Natural Language Understanding of Clinical Practice Guidelines

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Introduction

We present a framework for automatic natural language understanding of clinical practice guideline (CPG) text called Clinical Tractor.

Context: Automatic Computer Interpretable Guideline Generation

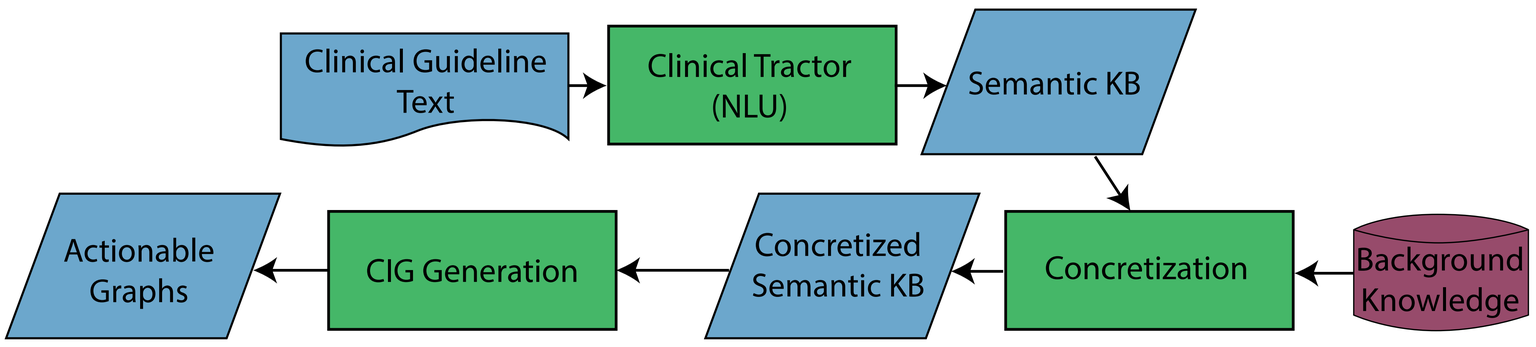

Figure 1. Overall system architecture for a guideline understanding and formalization system.

NLU with Clinical Tractor

Re-imagining the Tractor[1] natural language understanding system for the clinical domain

- Previously applied to the counter-insurgency domain – short intelligence messages
- Standardized XML input using a custom format combining JATS and GraphML
- Rule-based syntax to semantics transformation after text processing and importing background knowledge

