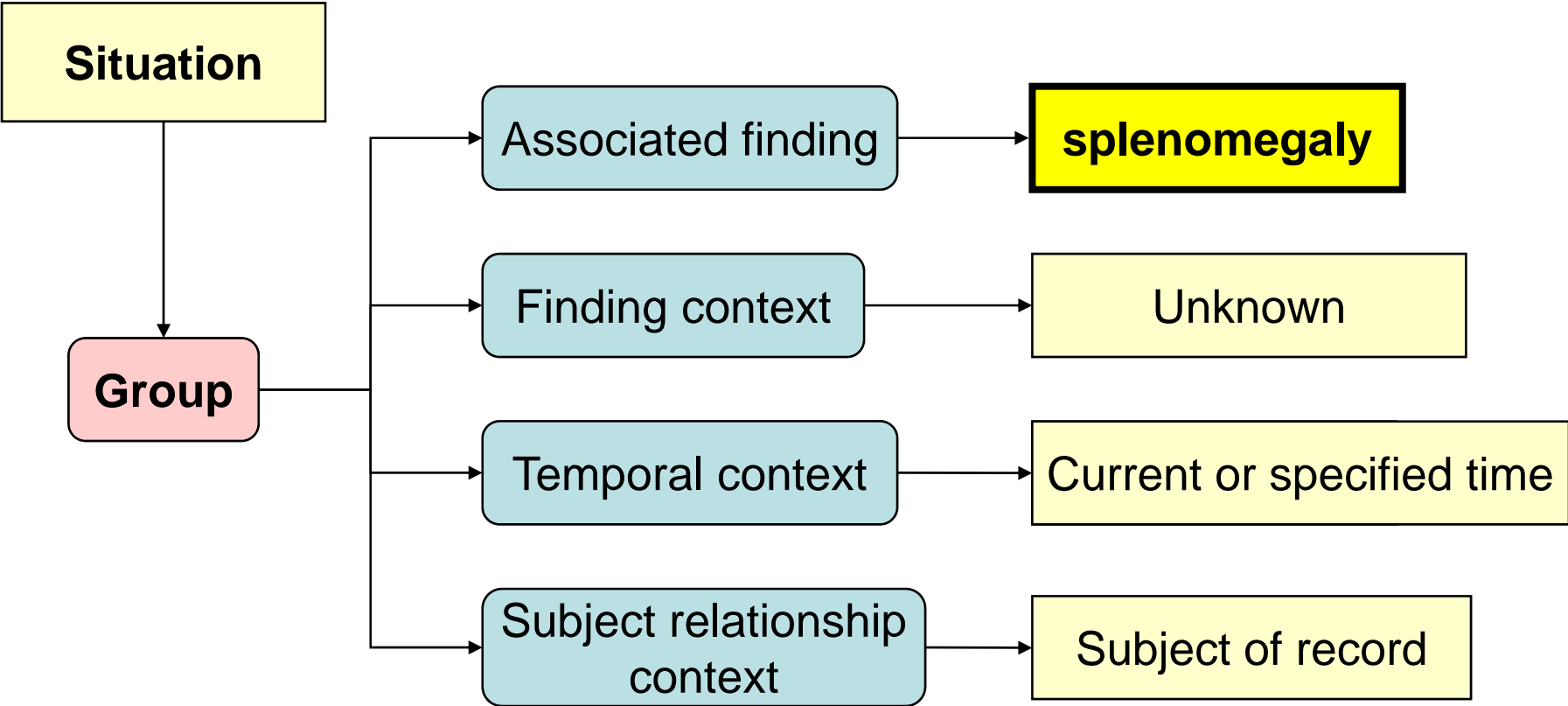
Clinical-finding-absent (chest wall retraction)

Clinical finding unknown



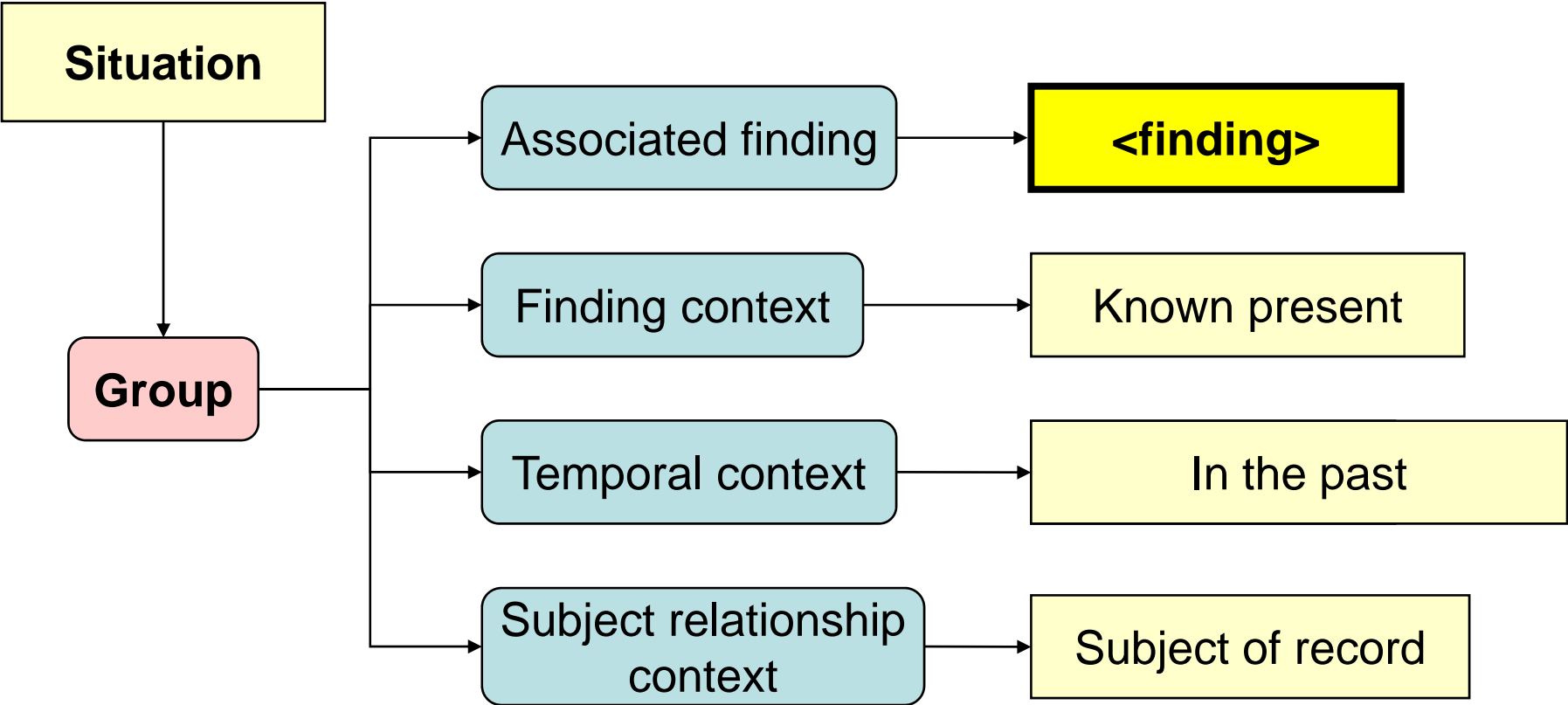
Clinical-finding-unknown (<finding>)

Splenomegaly: unknown



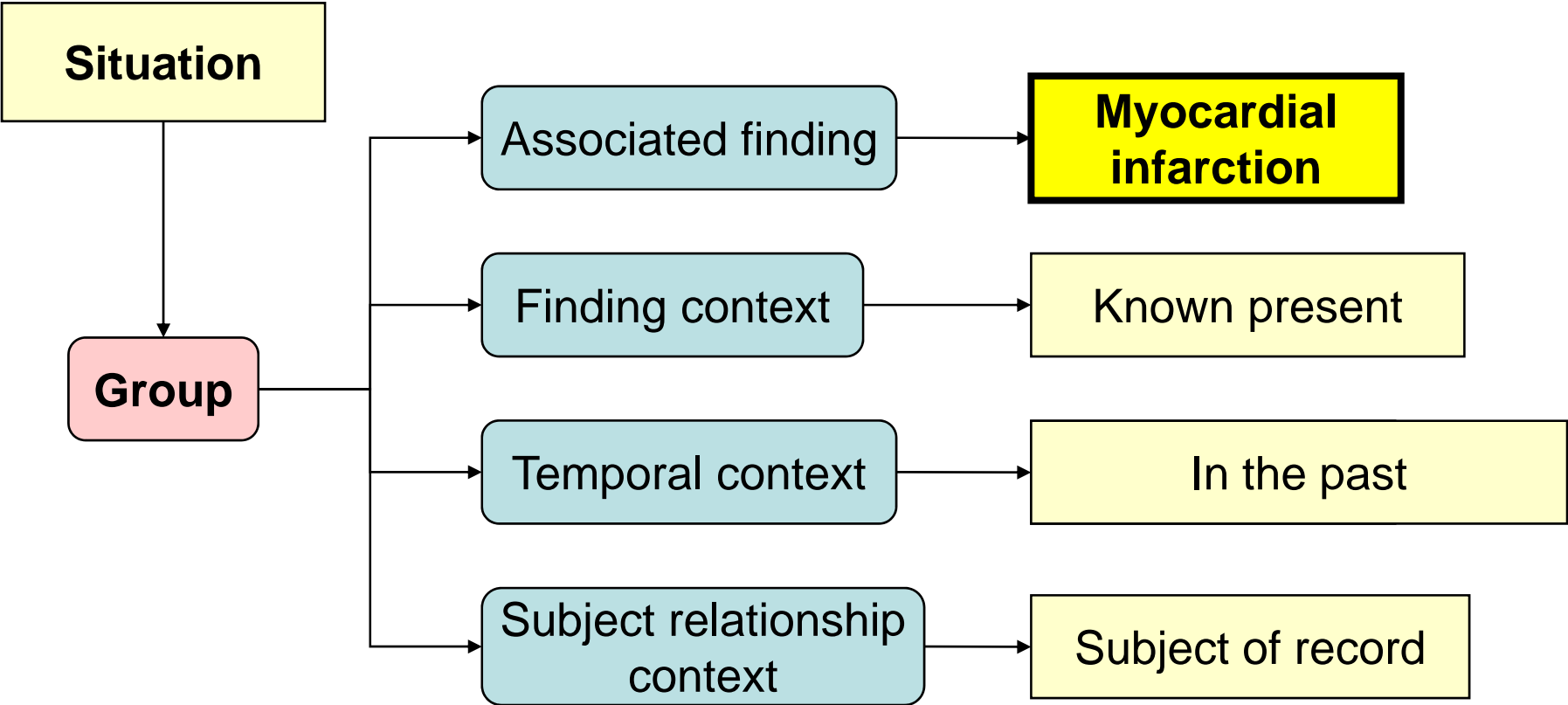
Clinical-finding-unknown (splenomegaly)

History of <finding>



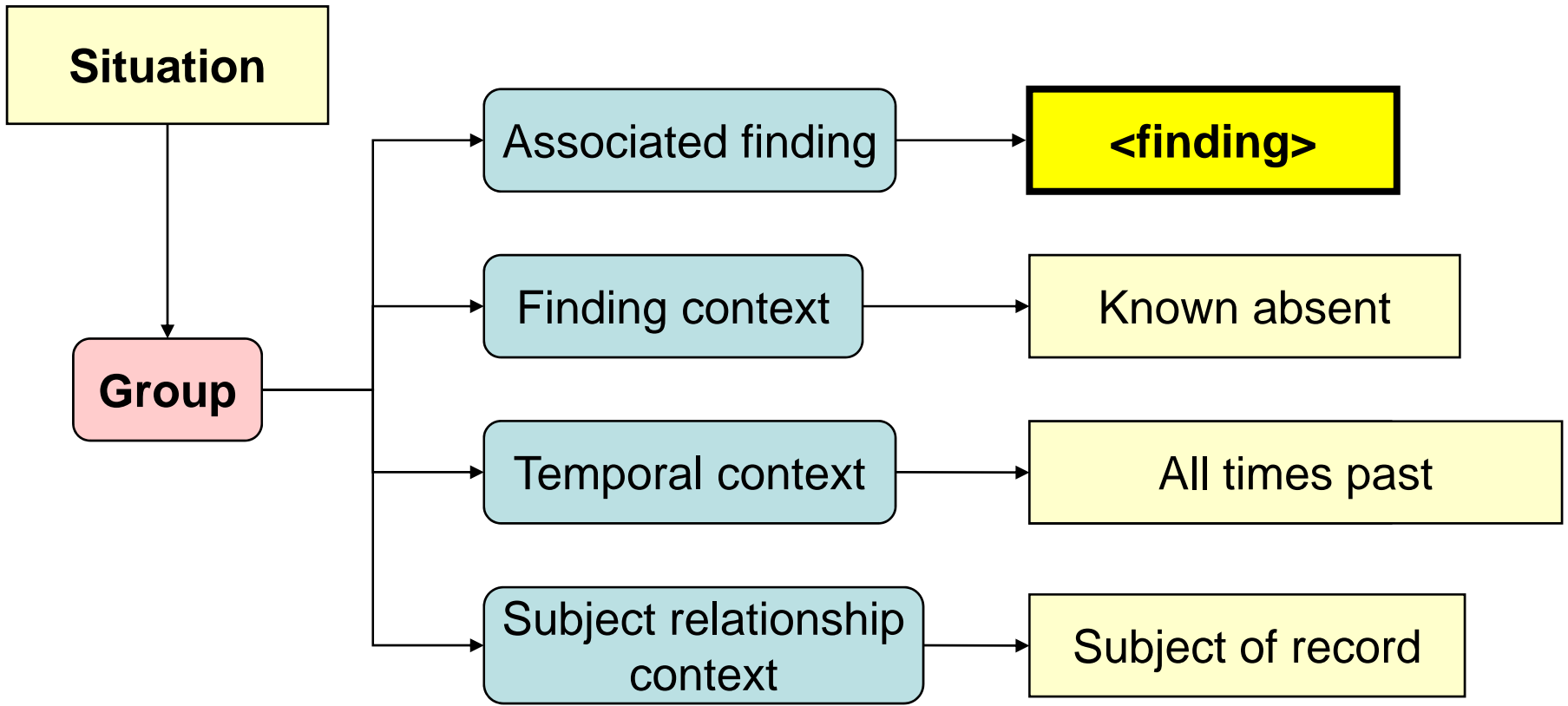
History-of (<finding>)

History of MI



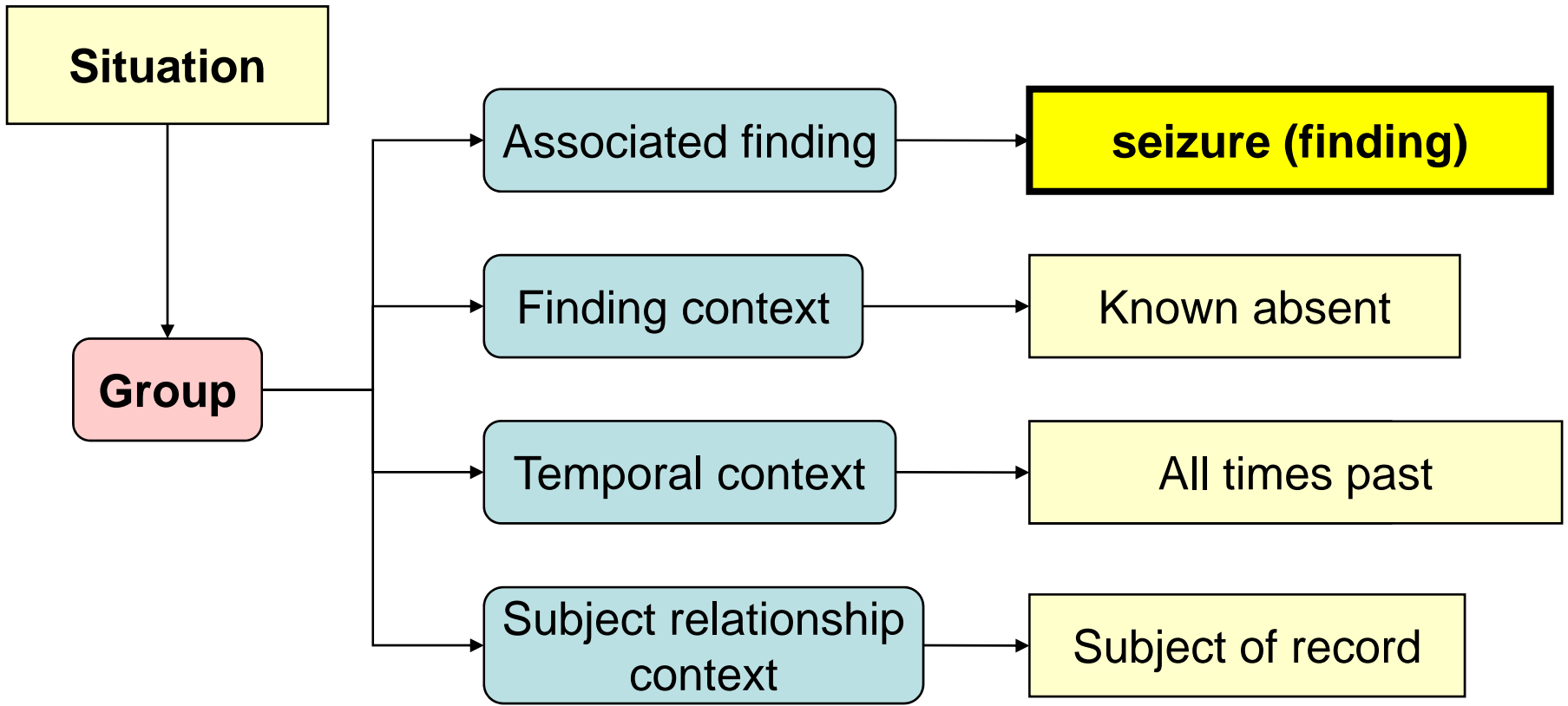
History-of (myocardial infarction)

