Clinical Cancer Informatics and Natural Language Processing for Research in Canada

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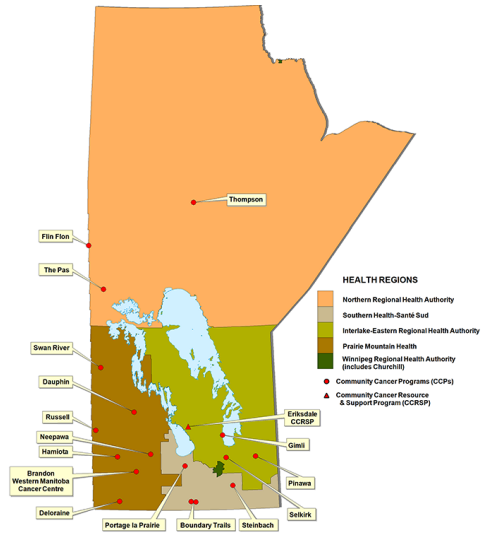
Disclosures

- No financial disclosures

- What I’m presenting is a very narrow view of Cancer Informatics and NLP in Canada

Background

- CancerCare Manitoba
  - Regional Cancer Centre
  - 1.5M people
- Manitoba Cancer Registry
  - 1937 basic reporting
  - 1956 – population based, legislated mandatory reporting
  - NLP for cancer reporting in use since 2009



Clinical Research and the Registry

Case Ascertainment

Excellent survival statistics

Biomarkers

(ER/PR/HER2, EGFR, IDH)

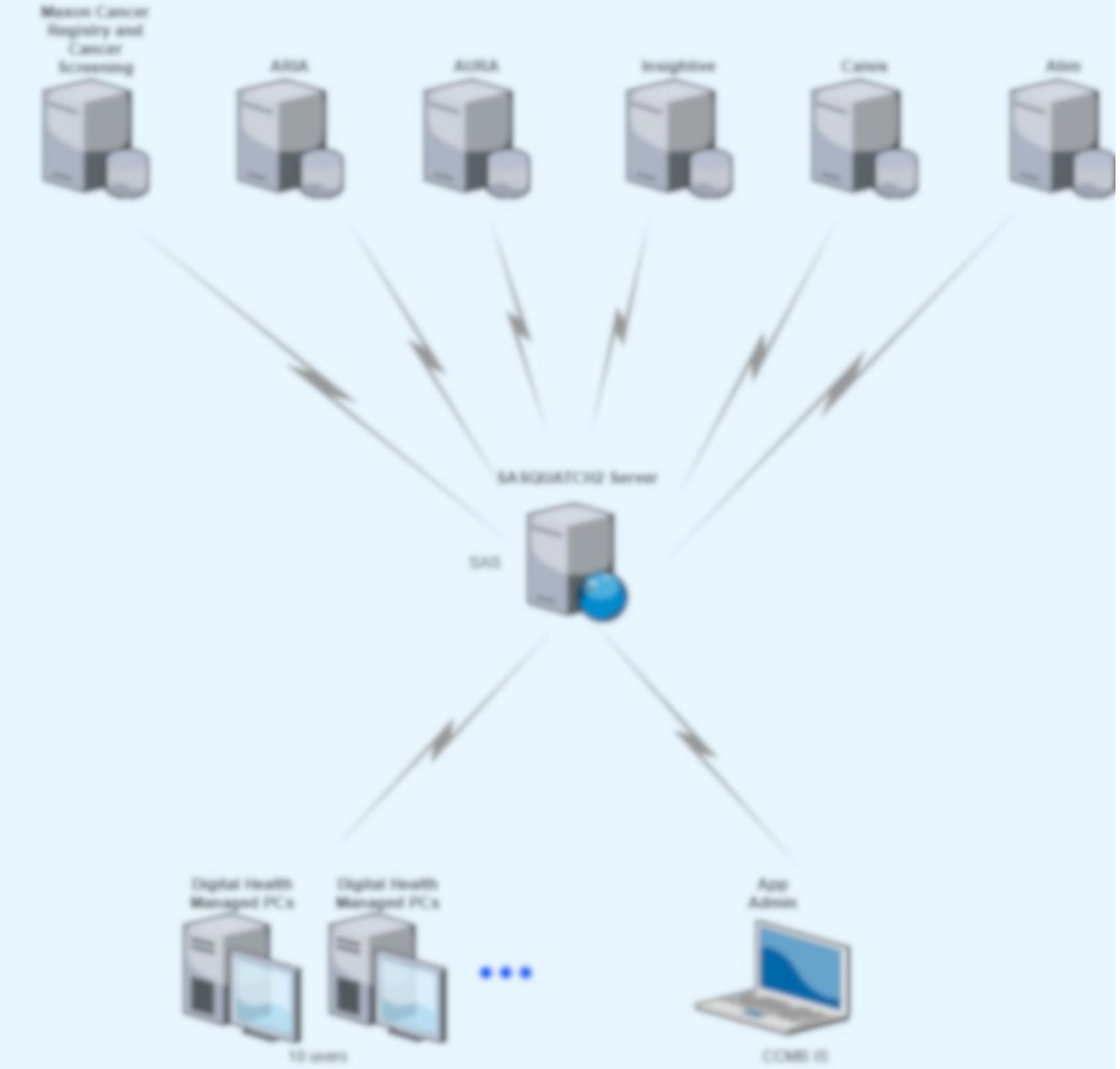
Recurrence and progression not captured well

