VeriCliG: Extraction and Verification of Clinical Guidelines via Syntactic and Semantic Annotation

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Outline

Problem - CIG Extraction

- We want to extract process representations from clinical guidelines

  1. basic tool in hospitals and clinics [Got12]
  2. describe state-of-the art therapies
  3. implemented in workflow and decision support systems
  4. processed manually
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  4. control flows (e.g., conditional, sequential, parallel)
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QUE: Use (clinical) NLP annotation to extract CIGs?

Process Extraction - Diabetes 2 NCCN

> 1.5.1.2 Emphasise advice on healthy balanced eating that is applicable to the general population when providing advice to people with type 2 diabetes.
>
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⇒ Apply business process extraction techniques [FMP11]

⇒ Distinguish

1. control-flow words (= discourse relations)
2. activity, resources and actor words (= content words)

NLP Annotation - Combining Resources

$\boxed{\textit{Continue}}$ $\boxed{\textit{with}\ \texttt{metformin}}$ *if* $\boxed{\texttt{blood glucose control}}$ $\boxed{\textit{remains}}$

Continue ⇓ reg. activity — with metformin ⇓ pharm. substance — blood glucose control ⇓ laboratory procedure — remains ⇓ ql. concept

$\boxed{\texttt{inadequate}}$ *and* $\boxed{\textit{another}\ \texttt{oral glucose-lowering medication}}$ *is* $\boxed{\textit{added}}$.

inadequate ⇓ ql. concept — another oral glucose-lowering medication ⇓ therapeutic procedure — added ⇓ fc. concept

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        (S (S (NP (NN blood) (NN glucose) (NN control))
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           (CC and)
           (S (NP (DT another) (JJ oral) (JJ glucose-lowering)
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activity evoking
resource evoking
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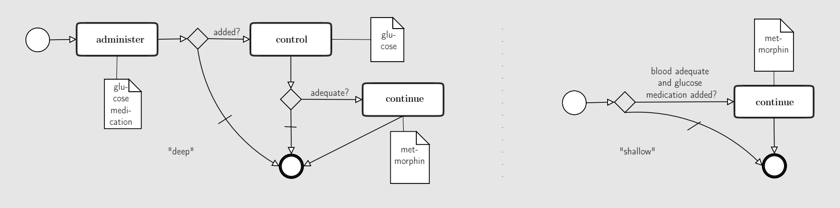
⇒ MetaMap & UMLS [AL10] finds activities, resources and actors

⇒ Stanford parser [dMMM06] finds discourse relations

CIG & Process Granularity



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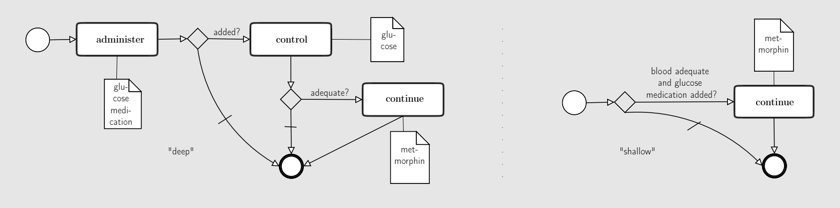

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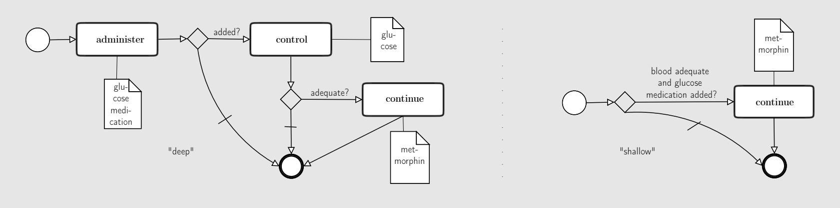

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1. no clear clinical meaning for control-flow evoking words !
2. no clear evaluation methodology !

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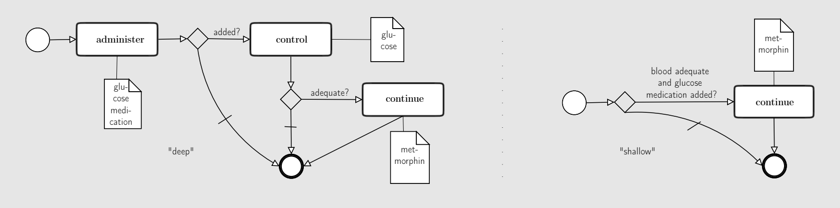

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⇒ Surface-level clinical language peculiarities deceptive

Linguistic Patterns - PEWs and NEGs

⇒ We checked control-flow evoking words (PEWs)

1. conjunctions and prepositions **IN**s (subordinating prepositions, e.g., "if") **CC**s (coordinating conjunctions, e.g., "and", "or") **CC**s (subordinating conjunctions, e.g., "then")
2. adverbs: **RB**s (base adverbs, e.g., "after") **RBR**s (comparative adverbs, e.g., "later") **RBT**s (superlative adverbs, e.g., "latest") **RN**s (nominalized adverbs, e.g.,) **RP**s (adverbial particles, e.g.,)

⇒ We also checked negative rules (NEGs)

1. "not", of category ***** (i.e., negation); "nobody", "none" and "nothing", of category **PN**, the negative determiner "no" of category **AT**
2. negated modal verbs of category **MD*** (e.g., "cannot", "will not").

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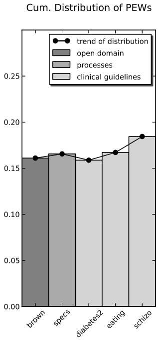
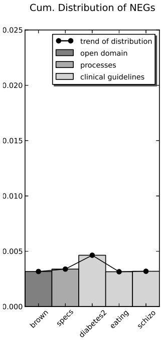
QUE: Distribution uniform across domains or correlated to clinical domain?

PEWs and NEGs - Uniform & Uncorrelated

Distrib.	χ^2-ind.	p (< 0.001 sig.)	df.	t-one way	μ_0	p (< 0.01 sig.)	df.
PEWs	9.39	0.009	2	1.02	0.20	0.36	4
NEGs	1.96	0.375	2	1.02	0.03	0.36	4





(Corpus)	(# Words)	(Domain)
Brown	1,391708	Open
Business	3,824	Business
Diabetes 2 guid.	7,109	Clinical
Eating dis. guid.	5,078	Clinical
Schizophr. guid.	5,367	Clinical

Current Work Plan

- Refine control-flow extraction methodologies
- Develop a methodology to evaluate process-mining rules vis-à-vis supervised techniques
- Use existing annotated corpora (e.g., SemRep) to understand how to disambiguate MetaMap/UMLS
  1. activity annotations
  2. resource annotations
  3. actor annotations
- Design ways to merge/integrate/link annotated datasets to experiment with supervised annotators

Thank you :-)

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