No history of <finding>



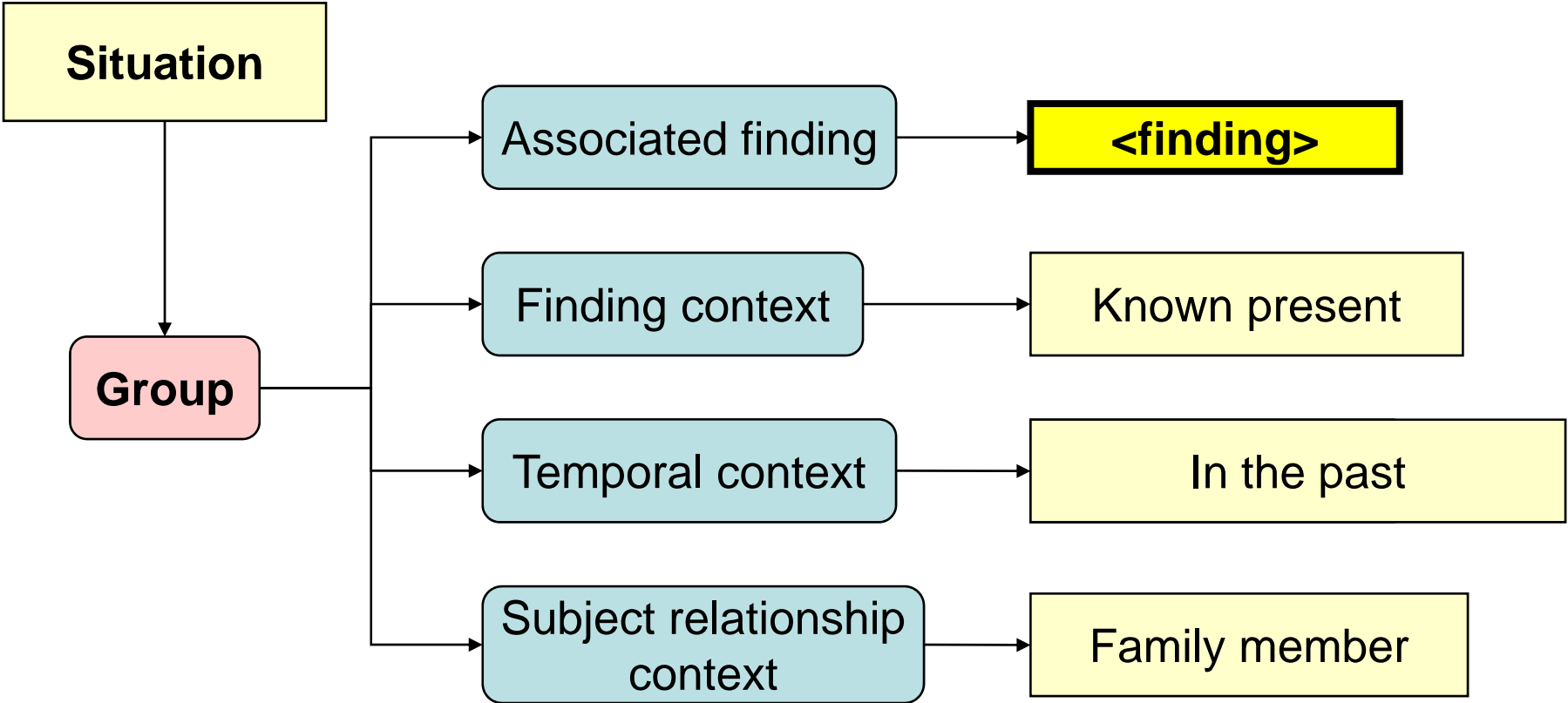
No-history-of (<finding>)

No history of seizure



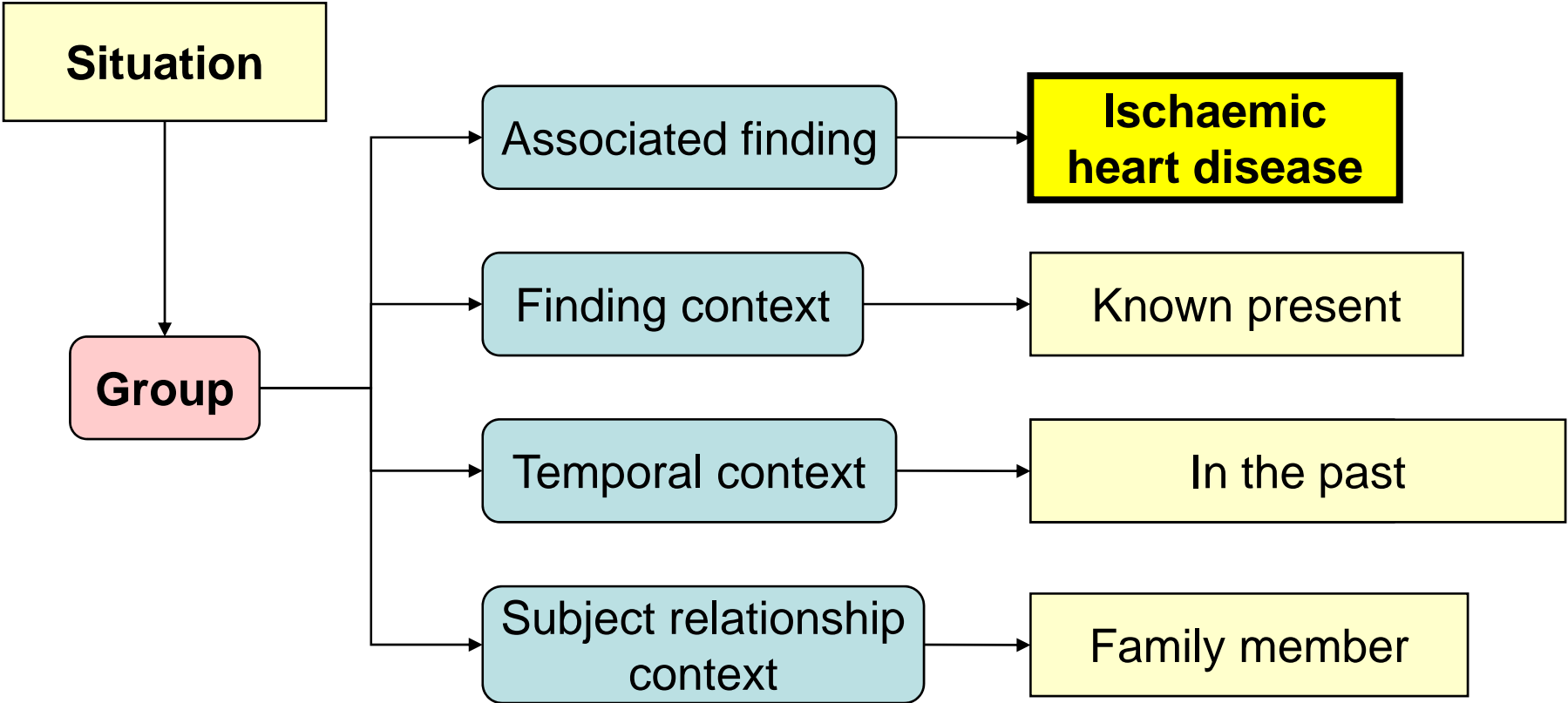
No-history-of (seizure (finding))

Family history of <finding>



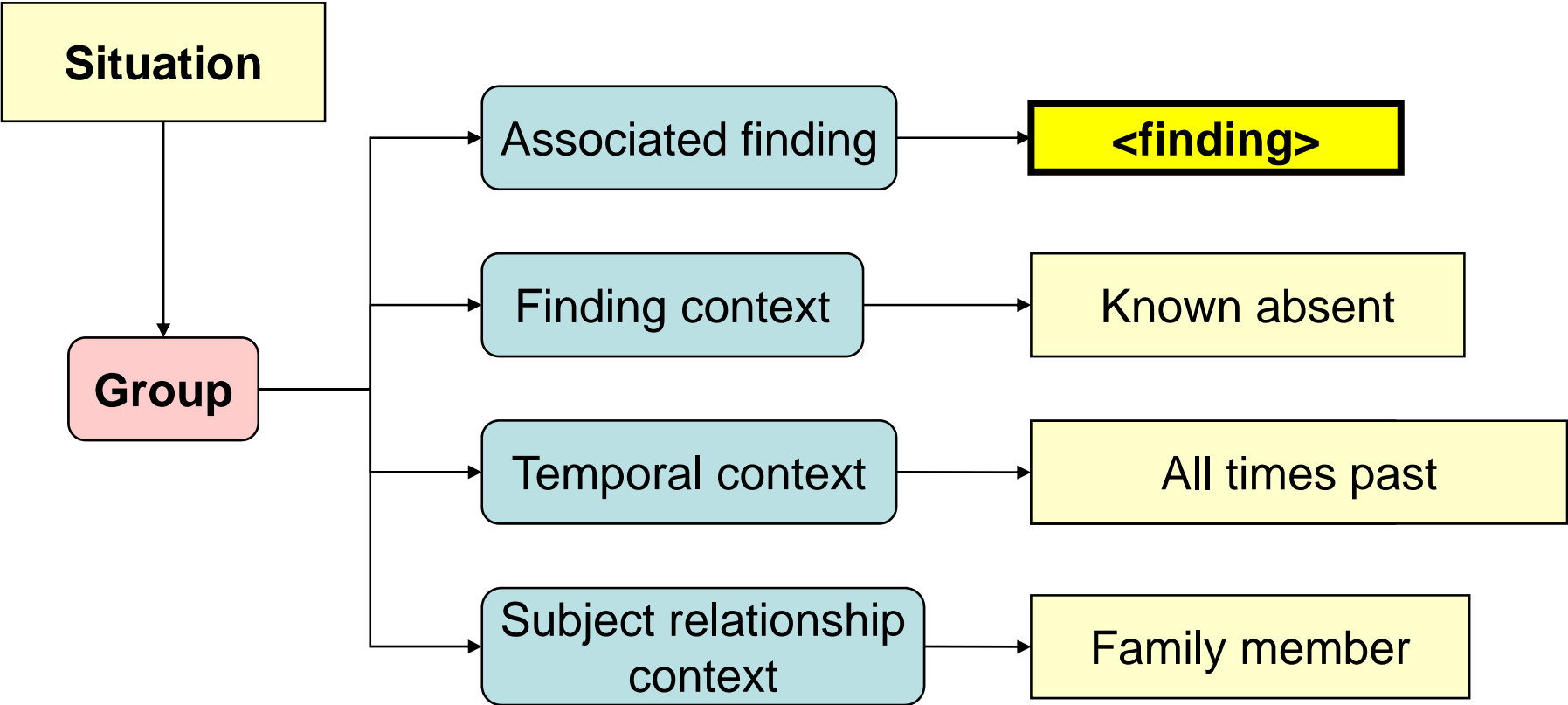
Family-history-of (<finding>)

Family history of ischemic heart disease



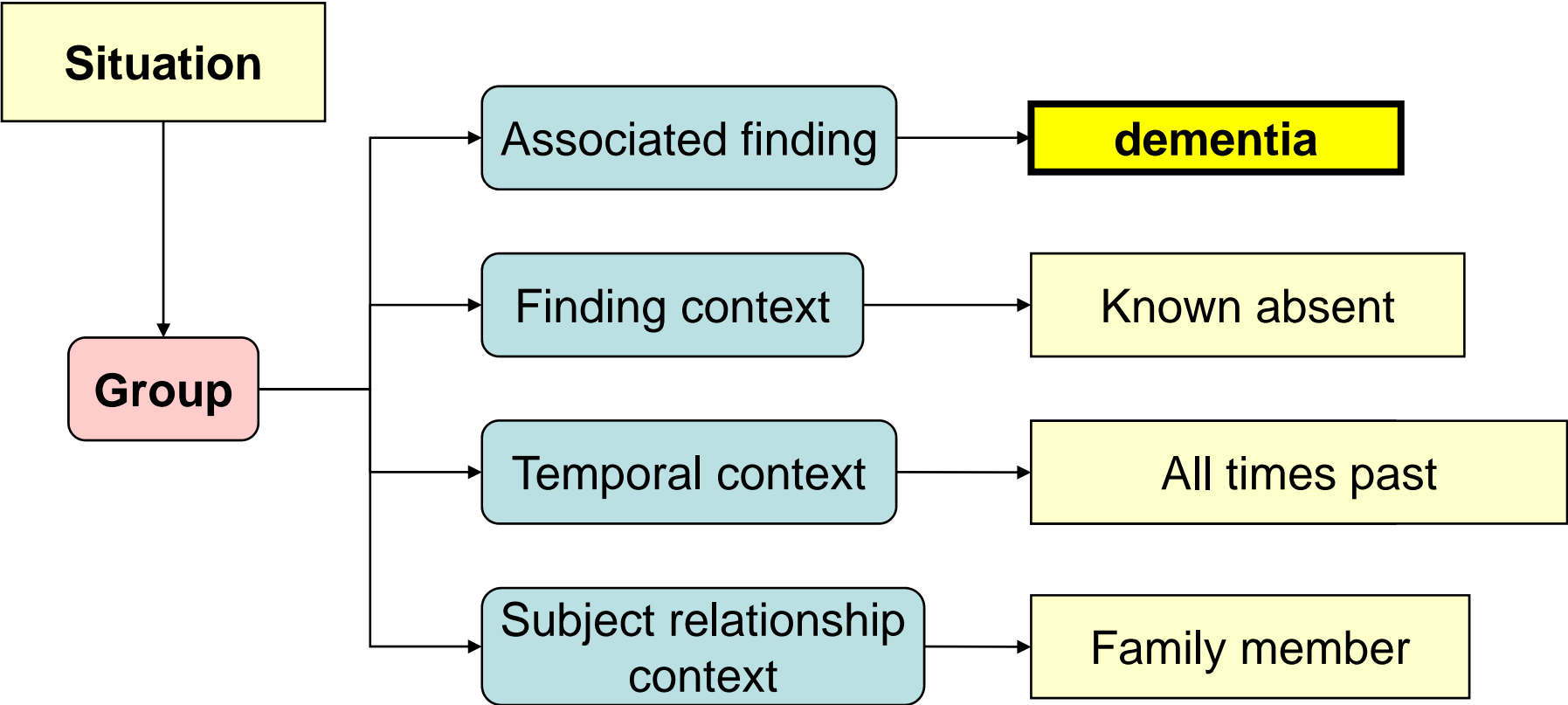
Family-history-of (ischemic heart disease)

No family history of <finding>



No-family-history-of (<finding>)

No family history of dementia

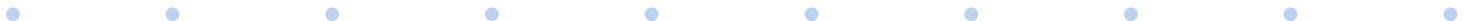


No-family-history-of (dementia)

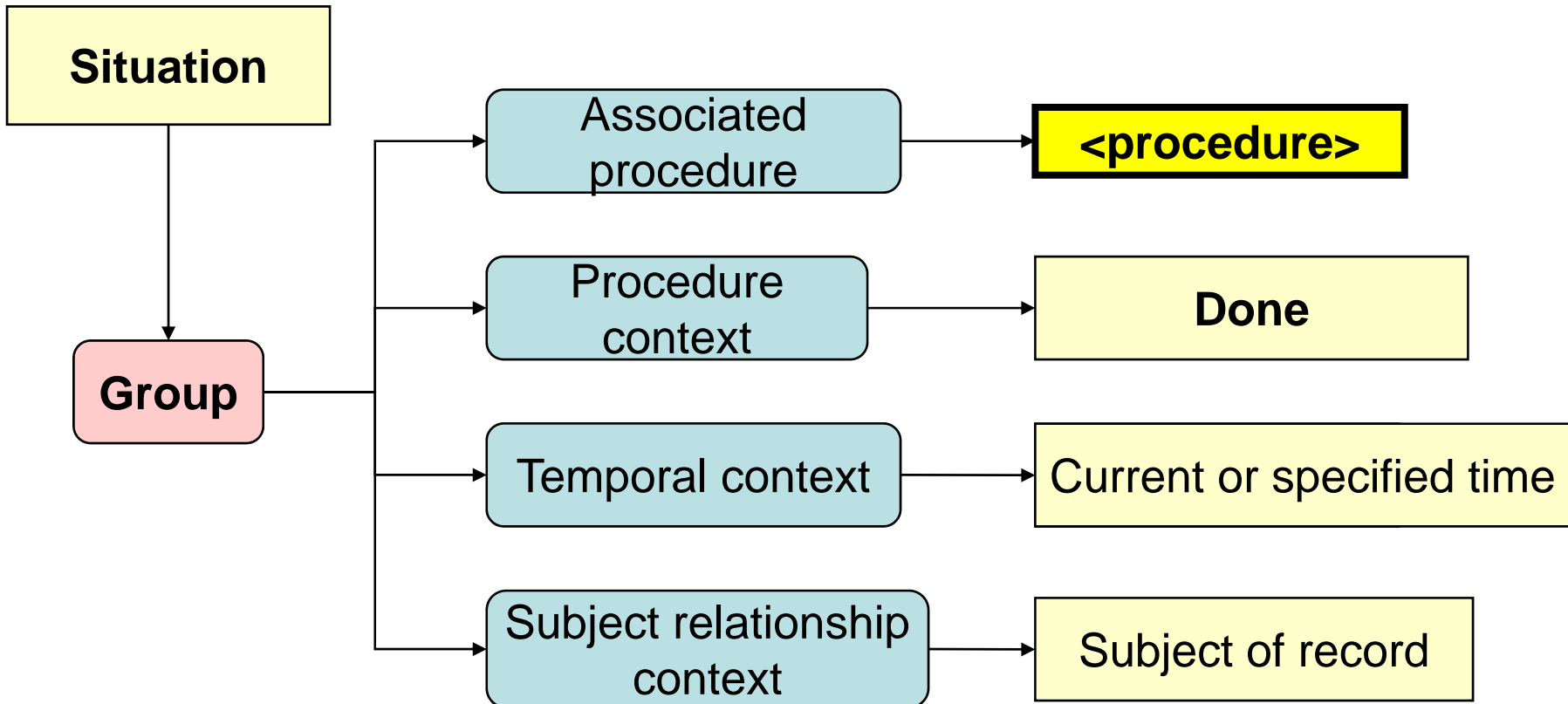


Switch to procedures

- Slightly different:
 - Two attributes:
 - Associated-procedure
 - Procedure-context
- Same:
 - Temporal context
 - Subject relationship context

