

Extracting Thyroid Nodules Characteristics from Ultrasound Reports Using Transformer-based Natural Language Processing Methods

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Background

More than **50,000 cases** in the US (2023)

- Reasons: Imaging tech, Overuse of Thyroid Biopsy

Unnecessary treatment:

- Thyroidectomy (surgery)
- Lifelong thyroid hormone replacement therapy

Serious complications:

- Hypoparathyroidism
- Hypocalcemia
- Vocal cord paralysis



Current Gaps

- Thyroid nodule ultrasound features are **yet not explored** in the current studies of thyroid cancer.
 - Reason: Nodule features are **unstructured and narrative**, thus requires **manual review** for incorporation
- Manual review is not feasible for **large scale studies** on tens of thousands of reports as it is **time-consuming, laborious and expensive**

There is a need for reliable extraction of thyroid nodule characteristics from ultrasound reports to counter overdiagnosis

Training



NLP Models used:

- BERT_MIMIC
- RoBERTa_MIMIC
- Longformer_MIMIC
- DeBERTa_MIMIC
- GatorTron

- NER Model: **Extracts** nodule characteristics
- Relation Extraction model: Identifies **relationship** among entities
- Evaluation: F1-score, recall and precision

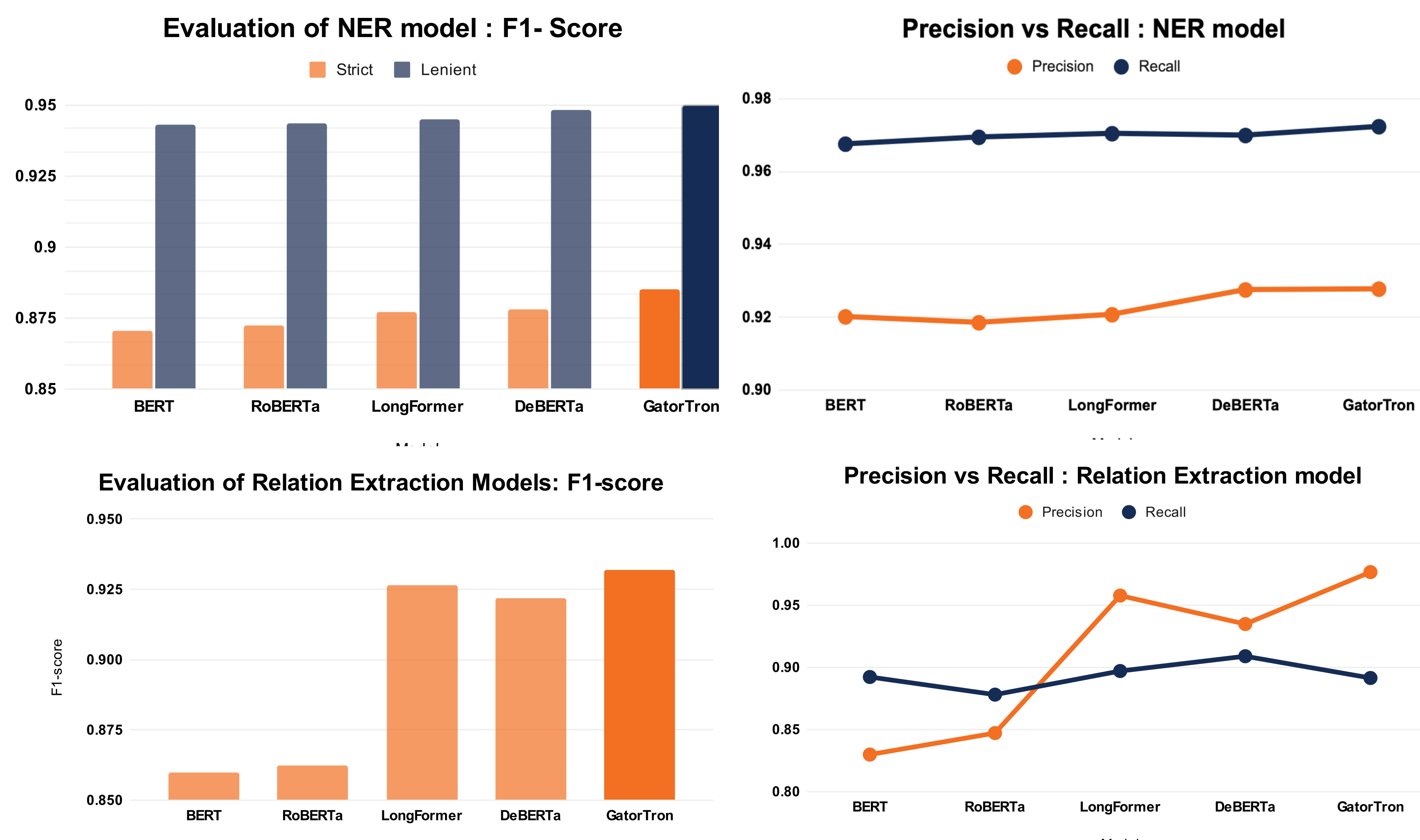
Significances

This study:

