Reducing Outpatient MRI Appointment No-show Rate Through Artificial Intelligence Predictive Analytics

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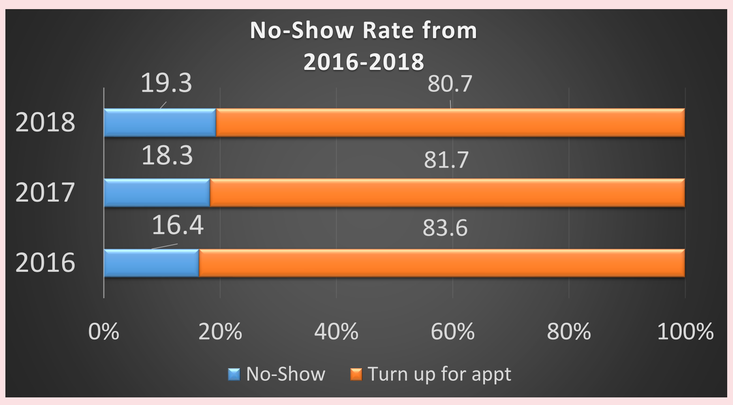
Problem Statement / Background:

❑Problem Identification: Outpatient MRI no-show rates have shown an increasing trend between 2016 to 2018 (*Figure 1*) leading to issues detailed in *Figure 2*.



❑Retrospective data of **32,957** MRI outpatient appointments between 2016-2018 were extracted from RIS and OAS.

❑Total no-shows of **5734 (17.4%)** with yearly increasing trend as shown in *Figure 1.*

Figure 1. Increasing Trend in No-show Rates

PROJECT OBJECTIVES:

☑To reduce no-show rate
☑Reduce MRI appointment lead time
☑Improve accessibility of MRI services
☑Improve patient care / pathway

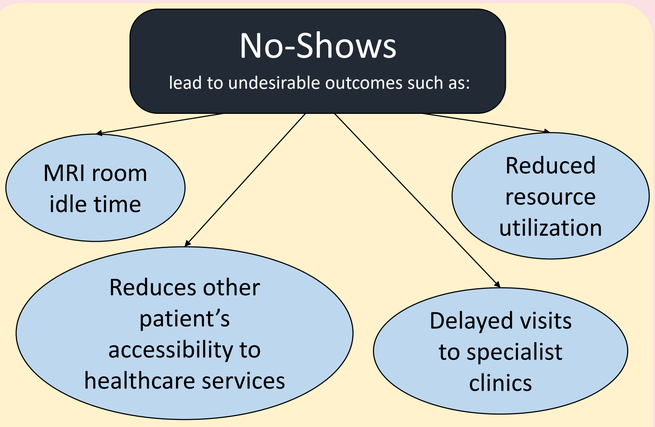


Figure 2. Undesirable Outcomes From Increasing No-show Rates.

Problem Analysis & Evaluation:

❑ Causes of appointment no-shows are complex, with multiple human and non-human factors potentially interacting in complex ways to influence appointment attendance.

Feature	Type	Values
Appointment Status	Categoric, Target	2 (show/no-show)
Age	Numeric	11-101 years
Appointment Duration	Numeric	30-150 minutes
Appointment Wait Days	Numeric	0-721 days
Appointment Reschedules	Numeric	0-5
Appointment Day	Categoric	6
Appointment Hour	Categoric	13
Appointment Location	Categoric	7
Appointment Month	Categoric	12
Appointment Session	Categoric	3
Appointment Timeslot	Categoric	31
Appointment Priority	Categoric	3
Gender	Categoric	2
Language	Categoric	8
Nationality	Categoric	47
Ordering Department	Categoric	45
Payment Class	Categoric	7
Postal District	Categoric	16
Race	Categoric	20
Referral Facility	Categoric	23
Scan Order	Categoric	93
Scan Region	Categoric	13

Table 1. Features extracted from RIS / OAS used for training of the model.