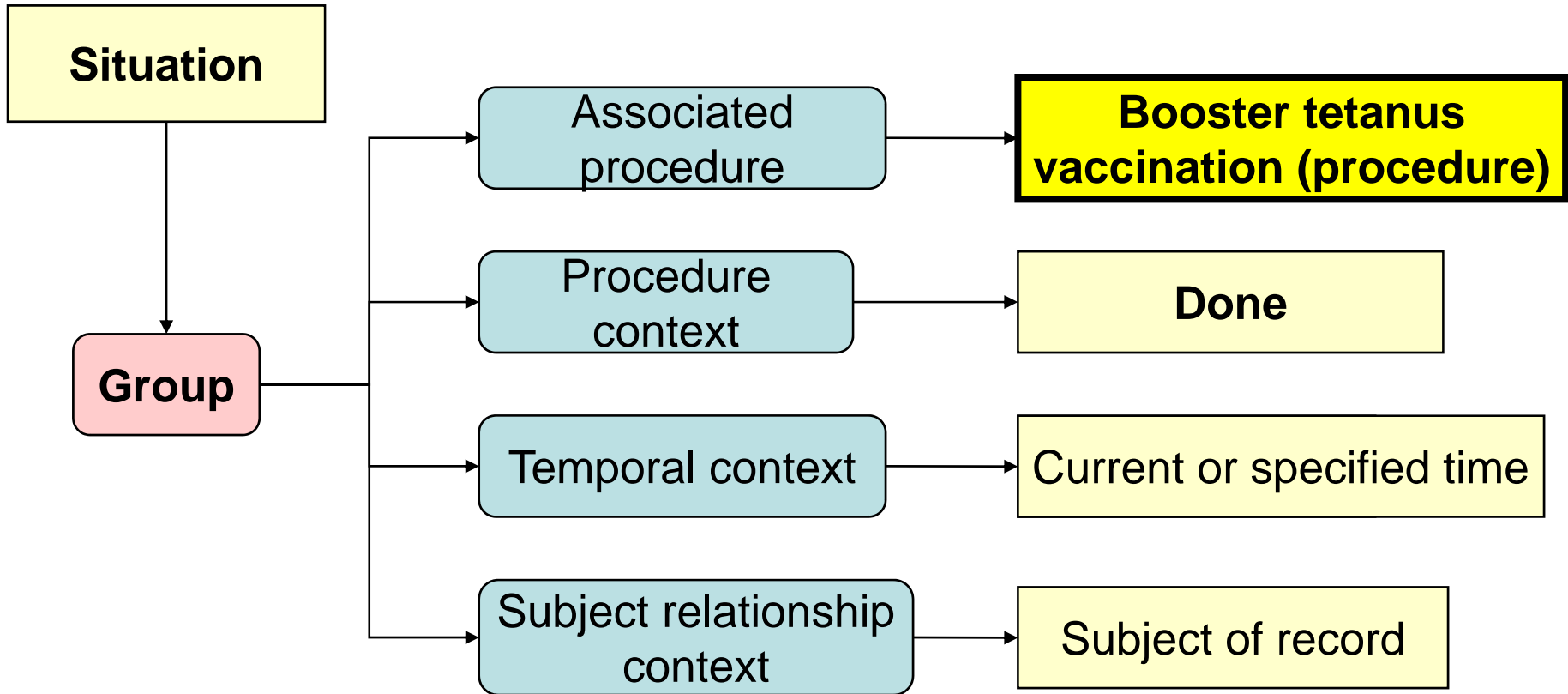


Procedure done



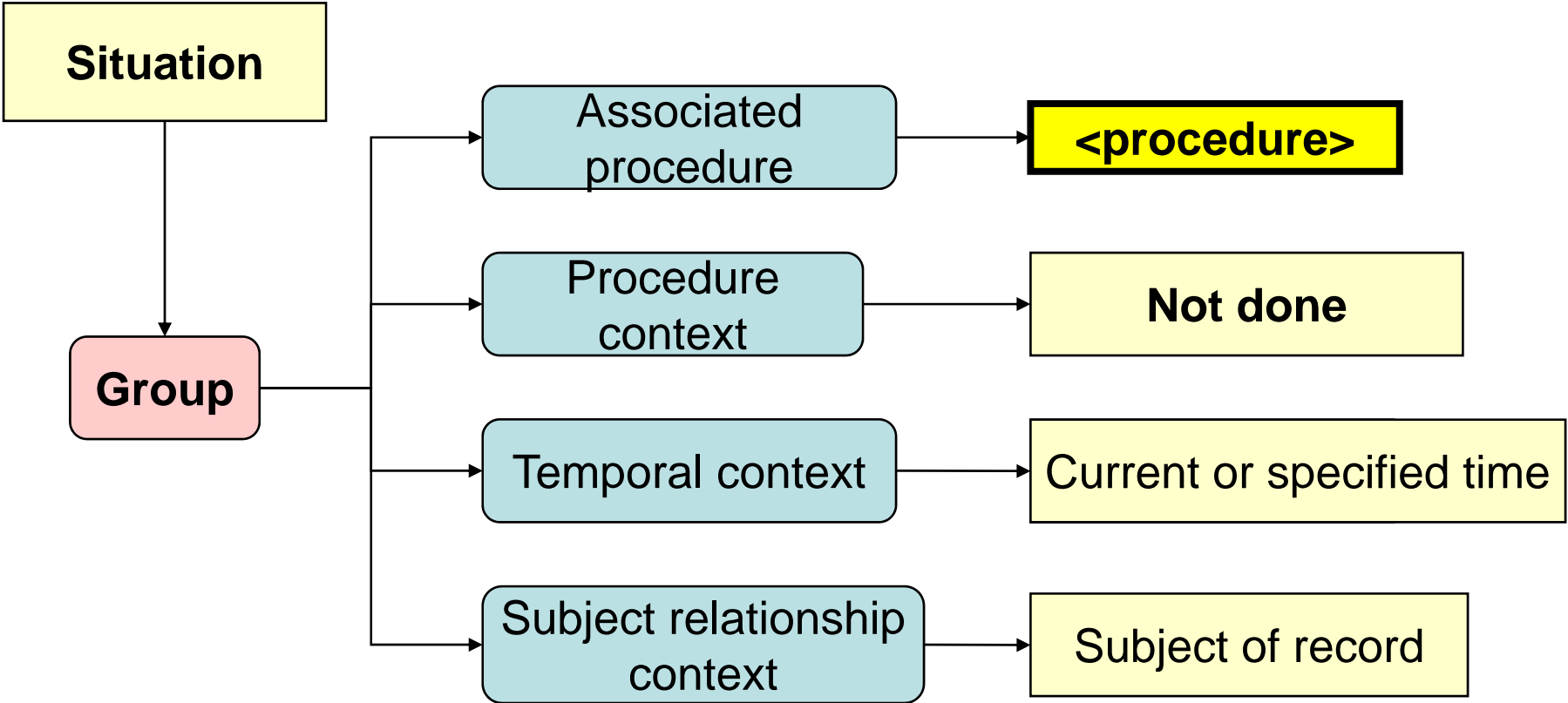
Procedure-done (<procedure>)

Tetanus booster given



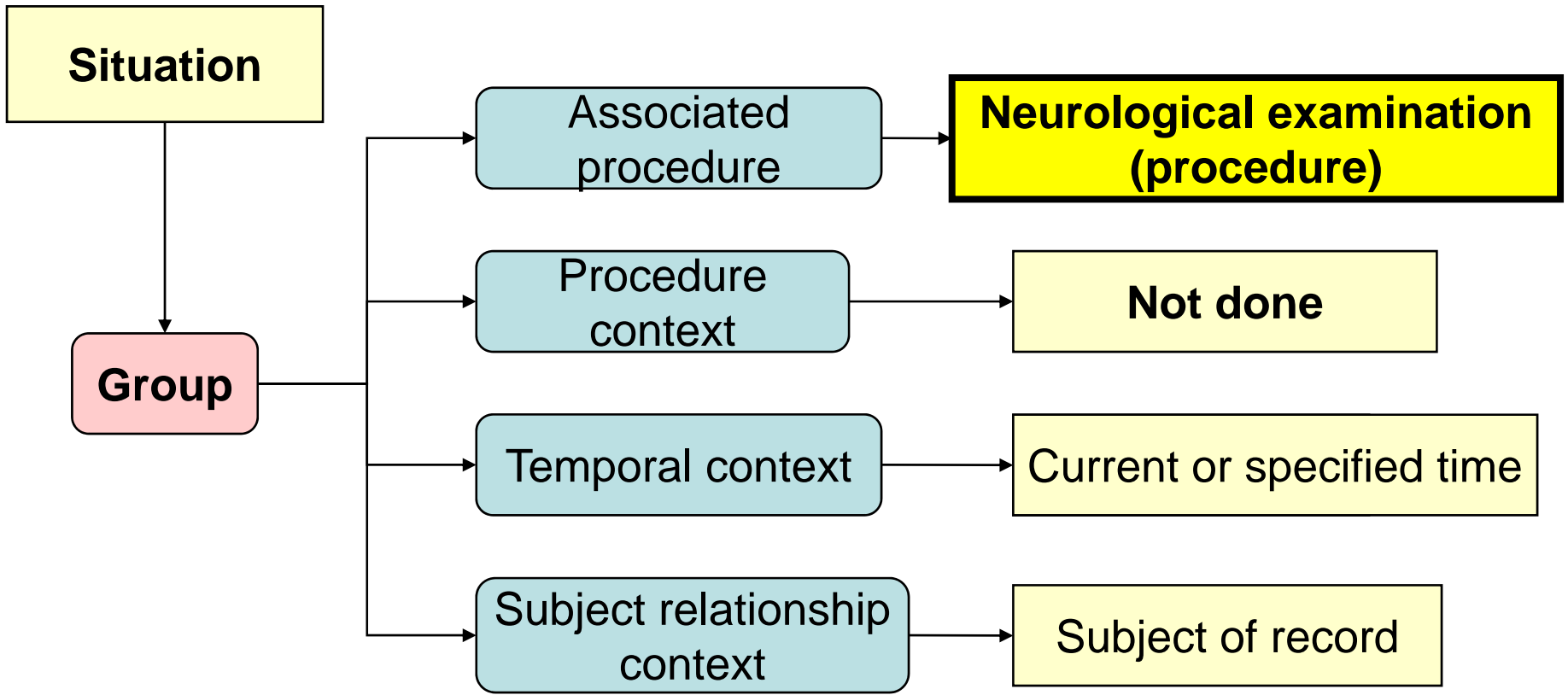
Procedure-done (booster tetanus vaccination)

Procedure not done



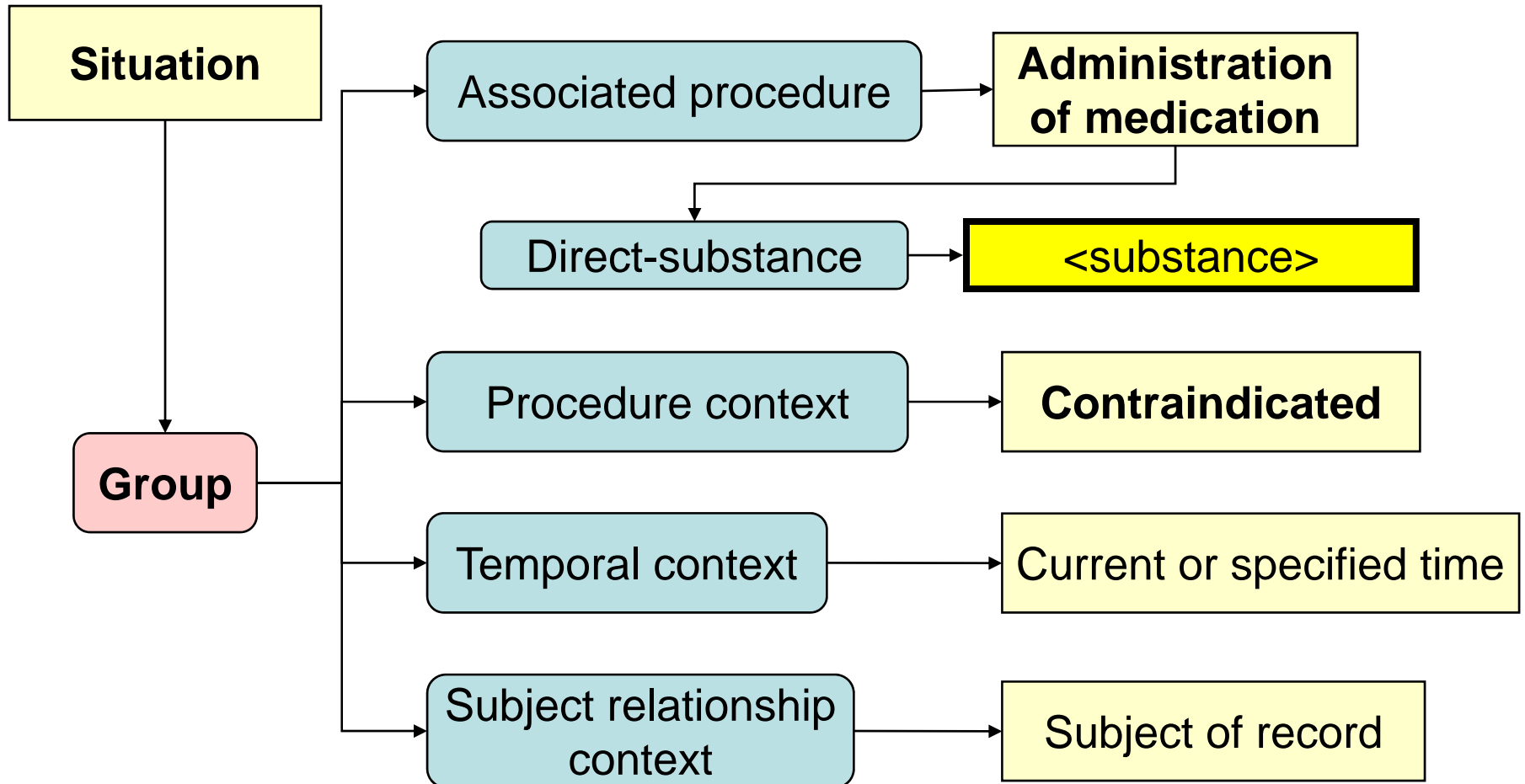
Procedure-not-done (<procedure>)

Neurological examination not done



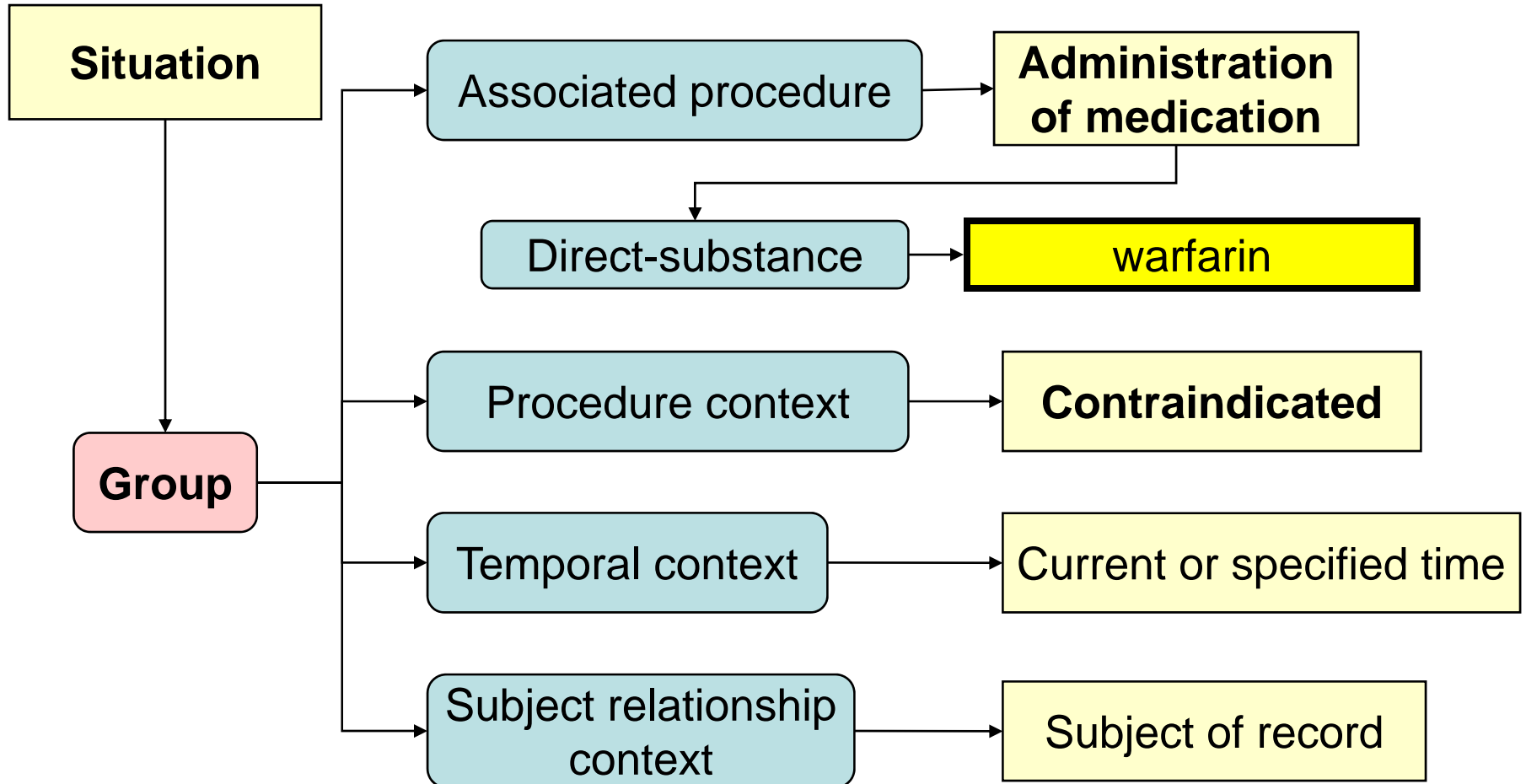
Procedure-not-done (neurological examination)

Drug contraindicated



Drug-contraindicated (<substance>)

Warfarin contraindicated

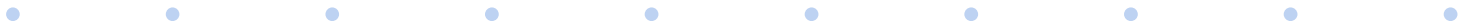


Drug-contraindicated (warfarin)

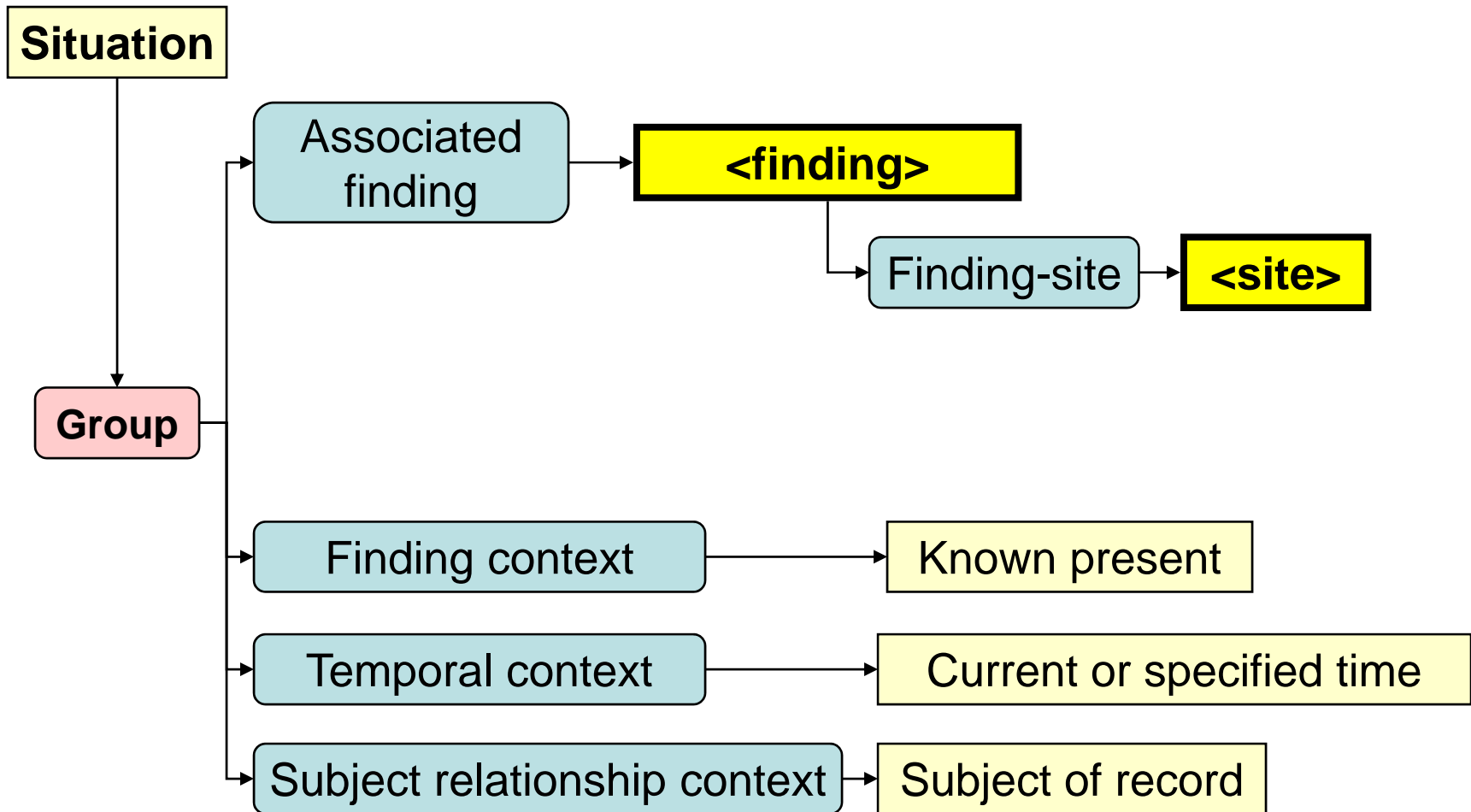


Add site to previous patterns

- Clinical finding present + site
- Clinical finding present + site + laterality
- Clinical finding absent + site
- Clinical finding absent + site + laterality

