Artificial Intelligence in Trial Monitoring: Using Machine Learning to Identify Poor Performance Sites in Clinical Trials

L Coutts*, C Diaz Montana, L Brown, S Love,
I R White, C Holmes, K Diaz Ordaz
*lcoutts@turing.ac.uk

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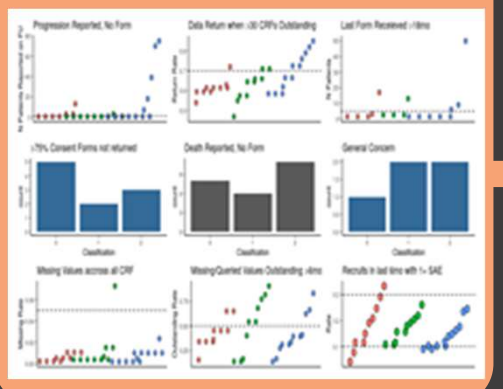
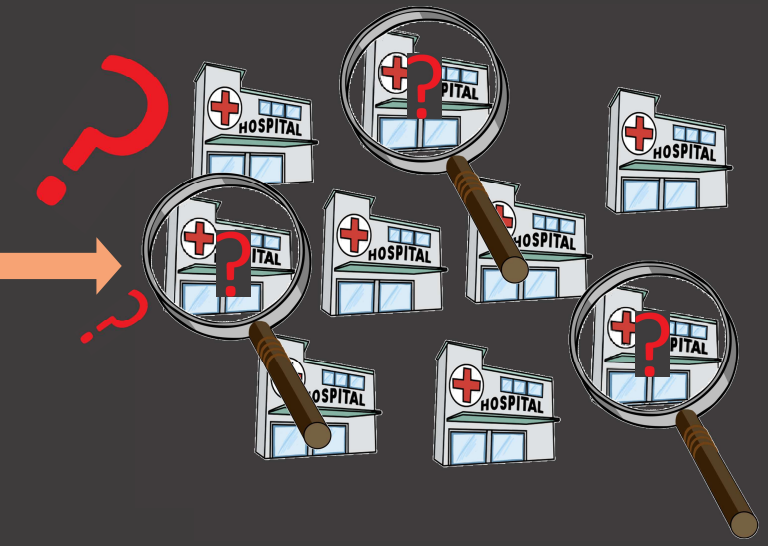
Current Practice in Clinical Trial Monitoring

- Sites suspected of poor performance are **visited** to **investigate** and **rectify issues**
- Site visits are **expensive** and **time consuming**
- Current metrics are **insufficient** at discerning which sites to prioritise for monitoring visits

Current Metrics





Examples of Currently Used Metrics:

- Data and Case Report Form Return rate
- Number of missing or queried values in forms
- Missing or queried values outstanding for >6 months
- Number of Serious Adverse Events (SAE, events that risk patient safety)

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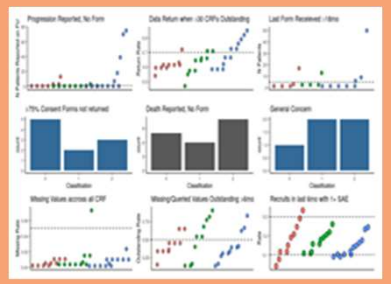
Machine Learning Models: XGBoost and Random Forest

Current Metrics



Model

No visit required (no 'critical' or 'major' findings)

Visit recommended (one or two 'critical' or 'major' findings)

Visit necessary (greater than two 'critical' or 'major' findings)

Performance Classifications:

The grading ('critical', 'major', 'other') and number of issues found at site visits were used to set classes for sites, from which the model was trained

Model Outputs:

Model Type:	Accuracy:
Random Forest	79%
XGBoost	69%

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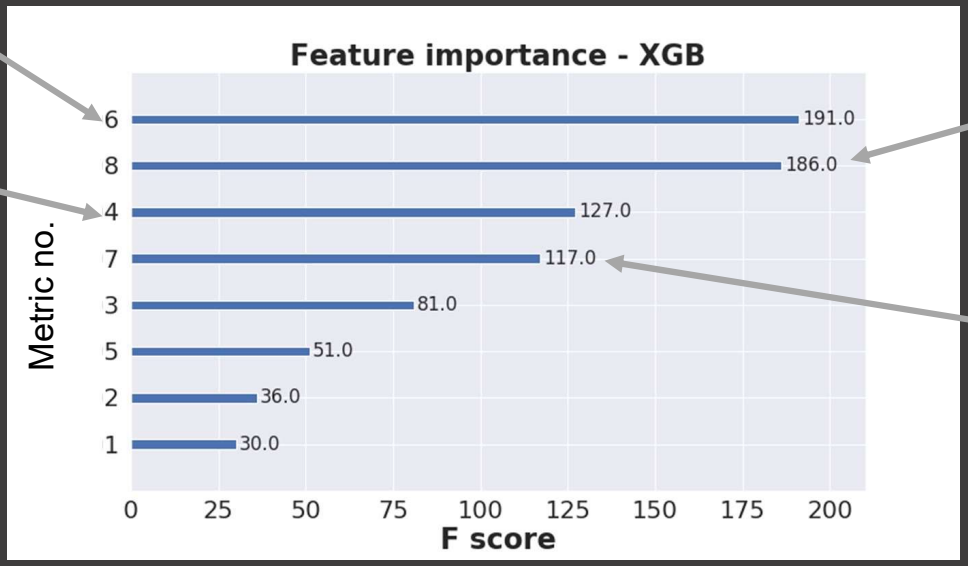
Machine Learning Models: Feature Importance

Number of values in forms missing or queried

Data and Case Report Form Return



Number of patients with at least 1 SAE

Number of missing or queried values outstanding for >6 months

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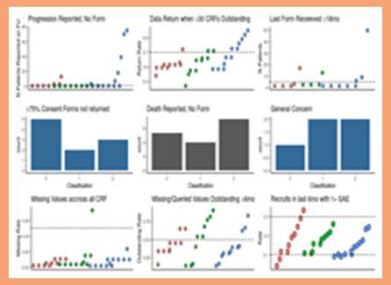
Novel Machine Learning Technique: Superlearner Model

Current Metrics



Case Report Form Data

Superlearner

- LSTM
- SVM
- Random Forest
- XGBoost
- Transformer
- Logistic Regression
- Bayes

No visit required
(no 'critical' or 'major' findings)

Visit recommended
(one or two 'critical' or 'major' findings)

Visit necessary
(greater than two 'critical' or 'major' findings)

Further development will use raw clinical trial data to extend ML model outputs, to predict the types of issues that would be found if a site were visited

Model Outputs:

Model Type:	Accuracy:
Superlearner	83%

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Comparison with Current Practice

- When simplified to a two class problem, i.e. visit required / no visit required:

Method:	Accuracy:	Sensitivity	Specificity
Standard Metrics	47%	55%	30%
XGBoost	76%	86%	57%
Random Forest	81%	87%	67%
Superlearner	85%	83%	89%

Both individual (Random Forest and XGBoost) machine learning models and the Superlearner model outperform the currently used method, using standard metric data

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Conclusions

- Machine learning has shown promise for aiding monitoring teams to make informed decisions about site monitoring visits
- Models using Case Report Form data are currently being built, to improve predictive accuracy and offer further information to the monitoring team

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Full report available here:

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