Developing an AI Model to Identify Malignancy Results on Imaging Reports to Delay Release to the Electronic Patient Portal

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Office of Health Informatics & Analytics

Summary of the Laws on Imaging Result Release

21st Century CURES Act	SB1419
Federal law	California state law
Took effect 10/2020	Enacted 10/2022, Took effect 01/2023
Immediate release of results to electronic patient portal	Imaging scan results that reveal a new or recurrent malignancy shall not be released to the patient portal until discussion with the patient by a healthcare professional





Manual Workflow: Overview



- Dictate phrase 'SB1419' at the bottom of the **IMPRESSION** section of the report.
- EHR will analyze for phrase dictated in reports from different reporting platforms (i.e. PowerScribe, CareConnect, and MagView)
- Manual flagging of reports to be held is onerous, prone to inconsistency, and difficult to standardize

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PowerScribe 360 Reporting	,	×					
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Automated Workflow with AI: Overview



ℜ Pre-existing malignancy classification schemes (i.e. BI-RADS, LI-RADS)

***** Positive defined as > 50% probability of malignancy on malignancy classification schemes (i.e. BI-RADS \geq 4, LI-RADS \geq 4)

- Pre-selected 12 most common keyword stems: Malignan, Cancer, Neoplas, Tumor, Carcinoma, Metastatic, Metastas, Lymphoma, Sarcoma, Leukemia, Melanoma, Lymphoproliferative
- + Training dataset labeled by physician informaticists was used to train the deep neural network (DNN) model



Data Preparation for Hybrid Machine Learning Model

Pre-Modeling Phase

Deep Neural Network Modeling Phase





Model Development: NLP Deep Learning



Deep Neural Networks' structure is designed to learn by multiconnection of layers (each layer only receives a connection from the previous and provides connections only to the next layer)



Model Training and Validation

Prepare training dataset from reports (12/01/2022-12/31/2022)



Apply AI model to reports (01/19/2023-02/12/2023)





Model Evaluation

Applying Al Model

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 Daily dashboard of AI model applied on reports that resulted from 01/19/2023-02/12/2023



 A total of 1,289 (2.6%) reports were positive and met the criteria for hold, with 996 reports identified from the DNN NLP and 293 reports from –RADS rule NLP, respectively.



Evaluating Performance

- Combining model output from both DNN and rule-base NLP
- Dataset: 25% of data from 12/01/2022-12/31/2022 (N=61K)



SE (Recall)	0.8336
SP	0.9958
PPV (Precision)	0.6857
NPV	0.9981
ACC	0.9940
F1-Score	0.7524

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Model Monitoring

System Monitoring

 CareConnect build to notify users of system failure

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Performance Monitoring

- Periodically review of model performance post deployment
- Analyze for data drift or performance deterioration



Business Monitoring

Evaluate how the model impacts the business with dashboards





EHR Workflow Integration

- Awaiting further development by Epic EHR to incorporate AI model into Radiant workflow to perform hold functionality
- Status of released or held reports visible to providers





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