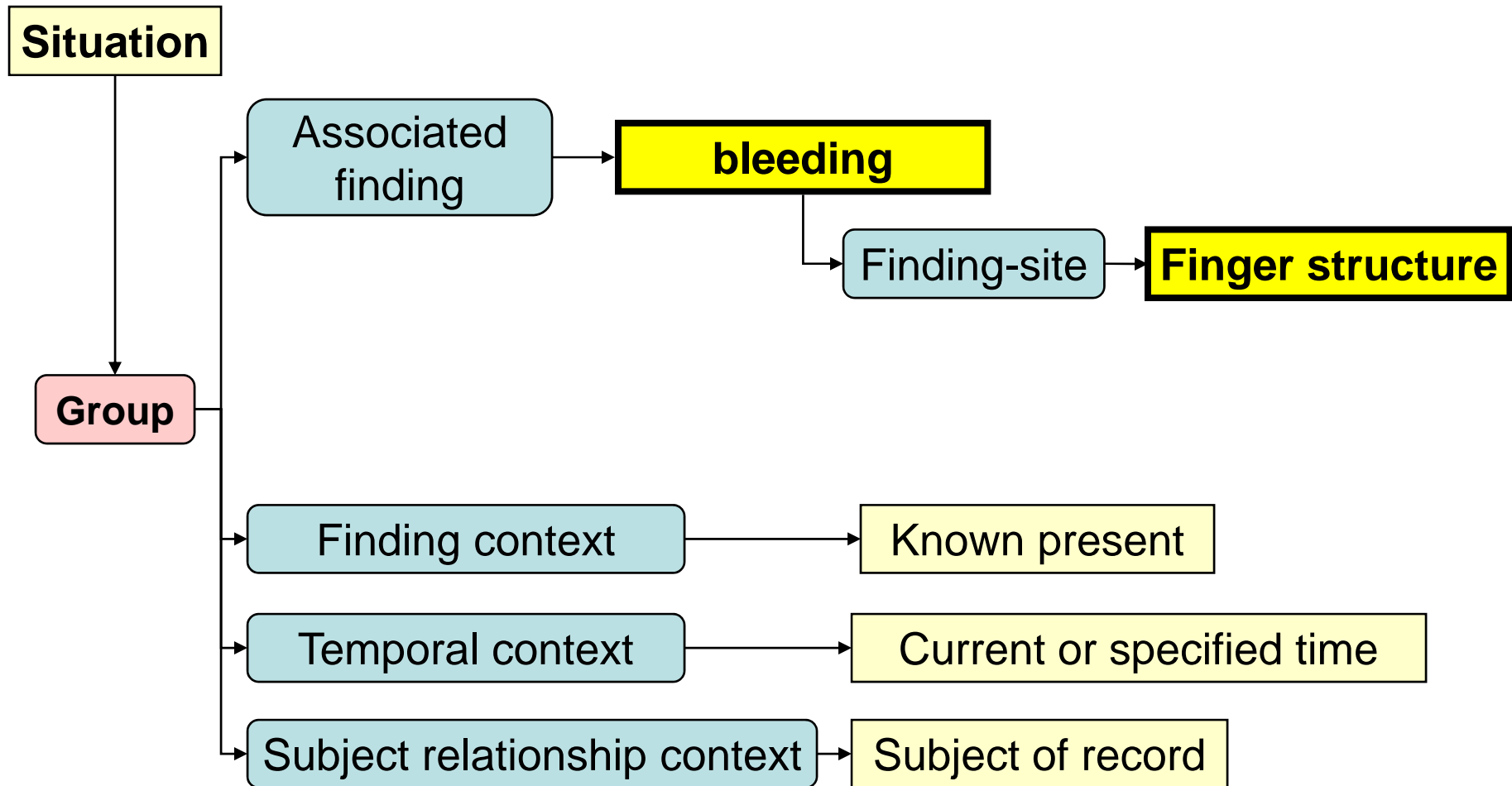


Clinical finding present + site



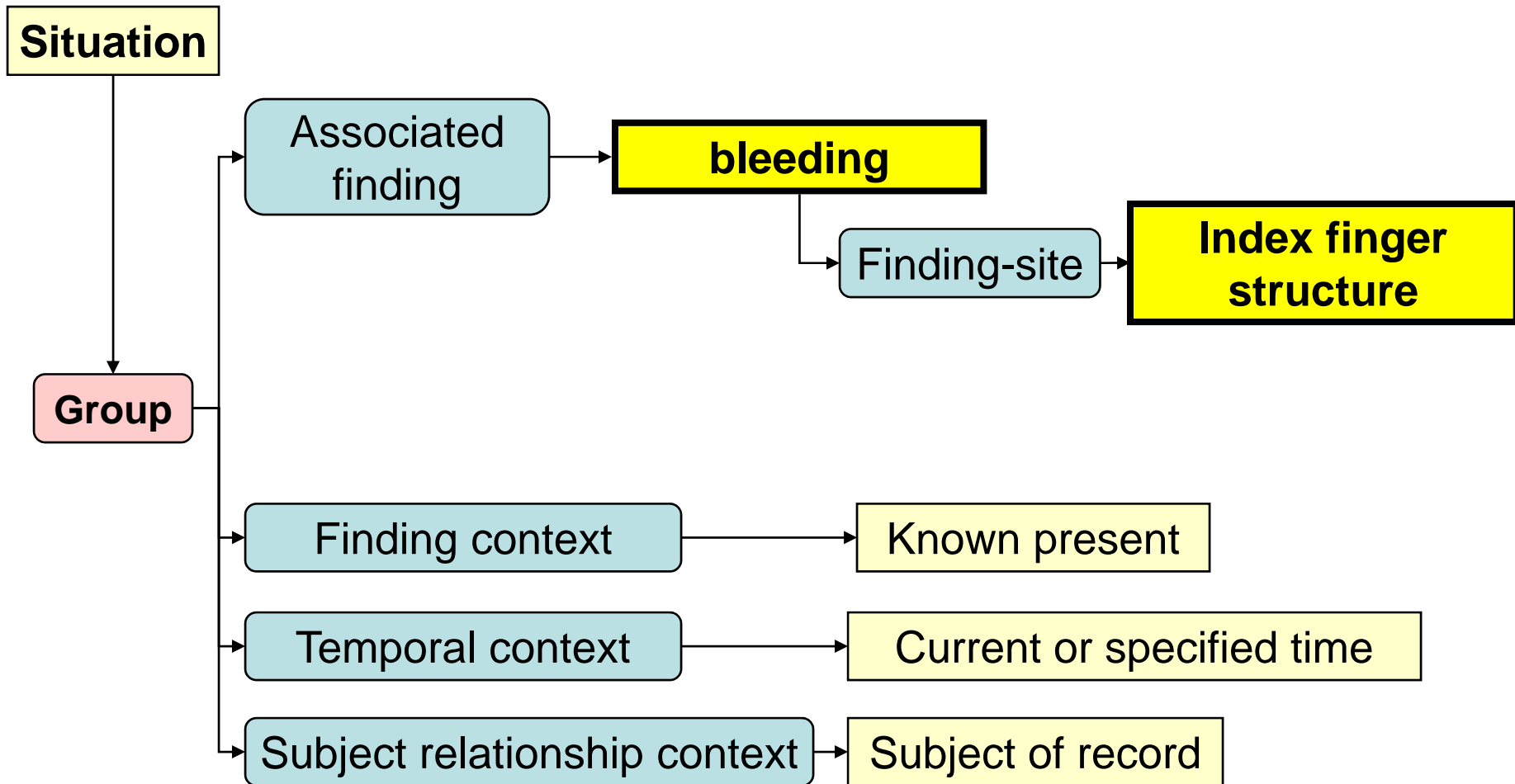
Clinical-finding-present-with-site (<finding>,<site>)

Bleeding finger



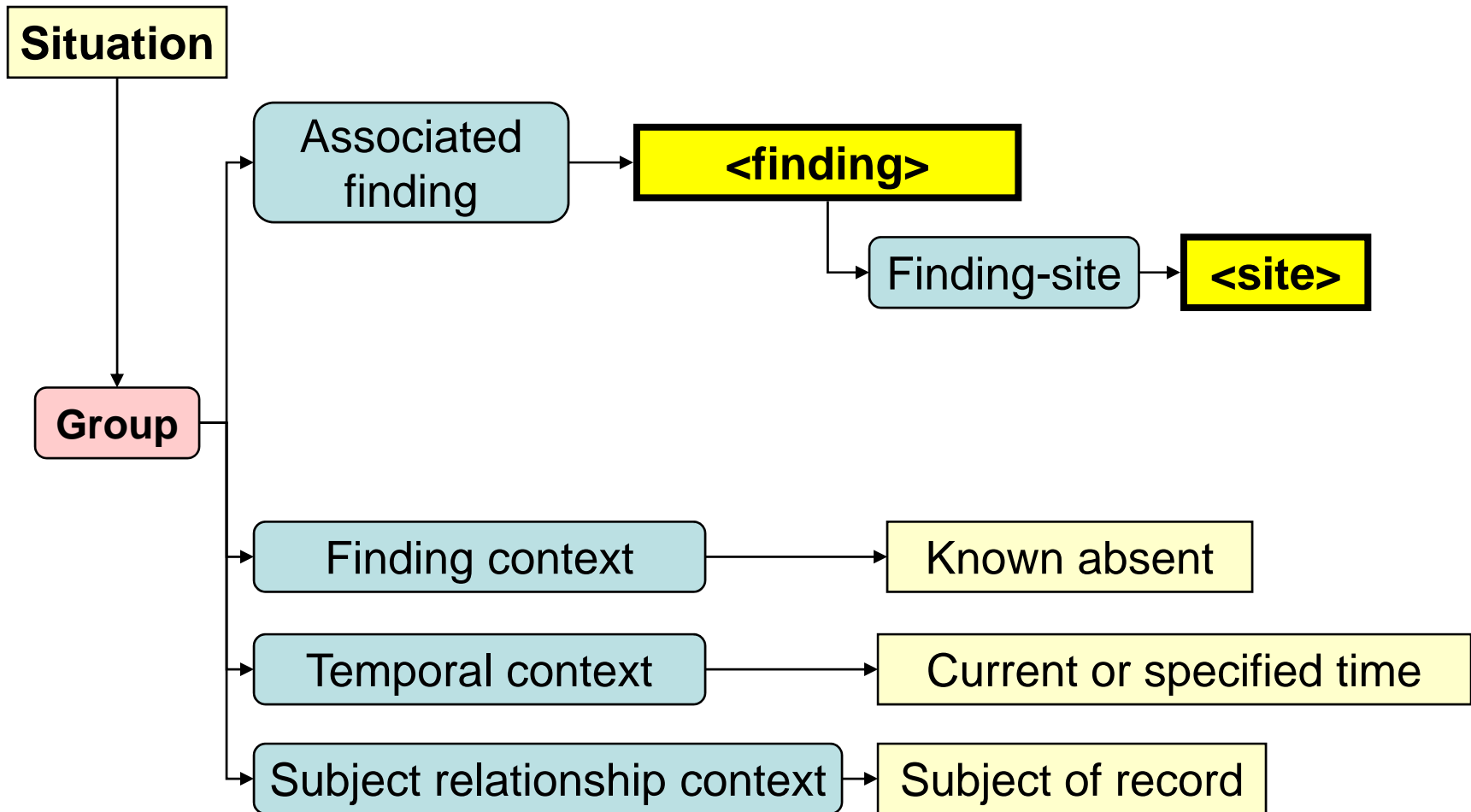
Clinical-finding-present-with-site (bleeding, finger structure)

Bleeding index finger



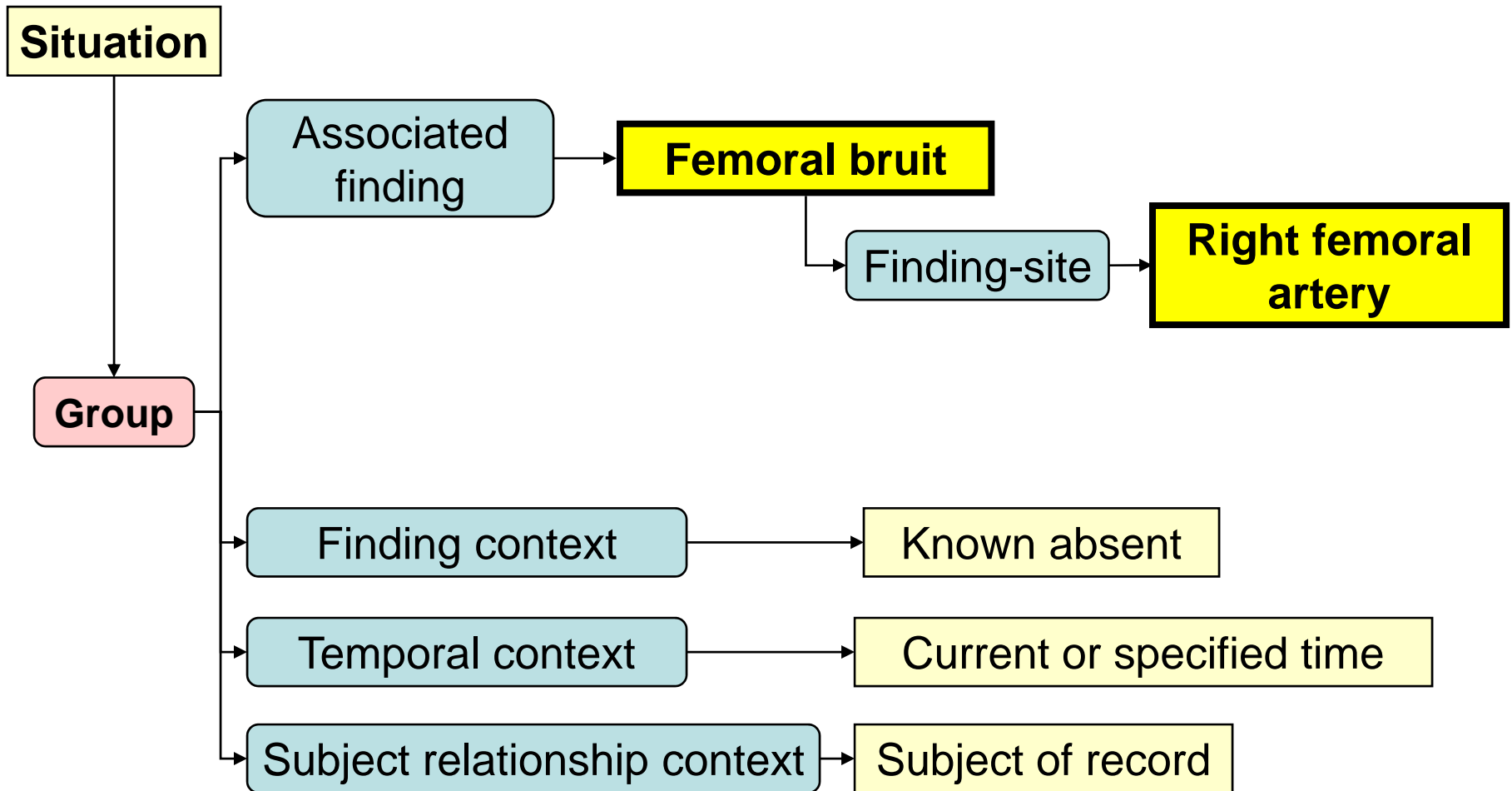
Clinical-finding-present-with-site (bleeding, index finger structure)

Clinical finding absent + site



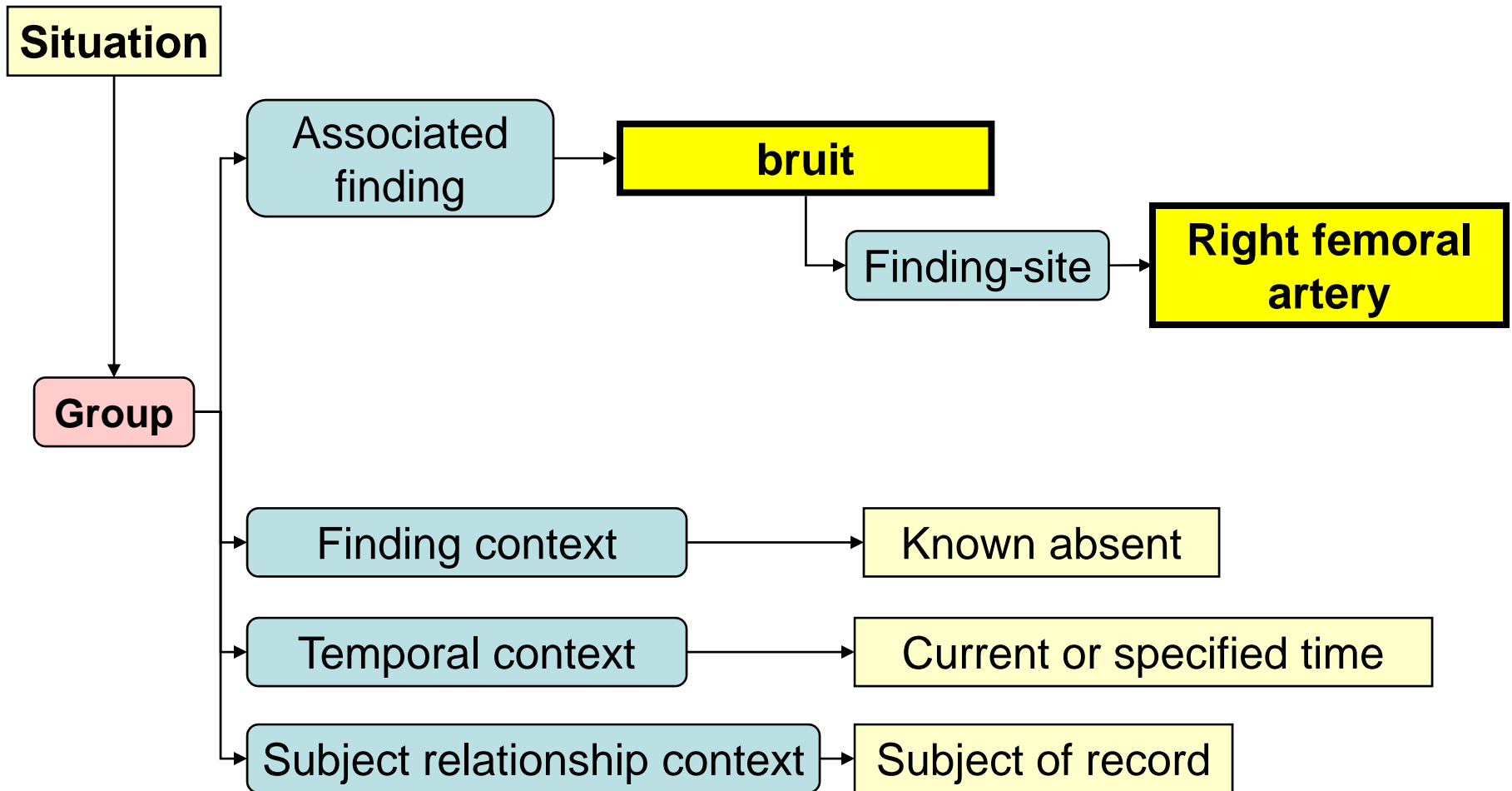
Clinical-finding-absent-with-site (<finding>,<site>)

