Interactive visual presentation of open institutional clinical trials using an AI-based oncology ontology model to structure the clinical trial inclusion-exclusion criteria for efficient clinical workflow
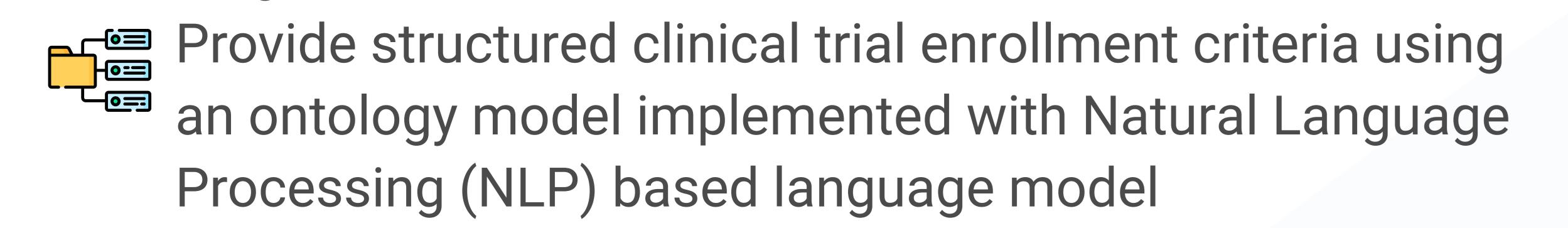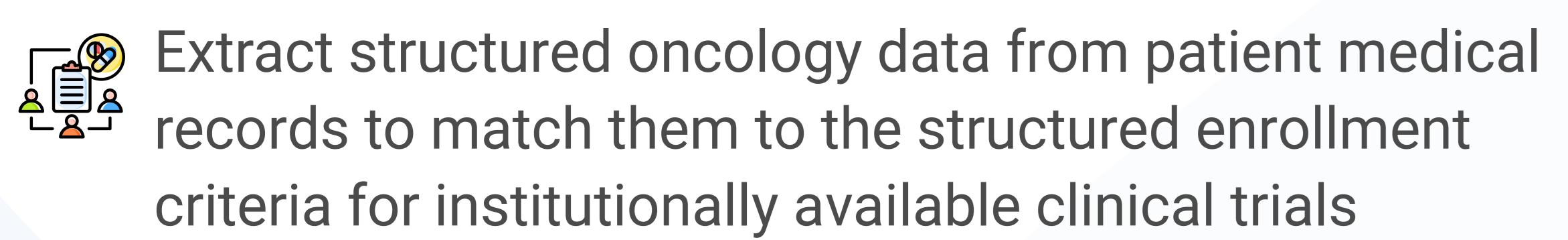
Carolyn Passaglia1, Kathryn Opfer1, Michael Gurley[1], Aleksandar Zafirovski1, Fang Lin[1], Anlil Brikha[1], Catherine Humphreys[1], Jazel Sugay[1], Sharon Hensley Alford[2], Tarun Kumar[2], Shilpa Mahatma[2], Deva Mahalingam[1], William Gradishar[1], Janice Lu[1], Jyoti Patel[1], Jochen Lorch[1]

Institutions: [1]Robert H. Lurie Comprehensive Cancer Center of Northwestern University; [2]Cancer Insights

Introduction

The Lurie Cancer Center (LCC) is implementing a stepped approach to address clinical trial recruitment and enrollment challenges:

- Provide structured clinical trial enrollment criteria using an ontology model implemented with Natural Language Processing (NLP) based language model
- Extract structured oncology data from patient medical records to match them to the structured enrollment criteria for institutionally available clinical trials

Objectives

- Extract structured oncology and treatment metrics from clinical trial inclusion-exclusion criteria
- Map the oncology and treatment metrics to clinical trial screening and enrollment phases
- Present the screening metrics as a hierarchical tree based visualization by organizing the oncology and treatment metrics as the nodes of the graph

Methods

- Create an ontology taxonomy having set of metrics to be extracted from each inclusion-exclusion criteria across diseases
- Enforce four properties for each metric: Label, Value Set, Standard Reference and Source Medical Record Type
- Build a Natural Language Processing (NLP) model to map to standard metrics to ICD, RxNorm, SNOMED, NCI etc.
- Create an interactive and configurable graph-based trial presentation for each disease team
- Validate the accuracy and usability of the tool through clinical review and software enhancements