Collaboration

- Build on to standard registry data capture
- Capture biomarkers
- More than just 1st treatment in the year
- Dose and fraction of RT

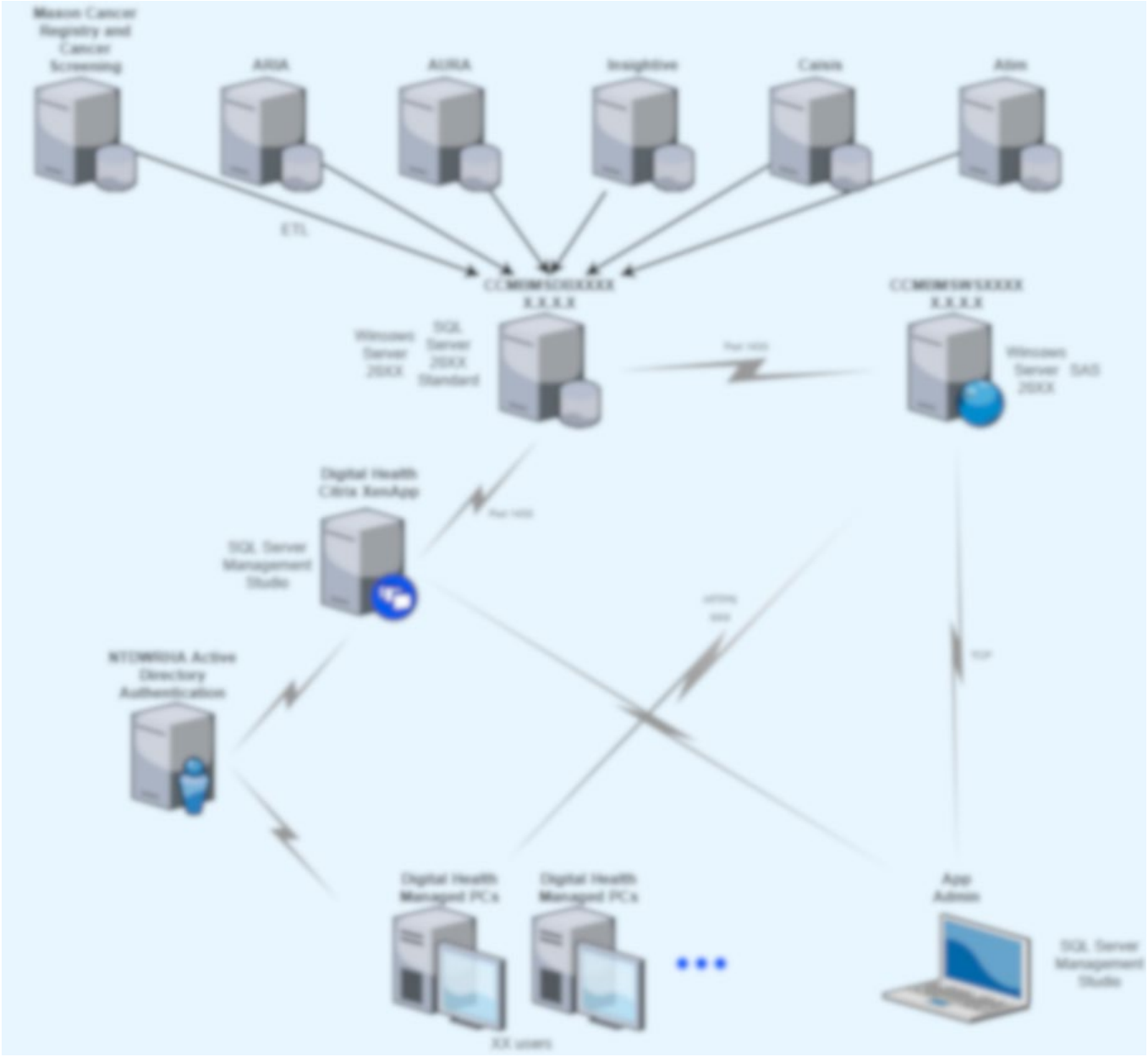
Clinical Research

- Cancer Registry forms the basis of cohort selection/identification
  - Demographics
  - Primary disease
  - Stage
  - Survival
- Link to:
  - EMR
  - Administrative Data
  - Research project data
  - Tumour Bank
  - …



Clinical Research Database Redesign

- Cancer Registry is core to the redesign of our research data structure
- Source of truth for many variables
- Linkage/patient identifier variables
- Highly structured
- Robust data dictionary



Cancer Recurrence as a Clinical Endpoint

Important endpoint for clinical research

Requires chart review (paper/electronic) and multiple systems

- Time consuming
- Expensive
- Reviewer dependent

Could we develop an algorithm that would identify cancer recurrence using:

- Registry
- Administrative Data
- EMR data
- Notes (Natural Language Processing)