No right femoral bruit



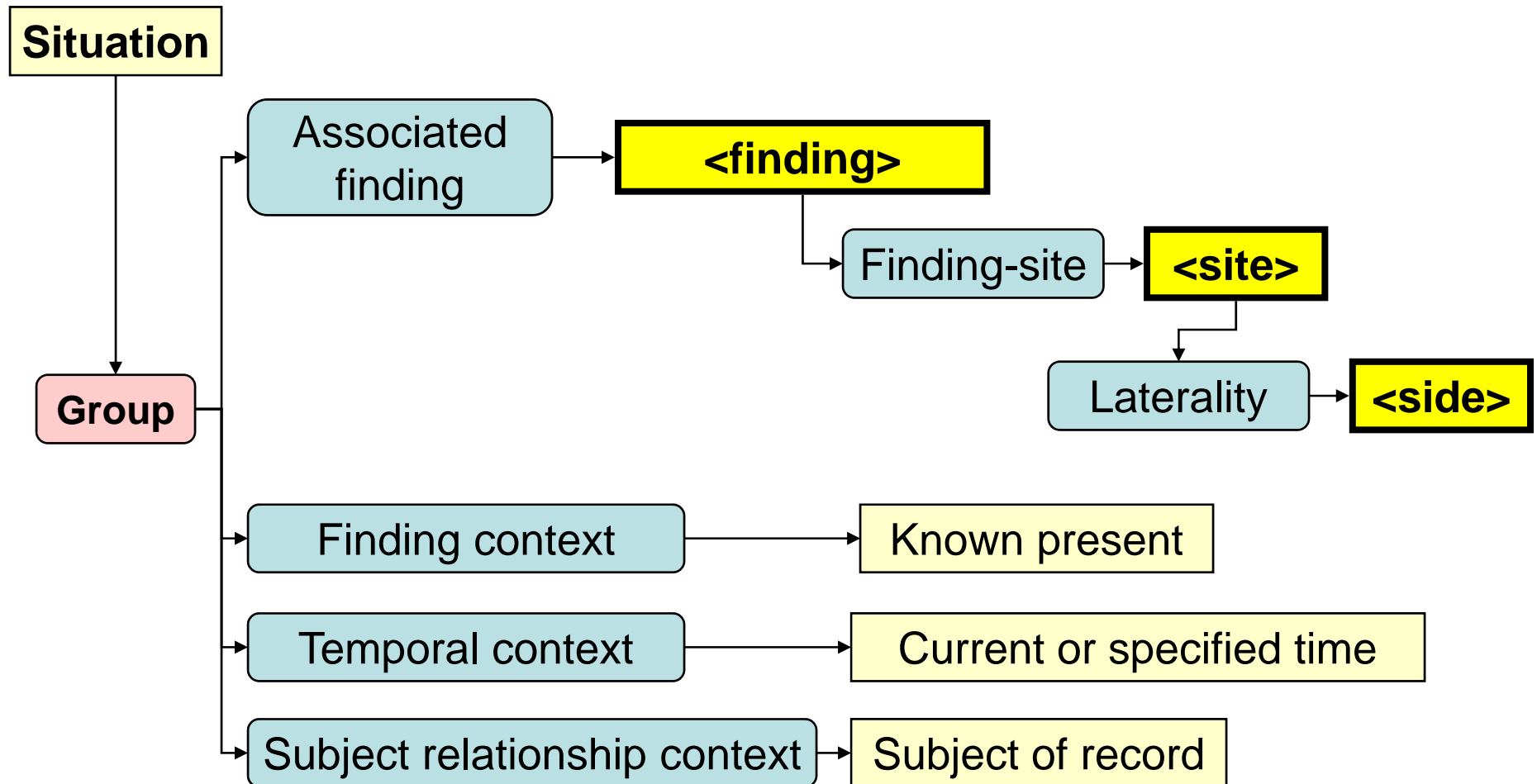
Clinical-finding-absent-with-site (femoral bruit, right femoral artery)

No right femoral bruit



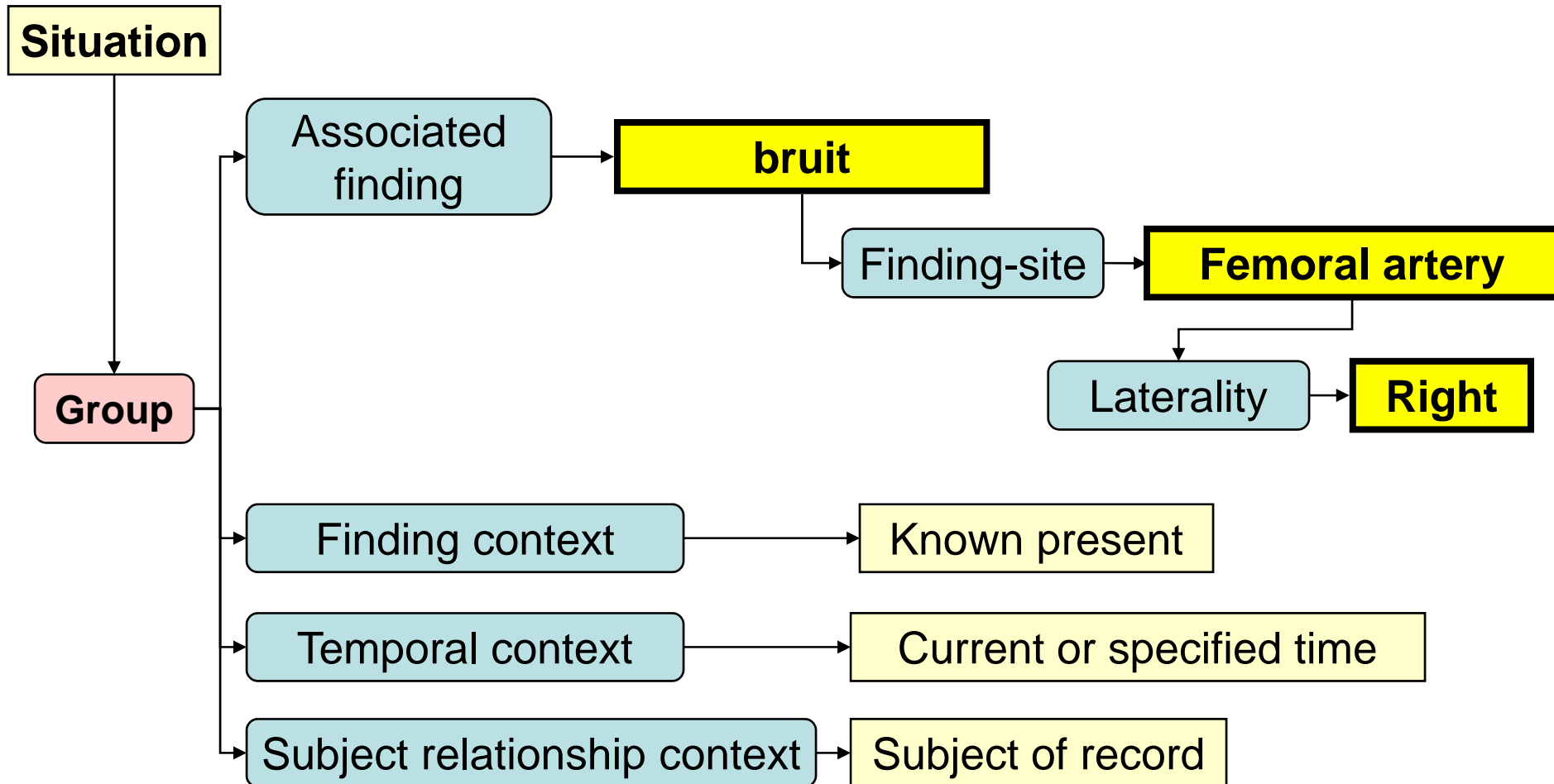
Clinical-finding-absent-with-site (bruit, right femoral artery)

Clinical finding present + site + side



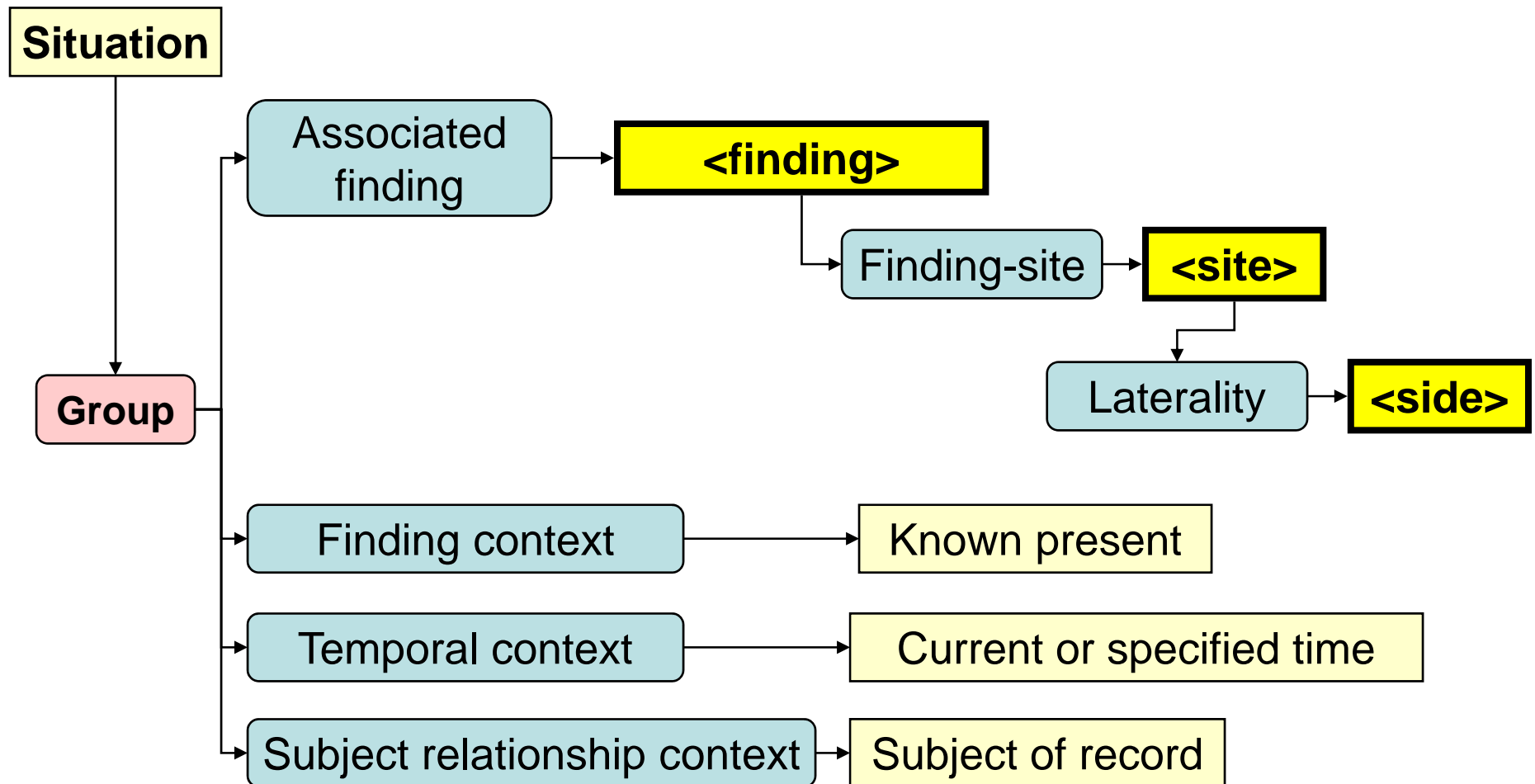
Clinical-finding-present-with-site-and-side (<finding>,<site>,<side>)

Right femoral bruit present



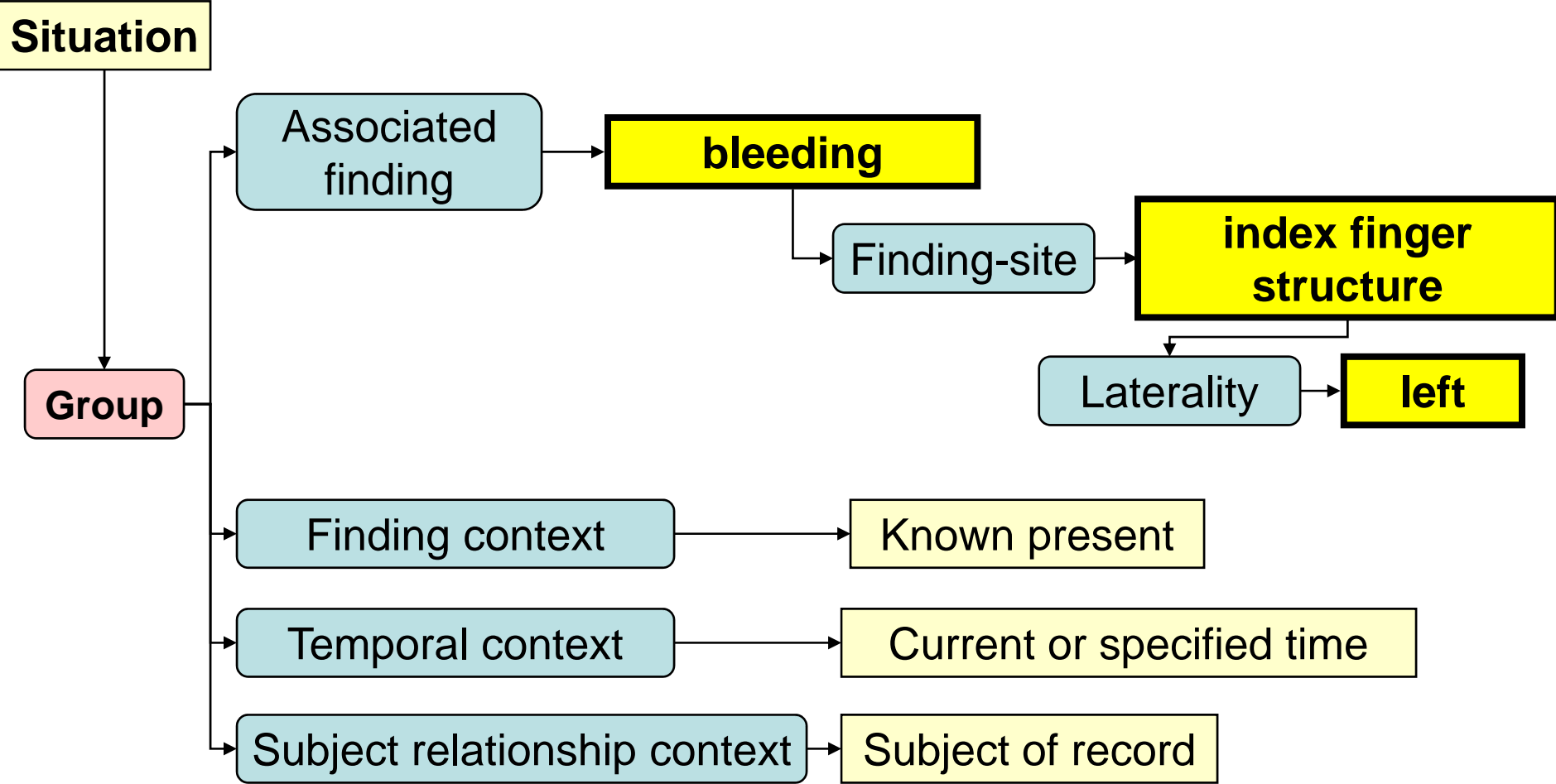
Clinical-finding-present-with-site-and-side (bruit, femoral artery, right)

Clinical finding present + site + side



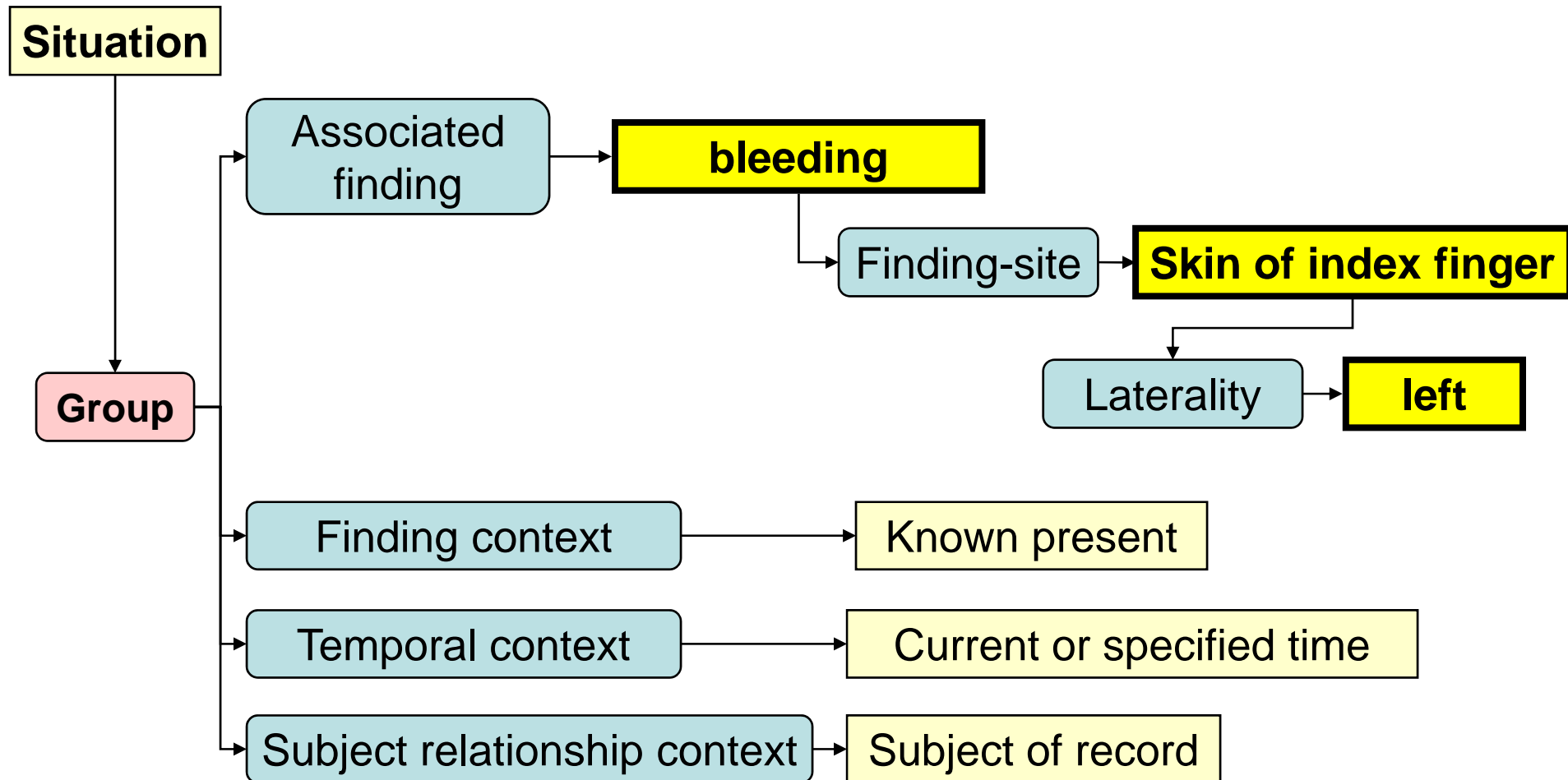
Clinical-finding-present-with-site-and-side (<finding>,<site>,<side>)