Clinical Trial Modeling and Visualization

Figure 1. NLP parsing of trial eligibility criteria

Figure 2. Interactive dashboard of trial criteria categorization
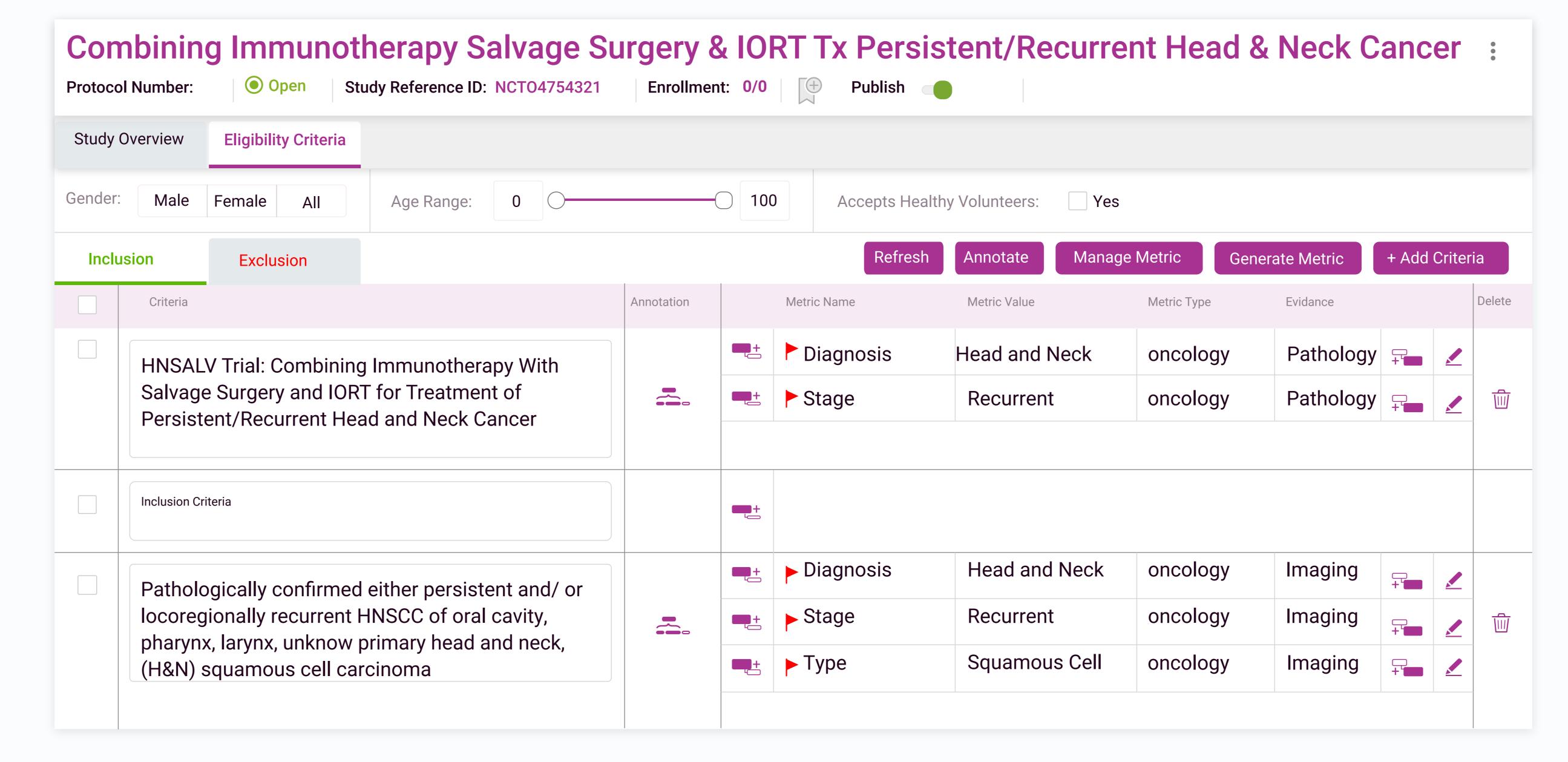