Cancer Recurrence Study

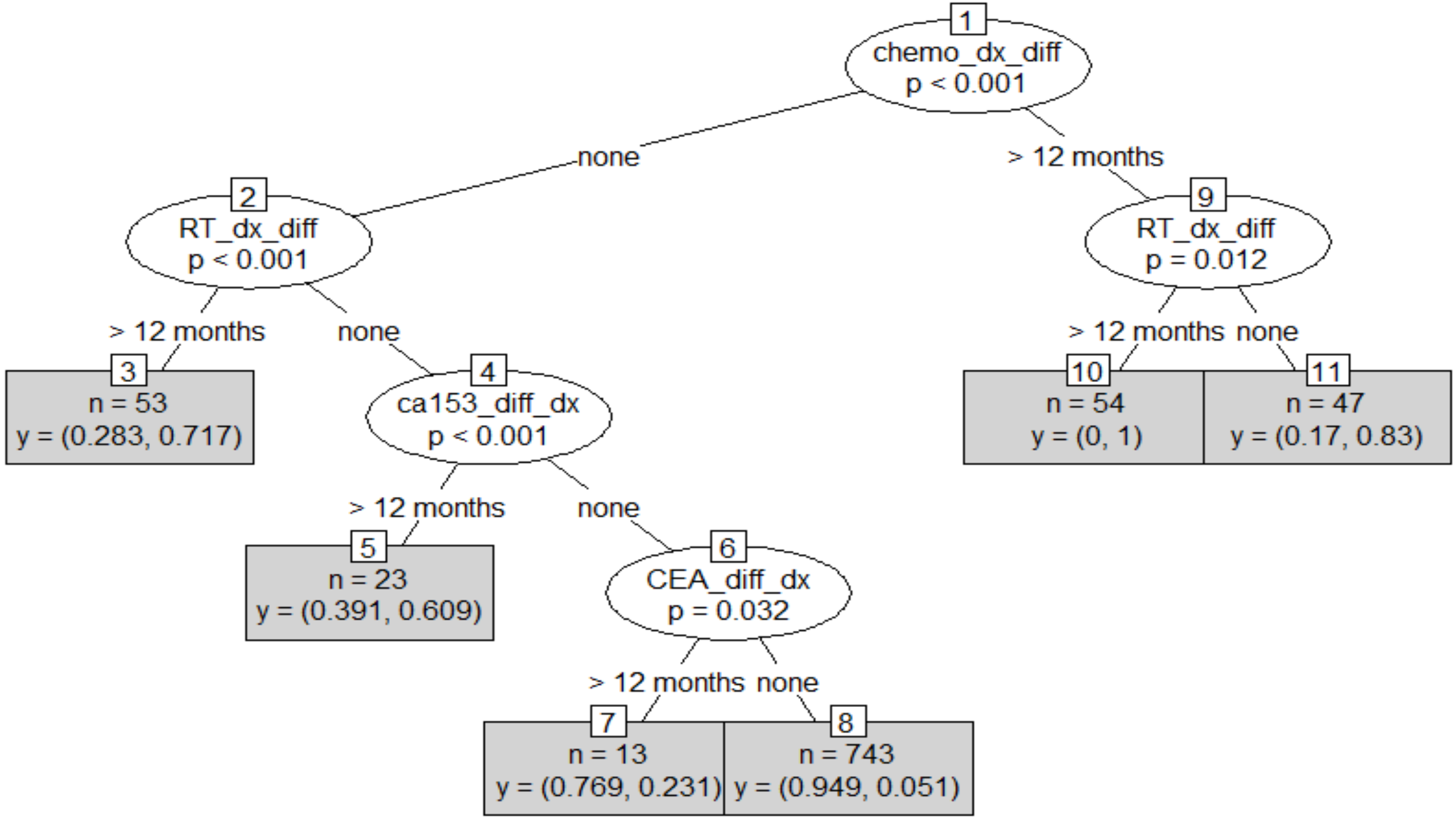
- Breast & Colorectal Cancer
- Stage I - III
- 2004 – 2007 (Algorithm development)
- 2008 – 2012 (Validation)
- Cancer Registrar chart review (gold standard)

- Does adding NLP of clinical notes improve detection of breast or colorectal cancer recurrence compared to existing discrete data?