Bleeding of left index finger present



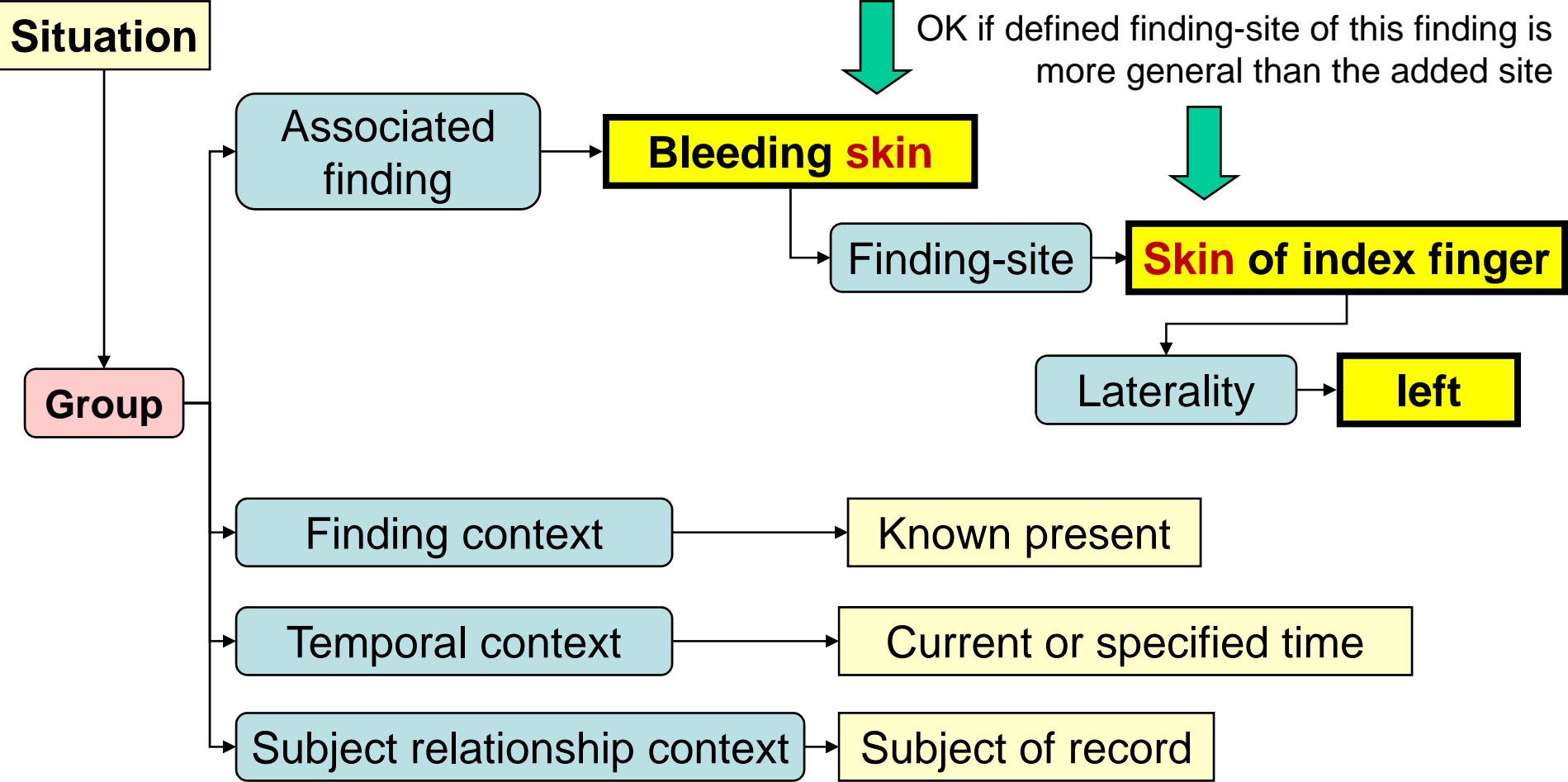
Clinical-finding-present-with-site-and-side (bleeding, index finger structure, left)

Bleeding skin, left index finger



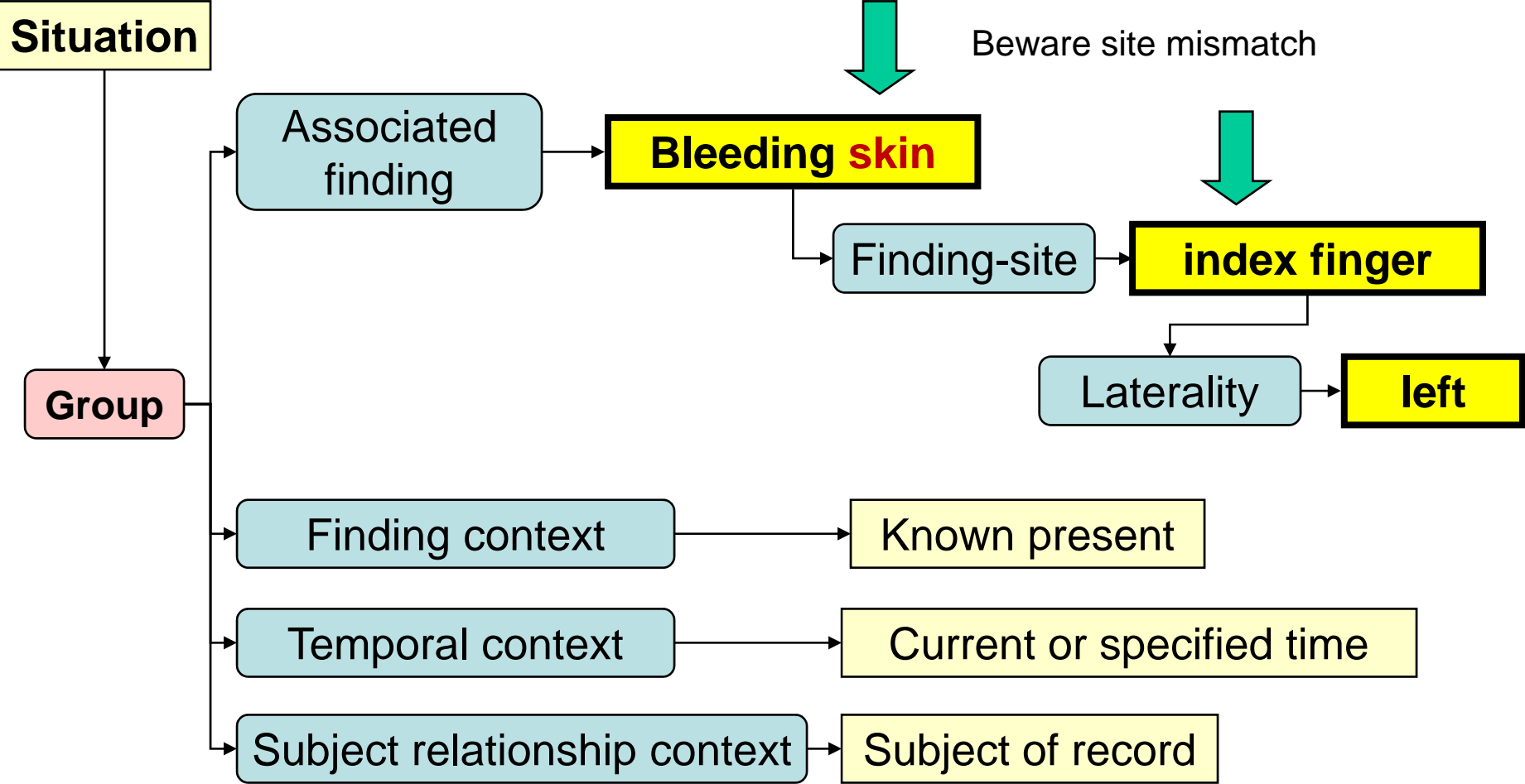
Clinical-finding-present-with-site-and-side (bleeding, skin of index finger, left)

Bleeding skin, left index finger



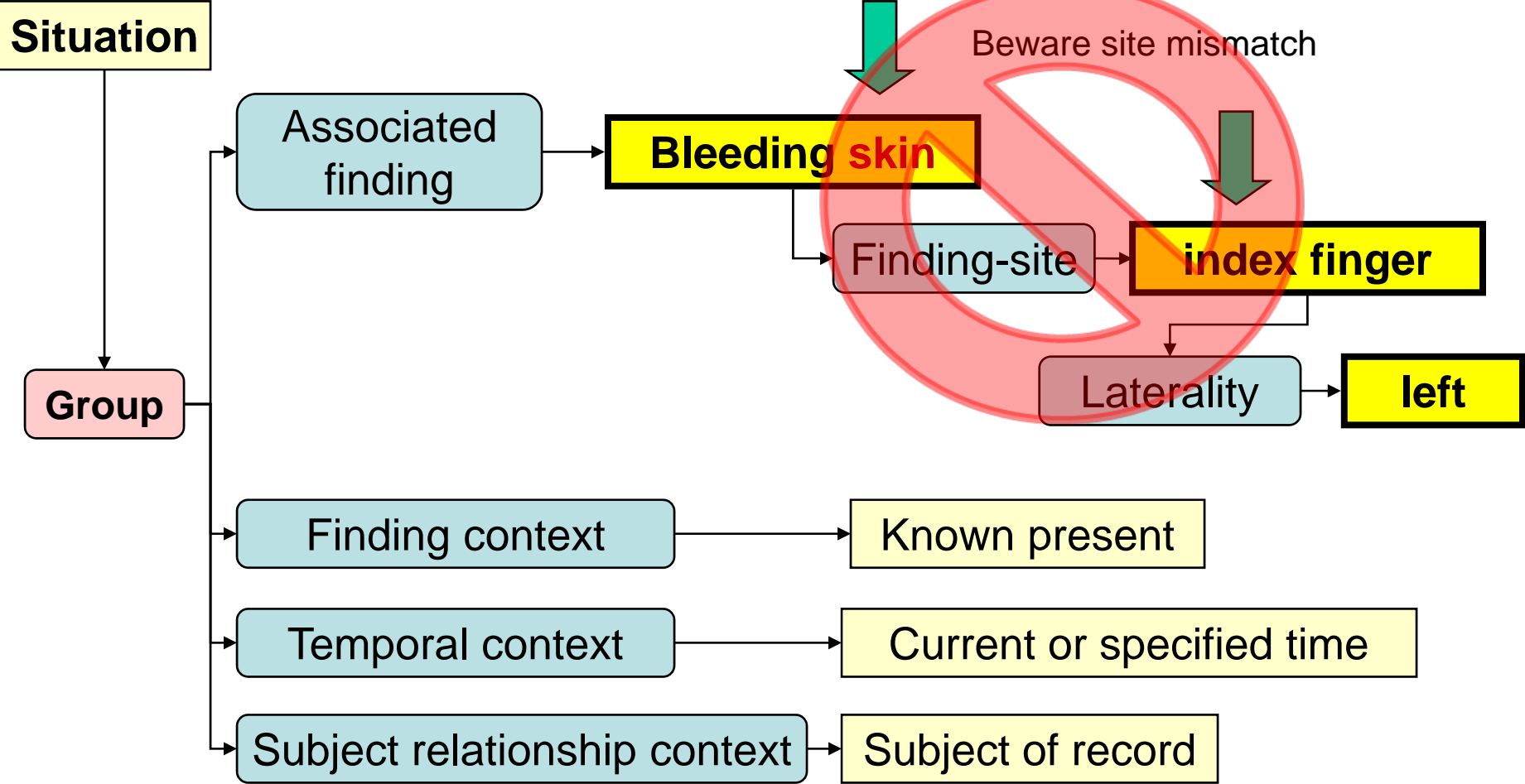
Clinical-finding-present-with-site-and-side
(bleeding skin, skin of index finger, left)

Bleeding skin, left index finger



Clinical-finding-present-with-site-and-side
(bleeding skin, index finger, left)

Bleeding skin, left index finger

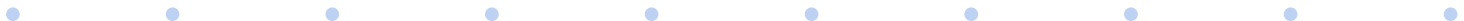


Clinical-finding-present-with-site-and-side
(bleeding skin, index finger, left)

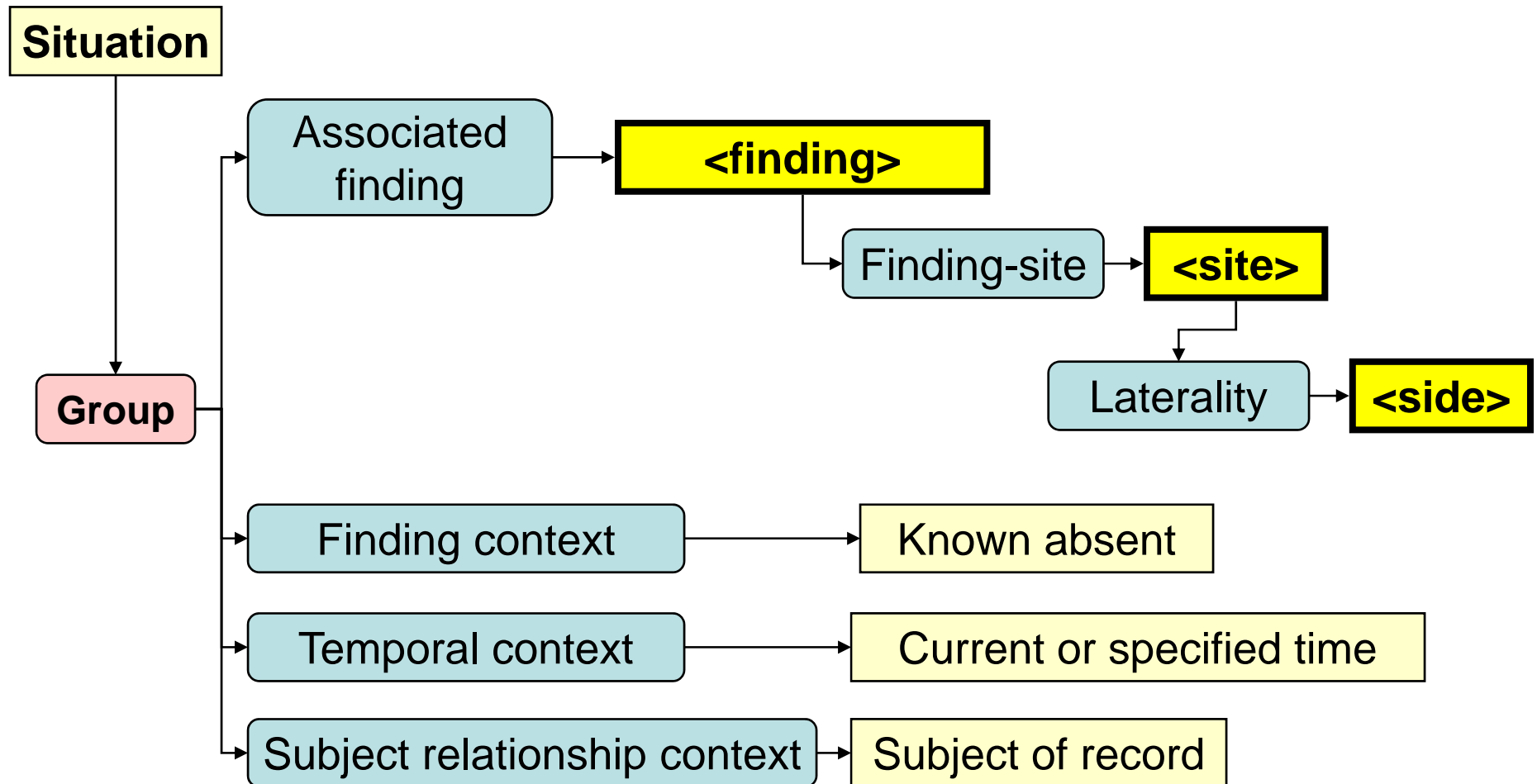


Frequent difficulty with sites

- Intersection of two modes of subdividing:
- For example, intersection of constitutional parts (skin, vein, nerve, muscle) with regional parts (finger, lower limb, scapular region, lower leg)
 - skin + index finger
 - vein + lower limb
 - nerve + scapular region
 - muscle + lower leg
- Current solution: precoordinate the combined sites and be sure to attach all subtypes

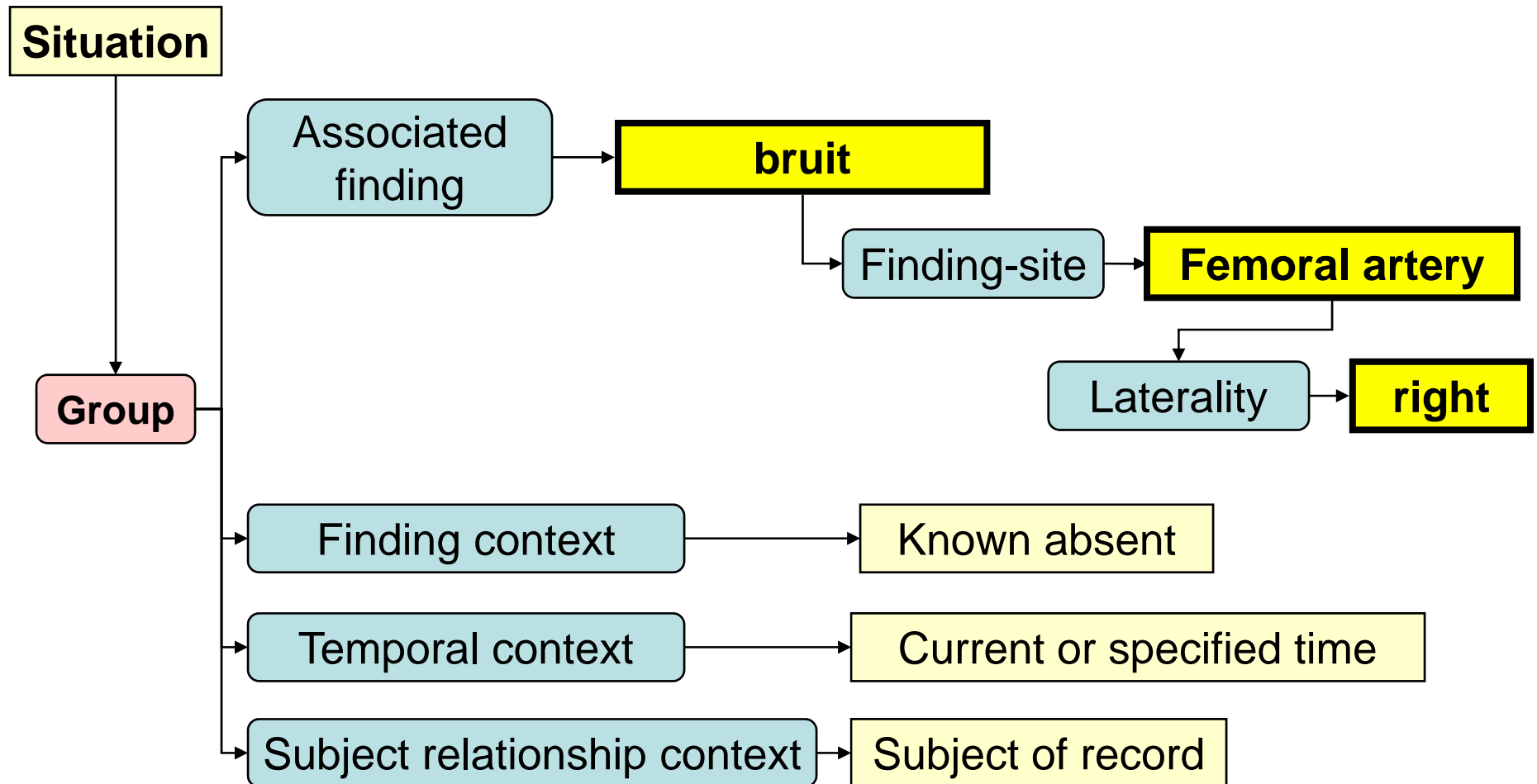


Clinical finding absent + site + side



Clinical-finding-absent-with-site-and-side (<finding>,<site>,<side>)

No right femoral bruit



Clinical-finding-absent-with-site-and-side (bruit, femoral artery, right)