Figure 3. Hierarchical map of open trials within the institution by key matching criteria
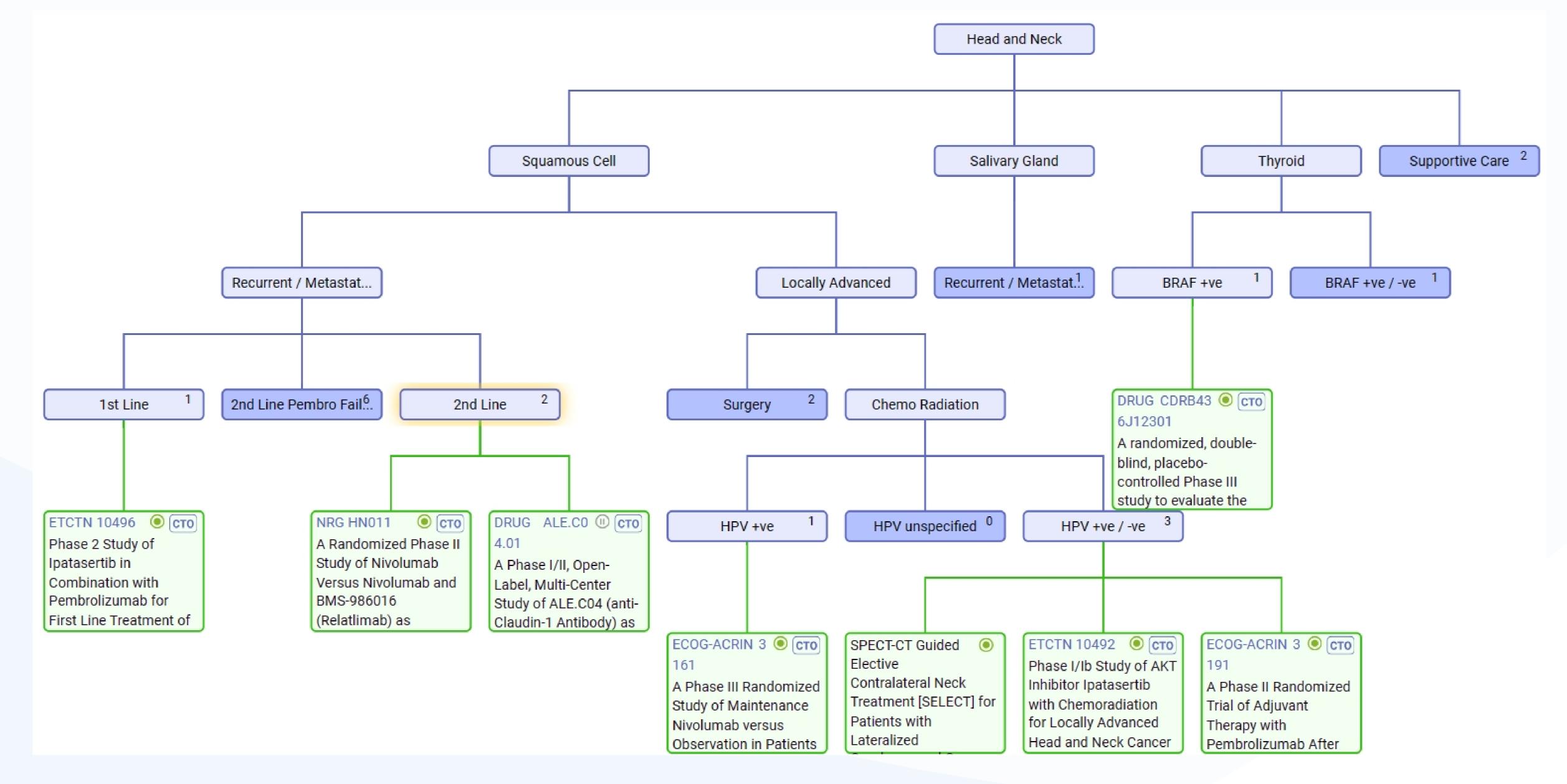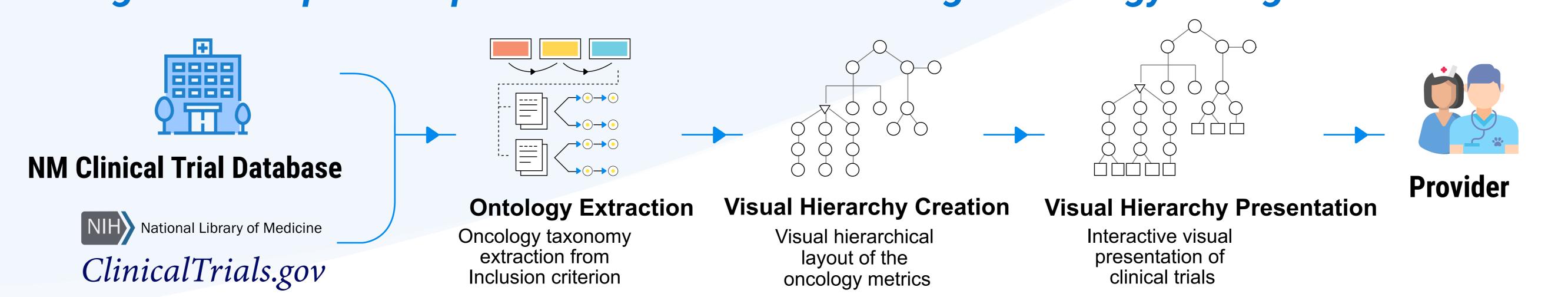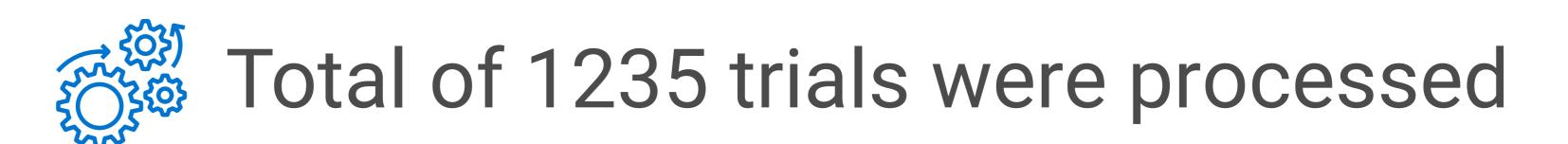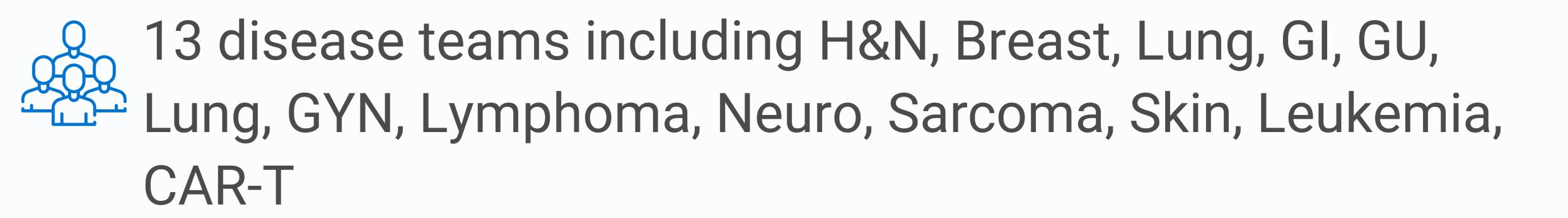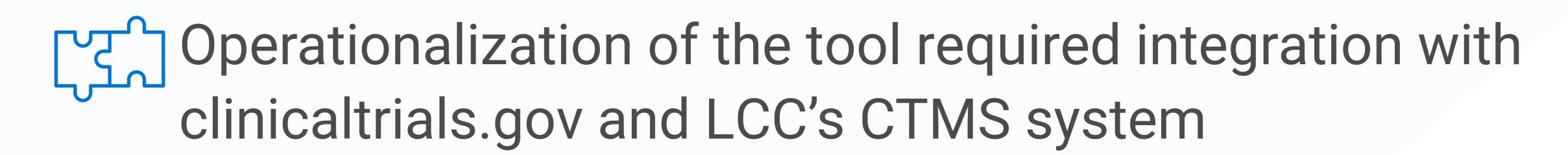