Administrative Definition of Recurrence

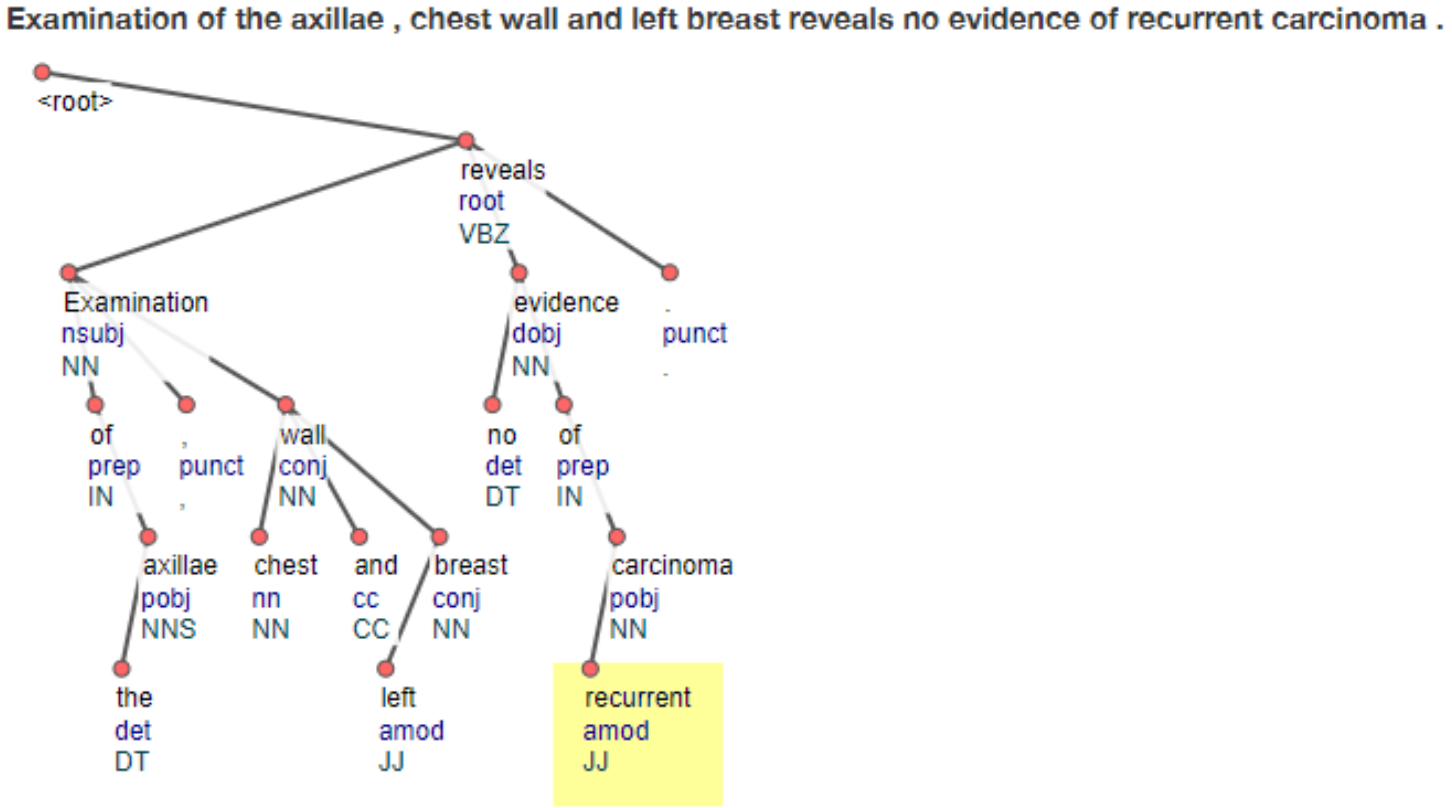
- Index date: original cancer diagnosis; initiation of treatment

- First surgery/chemo/RT >”X” months afterwards
- Second surgery/chemo/RT >12 months after first surgery/chemo/RT
- Palliative care consults >6 months after initial treatment


1
chemo_dx_diff
p < 0.001
none
> 12 months
2
RT_dx_diff
p < 0.001
9
RT_dx_diff
p = 0.012
> 12 months
none
> 12 months
none
3
n = 53
y = (0.283, 0.717)
4
ca153_diff_dx
p < 0.001
10
n = 54
y = (0, 1)
11
n = 47
y = (0.17, 0.83)
> 12 months
none
5
n = 23
y = (0.391, 0.609)
6
CEA_diff_dx
p = 0.032
> 12 months
none
7
n = 13
y = (0.769, 0.231)
8
n = 743
y = (0.949, 0.051)

Natural Language Processing to detect recurrence

- What is NLP?
  - Statistical algorithms that ‘read’ text (clinical notes) to assign values to structured variables
    - “recurrent breast cancer” labels that note as a “recurrence”
  - Different types of algorithms, machine learning and deep learning techniques
  - Natural language is a significant challenge:
    - Indirect language
    - Spelling mistakes
    - Unclear subjects for recurrence (eg. recurrence of cancer vs. recurrence of pain)



Iterative Process

- Tagging / Labelling features of notes
- Identify patients that have recurrence
- Identify the notes (dates) recurrence
- Improve the algorithm

Results

- 2114 Breast cancer patients; 353 recurrences

- Mean age 61
- Stage I: 39%
- Stage II: 43%
- Stage III: 18%

Results

Model	Sensitivity	Specificity	Scaled Brier
Administrative	78.0%	95.7%	0.51
NLP	90%	90%	0.42

*unpublished; preliminary

Conclusions

The use of NLP for clinical research is challenging

- Model building continues to improve
- Not yet a replacement for chart review

Cancer registry data can be foundational for clinical research

Clinician-Registry collaboration can greatly improve the utility

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