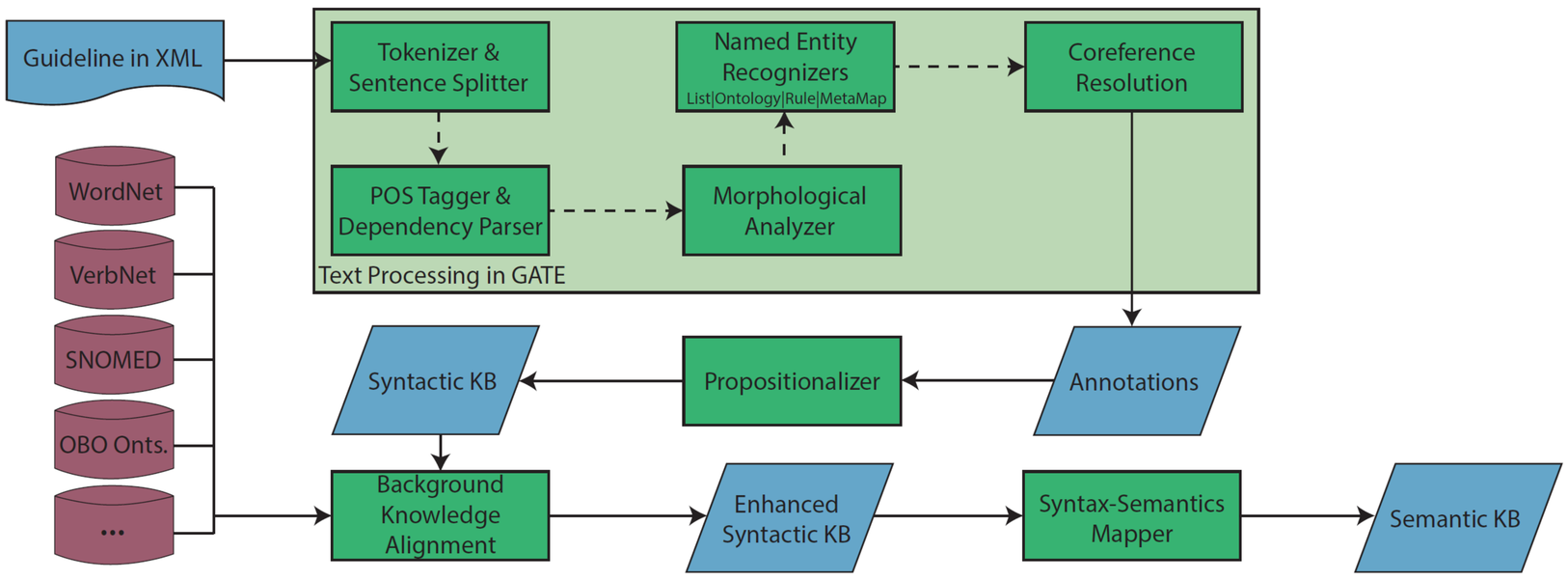

Figure 2. Clinical Tractor[2] system architecture.