Figure 4. Graphical representation of trial matching technology configuration

Results

- Total of 1235 trials were processed
- 13 disease teams including H&N, Breast, Lung, GI, GU, Lung, GYN, Lymphoma, Neuro, Sarcoma, Skin, Leukemia, CAR-T
- Operationalization of the tool required integration with clinicaltrials.gov and LCC's CTMS system
- Overall sensitivity of metric detection is near 90%
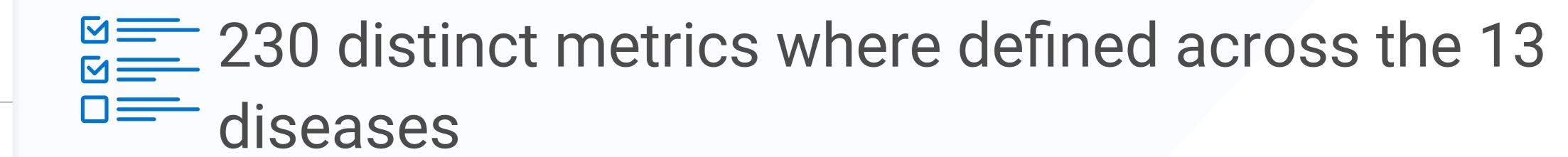- 230 distinct metrics where defined across the 13 diseases
- Processing time per trial was 3 seconds to complete ingestion, parsing, and structuring of inclusion-exclusion criteria text
- Challenging metrics to extract included line of therapy, adjuvant / neoadjuvant and complex conditional semantics

Next Steps

- Develop a graph / tabular presentation approach for multi-disease early phase trials
- Run an EMR-integrated clinical trial screening workflow that automatically identifies and matches patients that have upcoming consults or have completed a recent consult

Contacts

Robert H. Lurie Comprehensive Cancer Center
Carolyn Passaglia
Administrative Director, Clinical Trials Office
c-passaglia@northwestern.edu

Cancer Insights
Sharon Hensley Alford, PhD
Chief Information Officer
sharon@cancerinsights.com