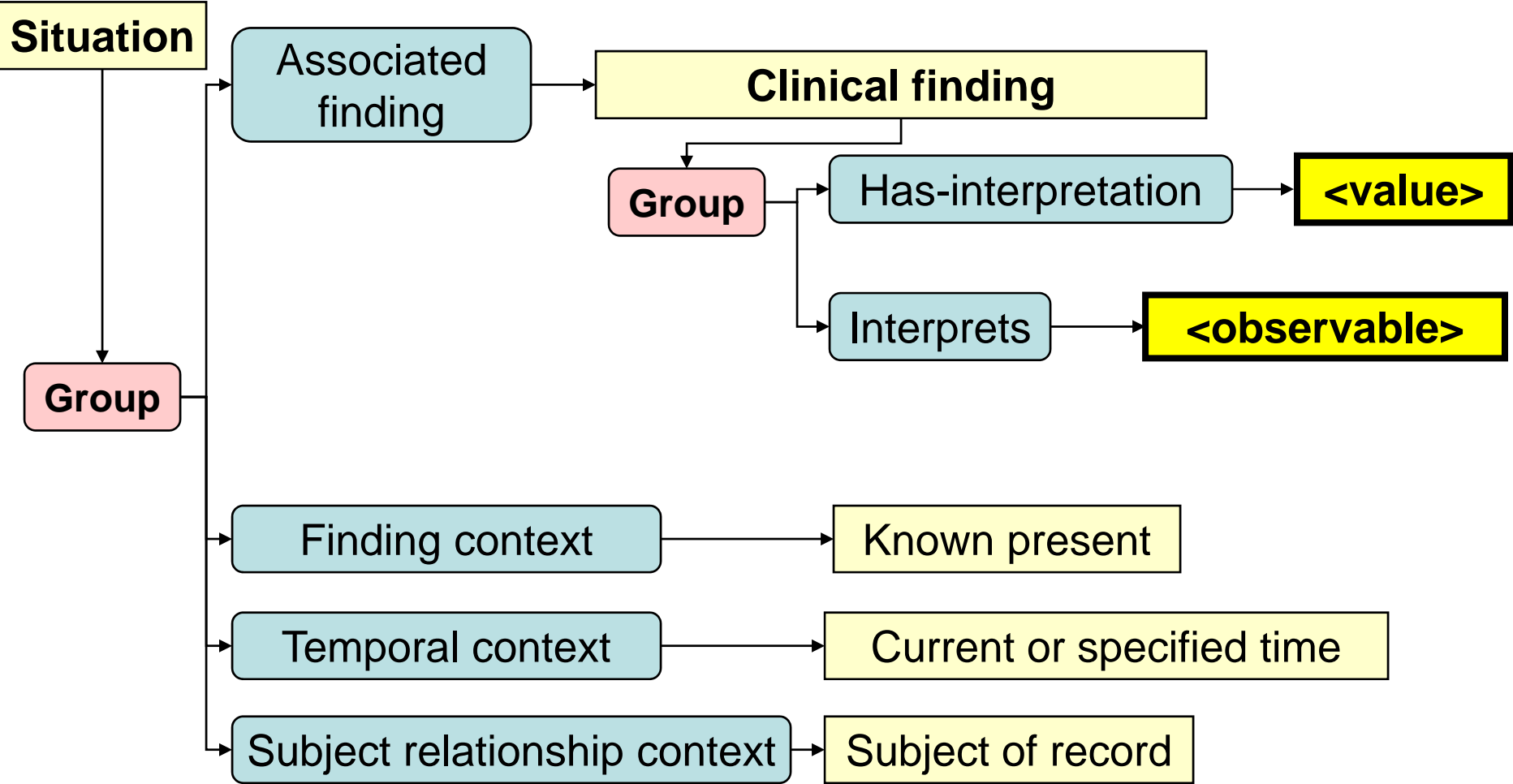


Using observables

- Finding present + observable + value (old pattern)
- Observation result + observable + value + site (new pattern – see observables project)

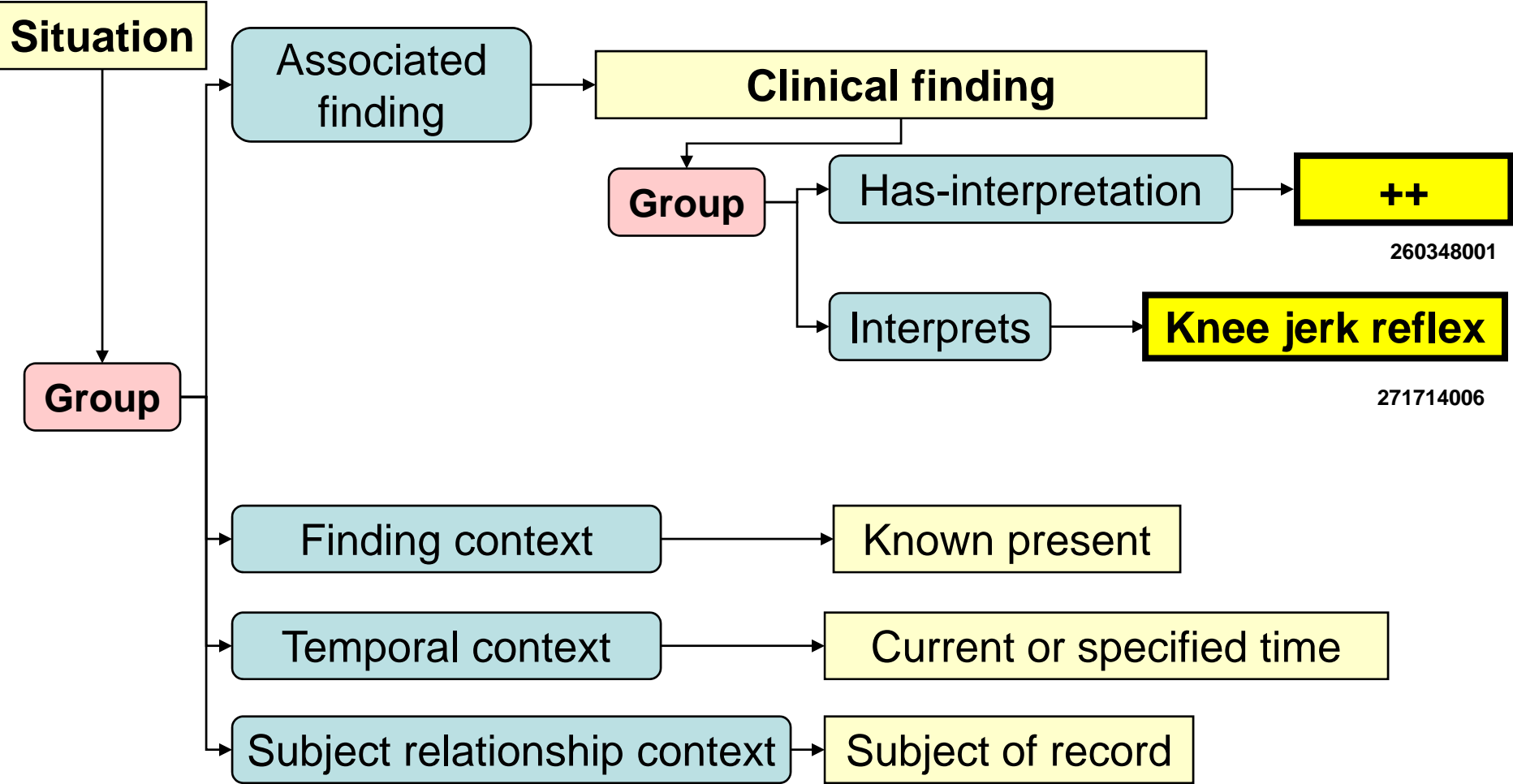


Finding present, observable + value



Finding-present-observable-value (<observable>,<value>)

Knee jerk reflex 2+ (out of 4)



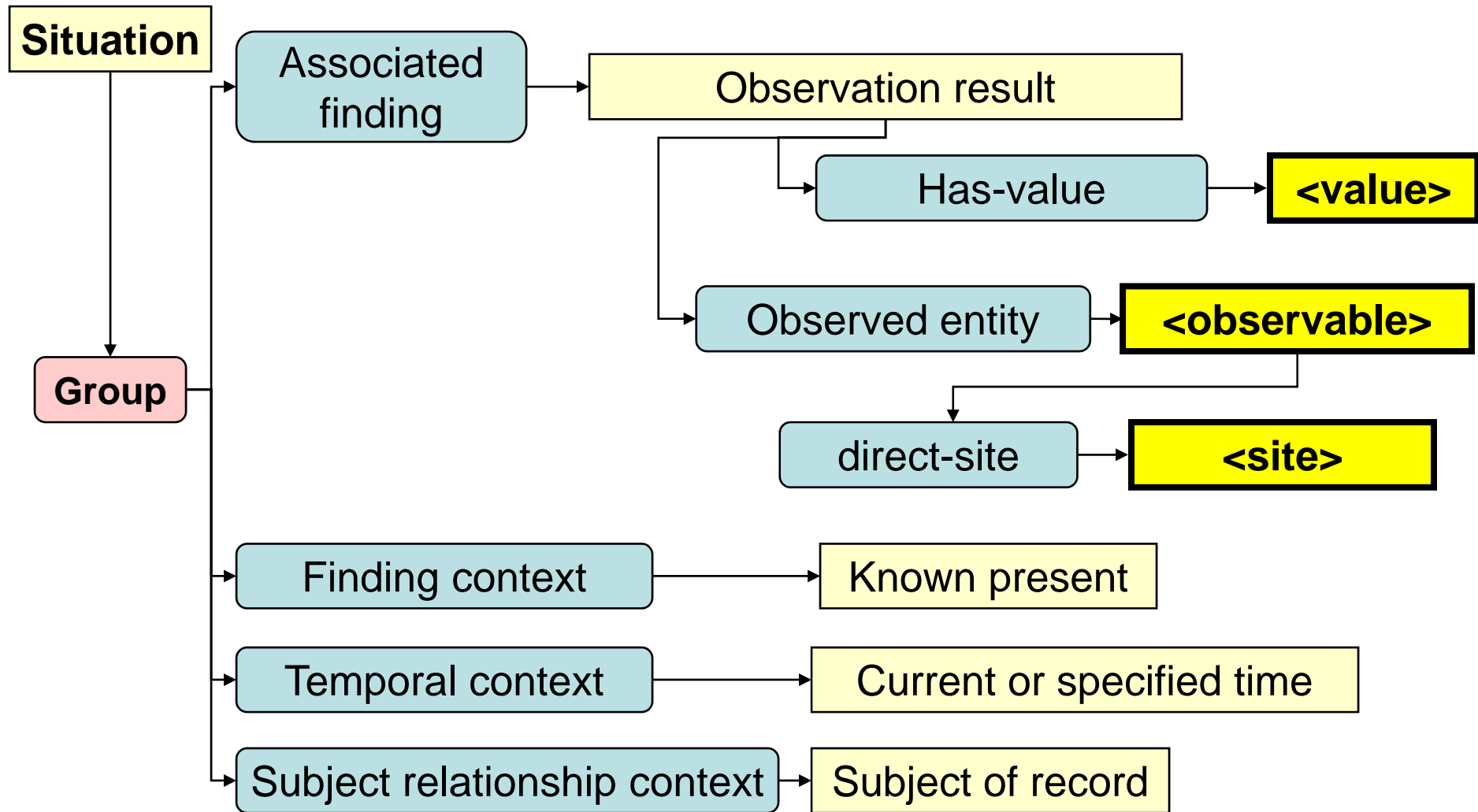
260348001

271714006

Finding-present-observable-value (knee jerk reflex,++)

Observation result + value + site

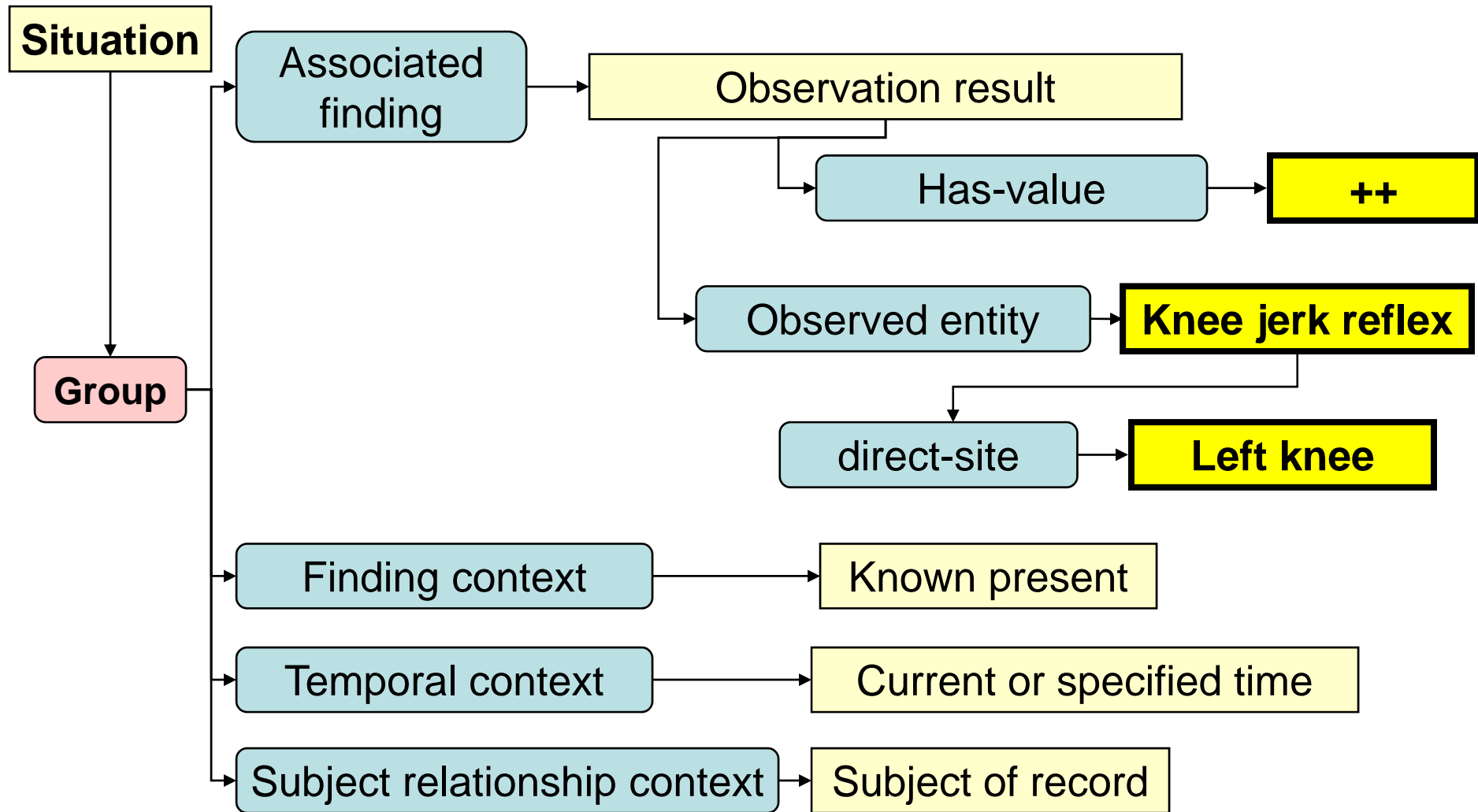
(assuming we approve new model for observation results)



Observation-result-site-value (<observable>,<site>,<value>)

Left knee jerk reflex ++

(assuming we approve new model for observation results)

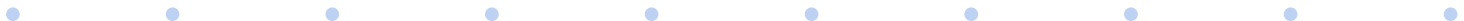


Observation-result-site-value (knee jerk reflex, left knee,++)