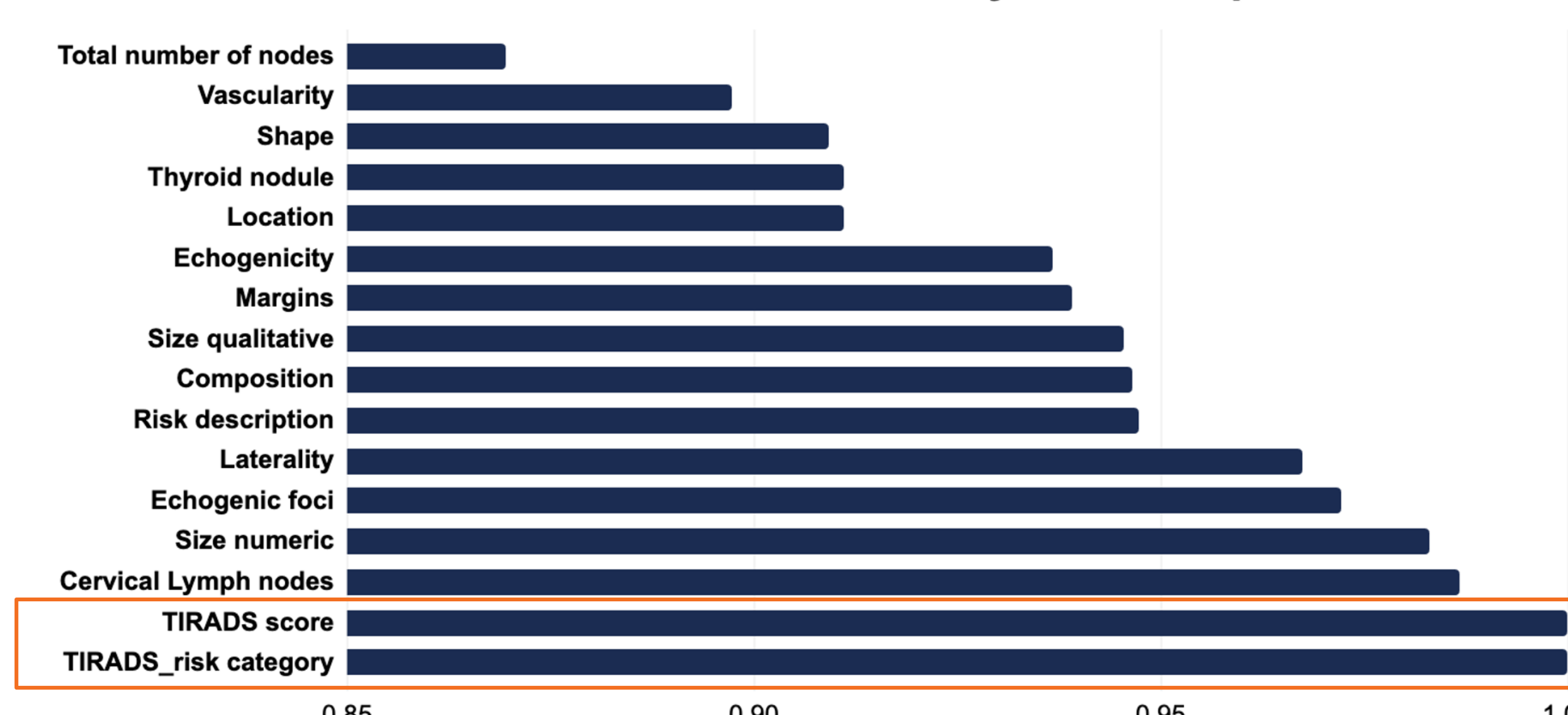
- Enables large-scale Health Service Research of overdiagnosis **that include** ultrasound features
- Helps **optimize** the benefit of thyroid biopsy
- Facilitates **decision support** for thyroid cancer diagnosis

Our work has the potential to **revolutionize thyroid cancer diagnosis** by extracting nodule features and enabling large scale studies to explore the links with thyroid cancer overdiagnosis.

Results



F1-Score - GatorTron over 16 Thyroid concepts



Conclusion

- We developed transformer-based NLP models to extract **16 thyroid nodule characteristics** from thyroid US
- GatorTron** achieved best performance on a large dataset of ultrasound reports from UF
- Future work to counter the overdiagnosis of thyroid cancer (Ongoing):
 - Integrate our NLP pipeline and develop algorithm to classify **inappropriate thyroid biopsy**
 - External validation** of our NLP pipeline

References

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- Vaccarella S, et.al *N Engl J Med.* 2016;375(7):614-617
- Li M, et.al *Lancet Diabetes Endocrinol.* 2020;8(6):468-470
- MIMIC Pretrained Models: <https://github.com/uf-hobi-informatics-lab/ClinicalTransformerNER>
- GatorTron: <https://huggingface.co/UFNLP/gatortron-base>

Paper: Pathak A, Yu Z, Paredes D, et al. Extracting Thyroid Nodules Characteristics from Ultrasound Reports Using Transformer-based Natural Language Processing Methods. AMIA Annu Symp Proc. 2024;2023:1193-1200. Published 2024 Jan 11. <https://pubmed.ncbi.nlm.nih.gov/38222394/>

Data