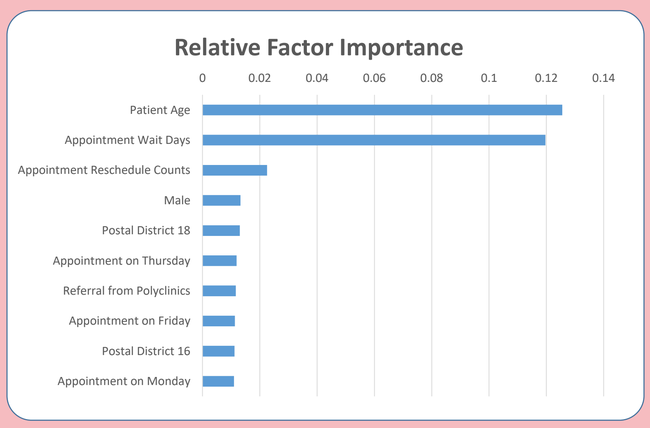


Figure 3. Relative importance of various features in predicting appointment no-show identified by the XGBoost model.

❑ A machine learning model trained with an extreme gradient boosting algorithm (**XGBoost**) was developed to predict outpatient MRI appointment no-shows.

❑ *Table 1* shows a list of features extracted from RIS and OAS used for model training.

❑*Figure 3* shows the relative importance of these features as identified by the XGBoost machine learning model in predicting no-shows.

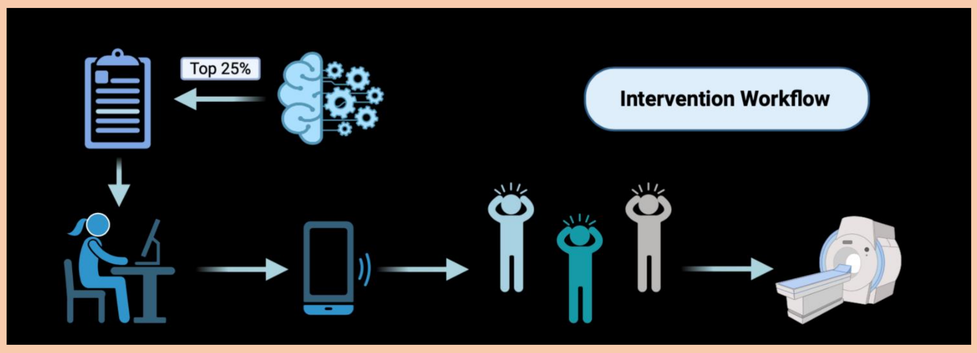
❑ The ROC-AUC of the model was 0.746, sensitivity of 85.2%, positive predictive value of 60.6% and overall accuracy of 65.4%.

Evaluation of solutioning involves consideration on the following aspects:

Sustainability | **Manpower** | **Cost Effective** | **Time Effective**

Main advantage of using AI predictive model → Computer generated list of patients with high probability of no-shows (Data supported selection)

Methodology & Results:



❖Machine learning model (XGBoost) developed with features extracted from RIS and OAS from 2016-2018 appointments.

❖Weekly list of outpatient MRI appointments with highest risks of no-show predicted by model generated.

❖MRI Radiographers call top 25% of patients at highest risk of no-show one working day before appointments to confirm attendance.

❑There was a significant absolute decrease in no-show rates of 3.4% over 6 months following implementation, with a relative decrease of 17.2% compared to the 12 months pre-intervention baseline no-show rate ($p < 0.0001$, *Figure 4*).

❑Appointment no-show rates for contactable and non-contactable patients at high-risk of no-shows were 17.5% and 40.3% respectively ($p < 0.0001$).