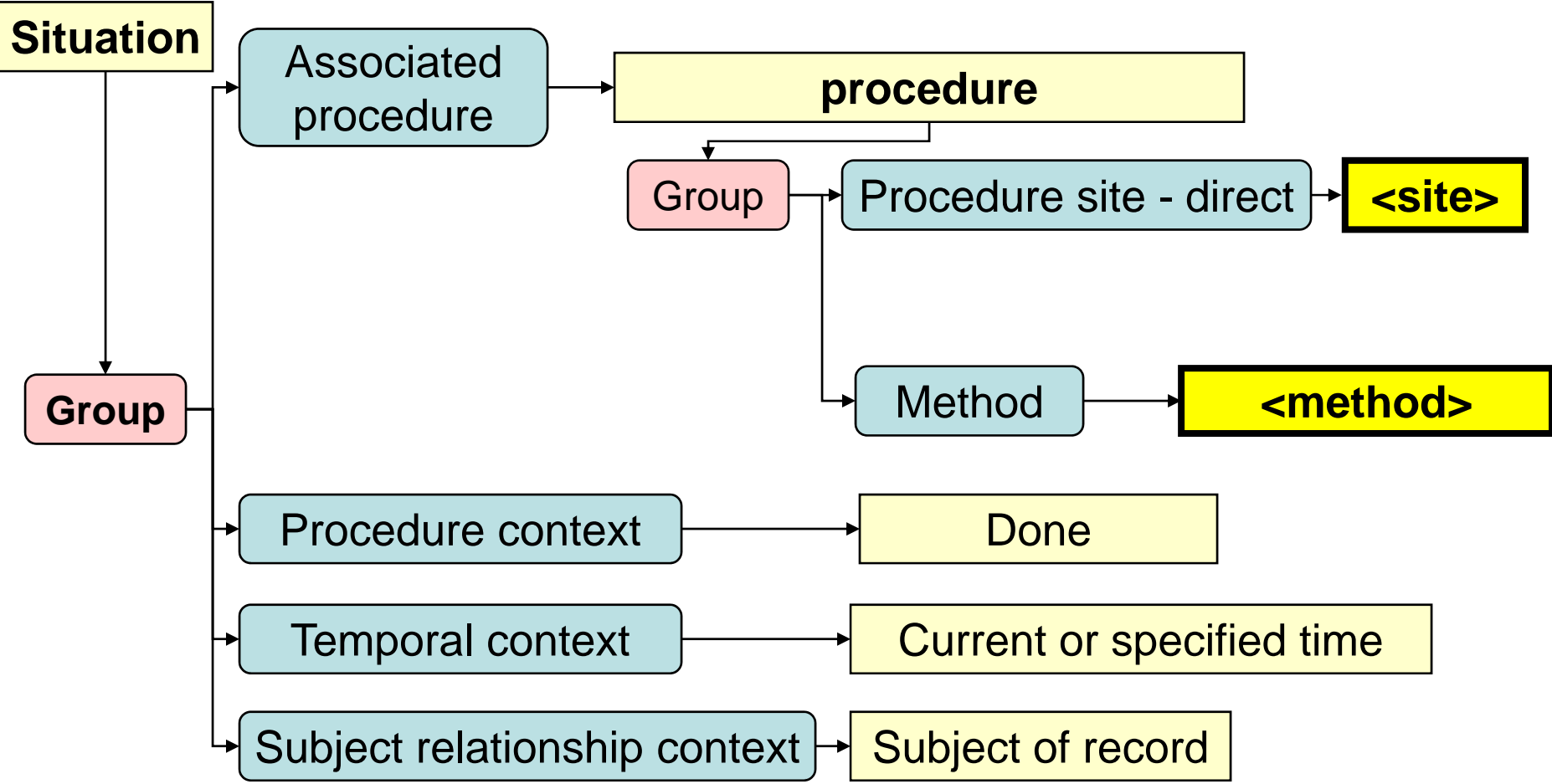


Procedure patterns

- Procedure done + method + site
- Procedure done + method + site + laterality

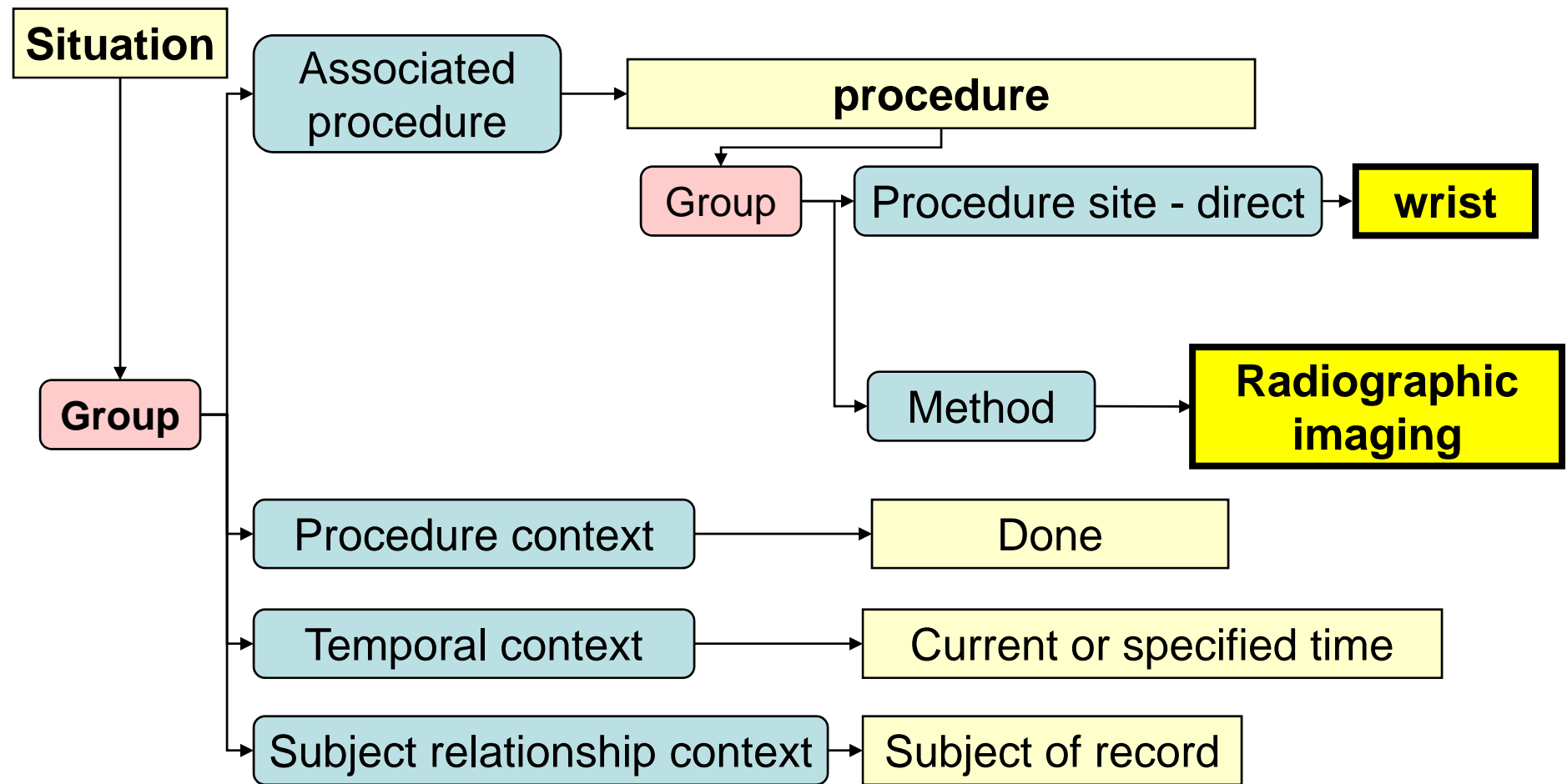


Procedure done, method+site



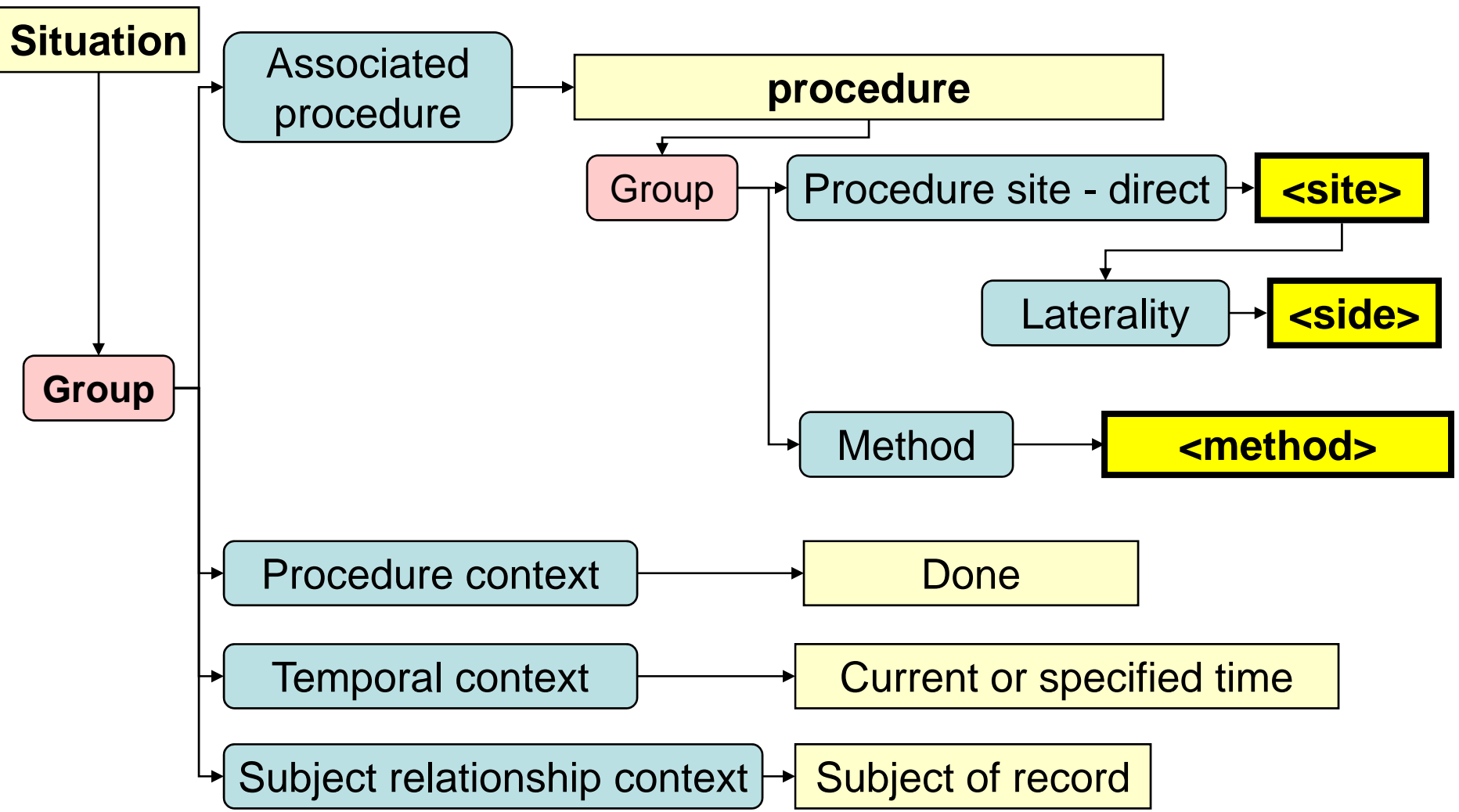
Procedure-done-plus-method-site (<method>,<site>)

X-ray of wrist done



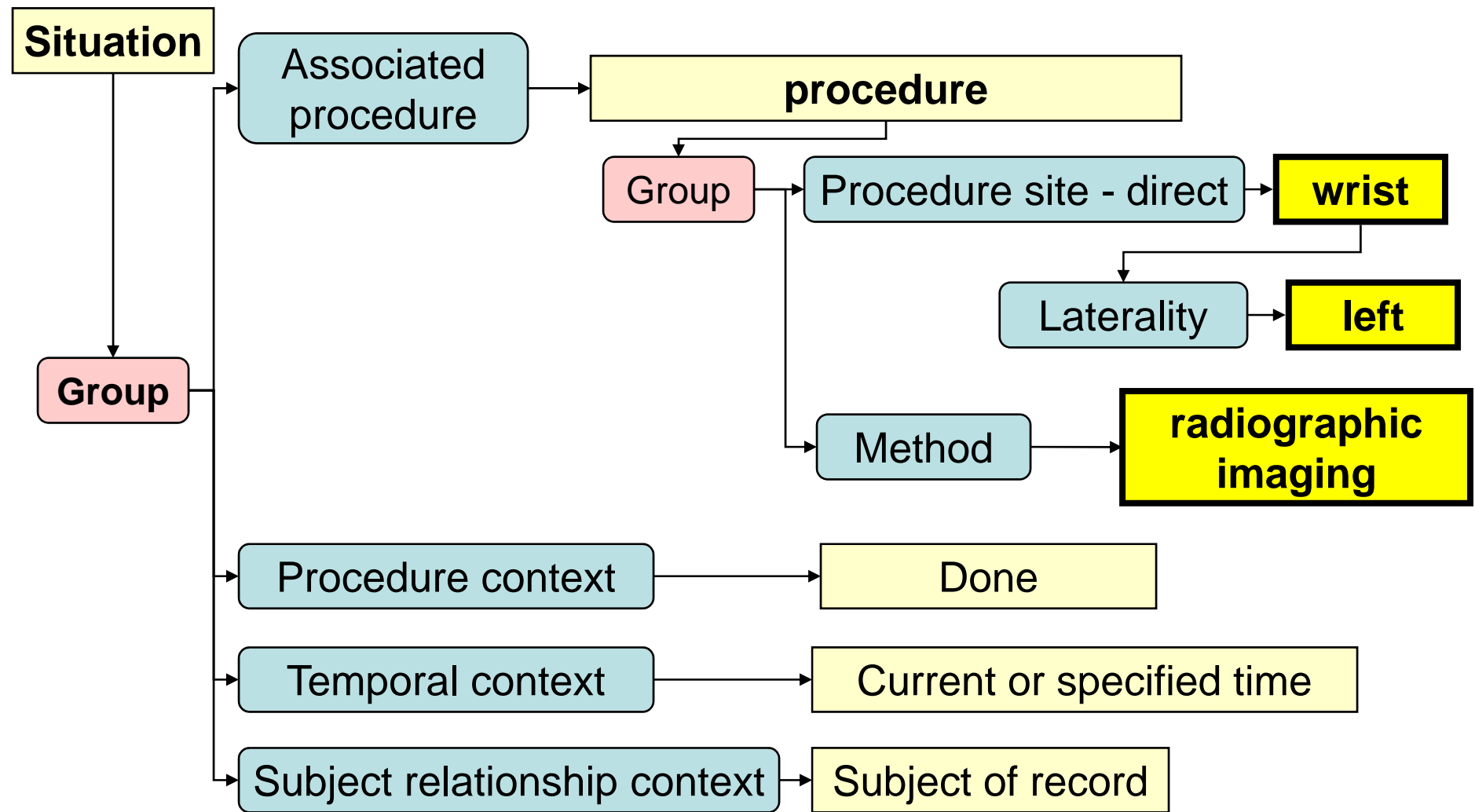
Procedure-done-plus-method-site (x-ray, wrist)

Procedure done, method+site+side



Procedure-done-method-site-side (<method>, <site>, <side>)

X-ray of left wrist done

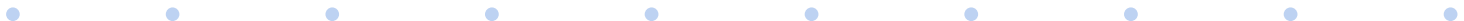


Procedure-done-method-site-side (radiographic imaging, wrist, left)

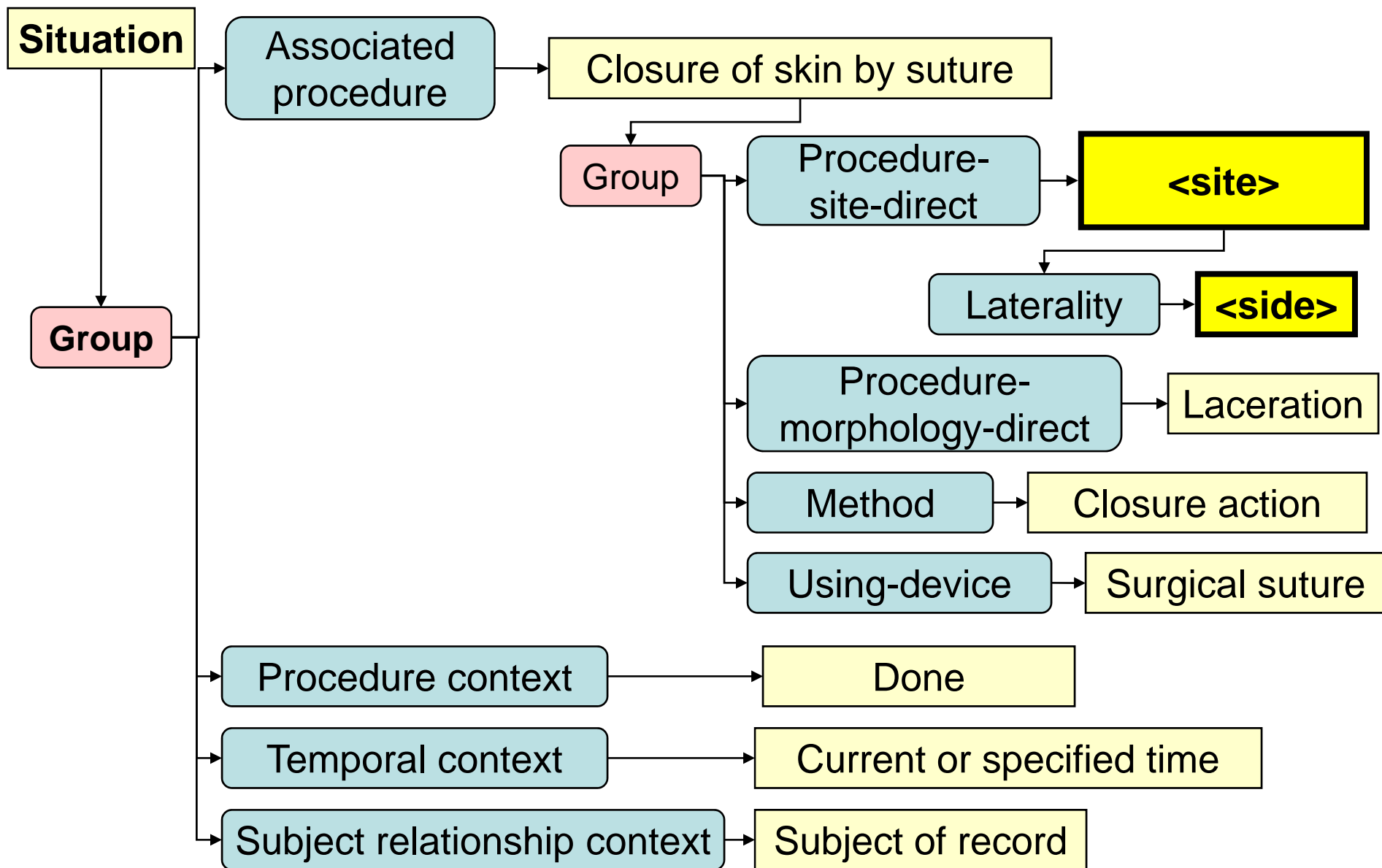


More specific patterns also possible

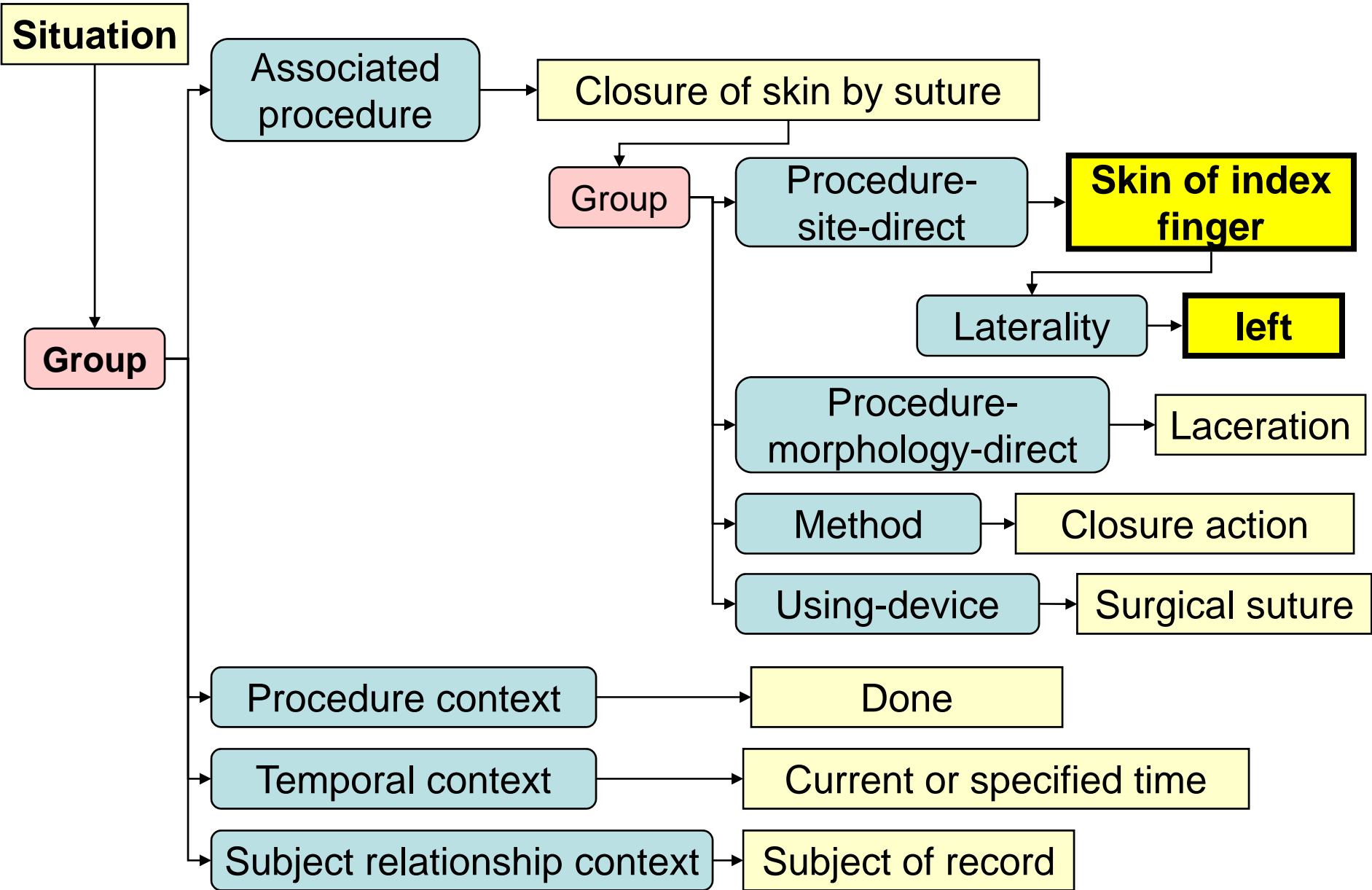
- For example:
 - Suture of skin done + site + laterality



Suture of skin done, site + side



Suture of laceration of skin of left index finger: done



Review of some of the examples recorded as patterns & post-coordinated in a table

Concept name	Pattern name	Variable 1	Variable 2	Variable 3
Severe pain in left thumb	My-pain-pattern	Thumb	Left	Severe
Tetanus booster given	Procedure done	Booster tetanus vaccination		
Bleeding of skin present	Clinical finding present	Bleeding of skin		
Triceps reflex ++	Observation result + observable + value	Triceps reflex	++	
No right femoral bruit	Clinical finding absent	Bruit	Right femoral artery	
X-ray of left wrist done	Procedure done	Radiographic imaging - action	Wrist structure	Left
Suture of laceration of skin of left index finger: done	Suture of skin done, site+side	Skin of index finger	Left	