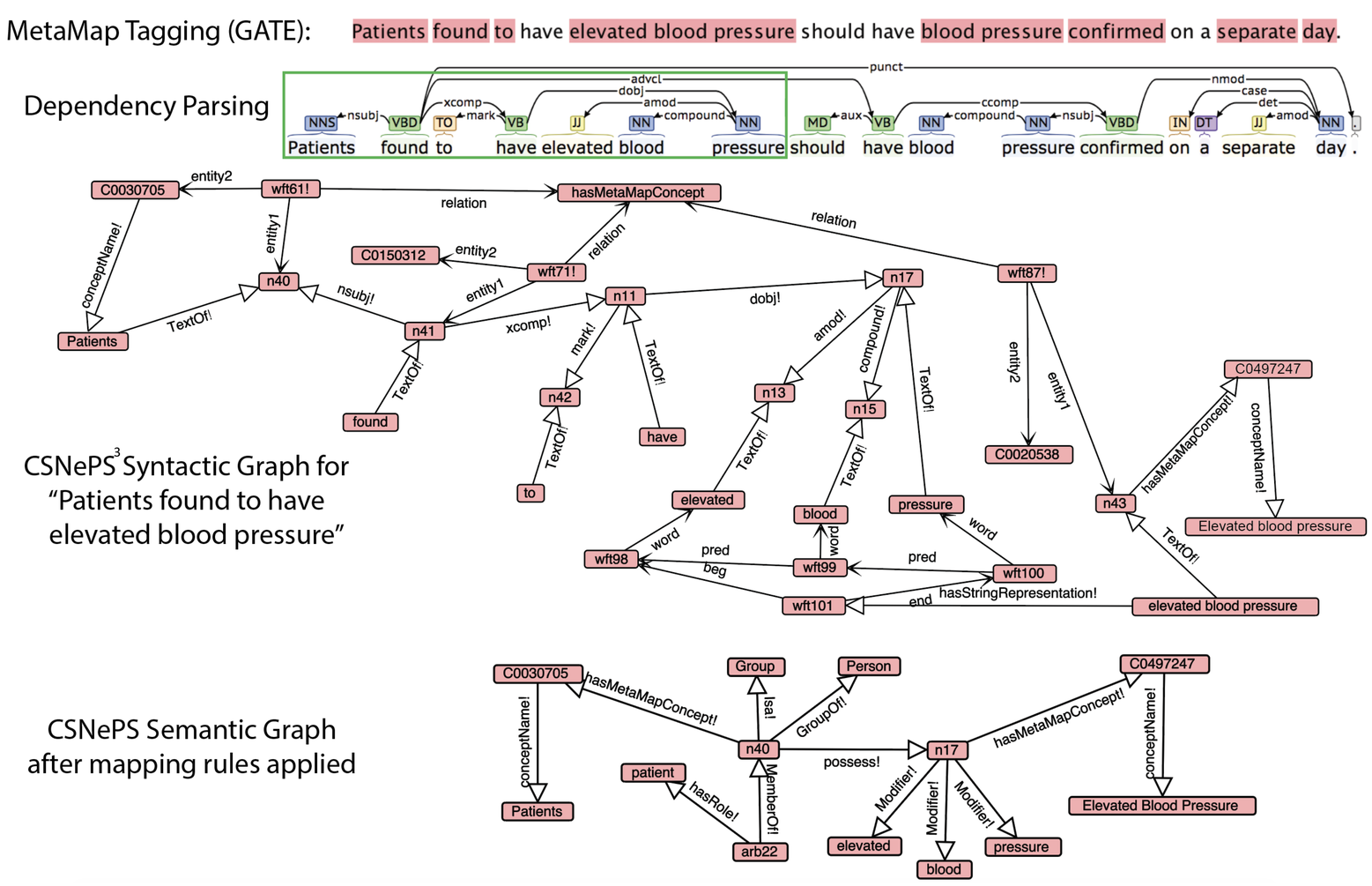

Figure 3. MetaMap matches and the dependency parse for "*Patients found to have elevated blood pressure should have blood pressure confirmed on a separate day.*" [4] are shown at the top, with a subset of the CSNePS syntactic KB after propositionalization, and semantic KB after the mapping rules have been applied shown for the phrase "*Patients found to have elevated blood pressure*".

Design Goals

1. Use off-the-shelf tools and data for the standard NLP pipeline
   - Make customizations as needed for the domain
2. Map (complete) Syntax -> Semantics
   - Use a set of rules, applied in a specific order, to gradually build the semantic representation from the syntactic one.
   - Be as general as possible
   - Avoid specific cases wherever possible
   - Make judicious use of background knowledge to maintain generality
   - Be pragmatic; don't get lost in the weeds needlessly

Continuous Evaluation

We have adopted a model of continuous evaluation, where each new rule developed for the system is rigorously tested for precision, and integrated only when it is deemed satisfactory.

- An *answer key* is iteratively developed by marking each rule firing as good or bad.
- When a rule is modified only minor changes are needed of the answer key.
- When a rule is added only the new items need to be added; regression testing is straightforward.

Recall can be evaluated by having a human produce a complete answer key independent of the system, and feeding it into the evaluator.

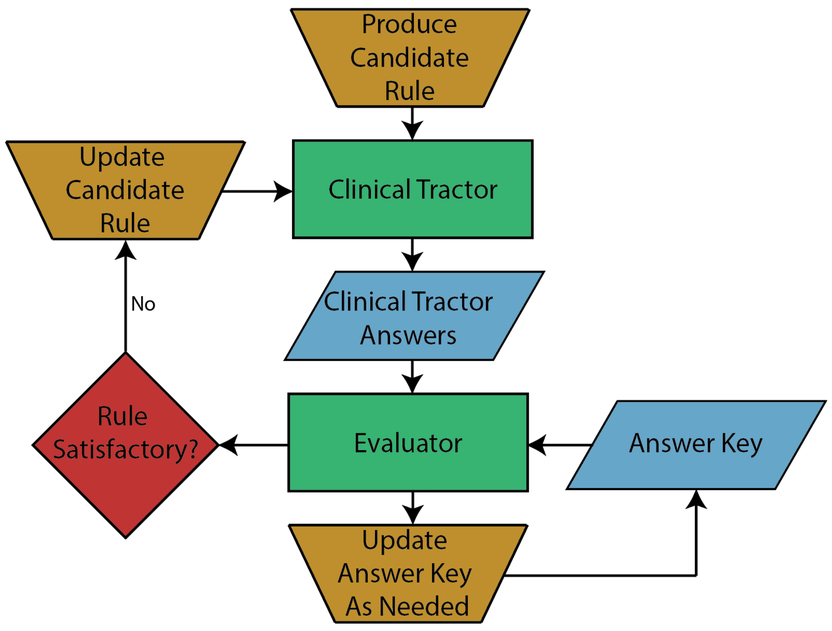

Figure 4. Clinical Tractor continuous evaluation framework.

References

1. Stuart C. Shapiro and Daniel R. Schlegel. Natural language understanding for soft information fusion. In *Proceedings of Fusion 2013*. IFIP, July 2013. 9 pages.
2. Schlegel, Daniel R., et al. Clinical Tractor: A Framework for Natural Language Understanding of Clinical Practice Guidelines. AMIA Annual Symposium 2019.
3. Daniel R. Schlegel and Stuart C. Shapiro. Inference graphs: Combining natural deduction and subsumption inference in a concurrent reasoner. In *Proceedings of AAAI-15*, 2015.
4. American Diabetes Association. Standards of Medical Care in Diabetes. *Diabetes Care*, 40(suppl 1), 2017.

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