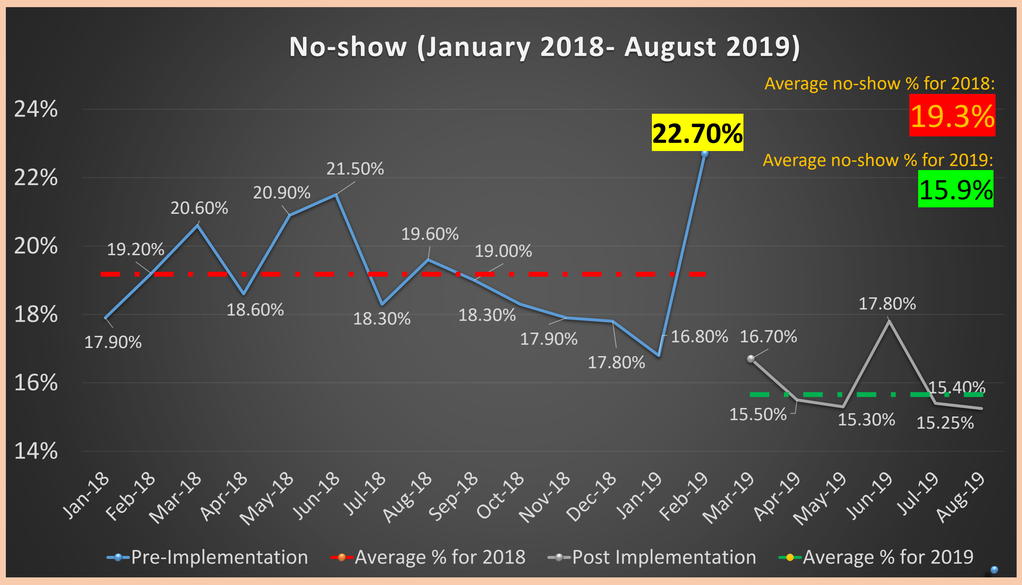


Figure 4. No-show rates 12-months preceding and 6 months after intervention measures.

Positive Outcomes & Conclusion:

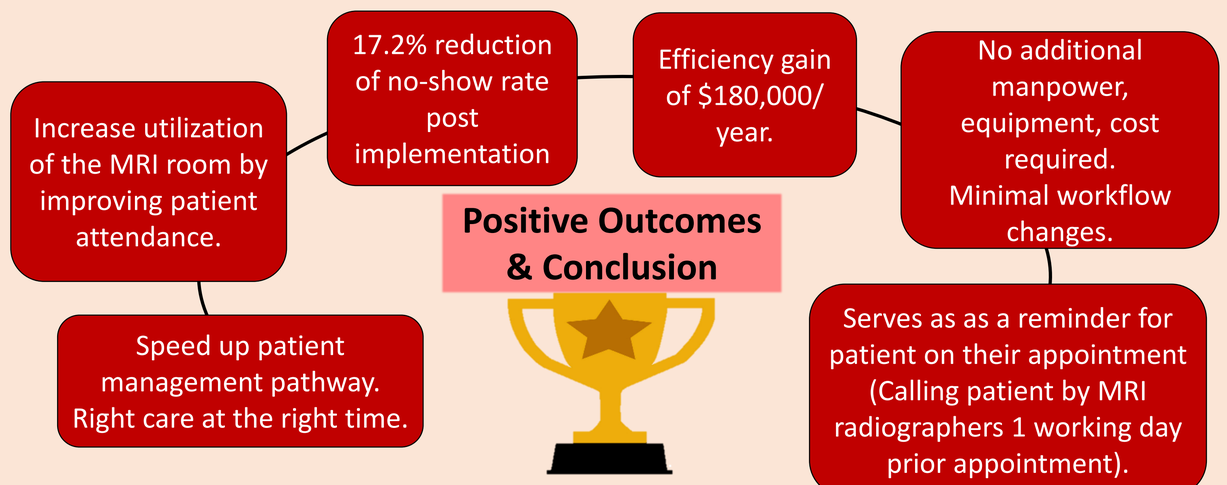


Diagram 3. Post-implementation positive outcomes & conclusion.

Subsequent Implementation & Improvement:

➢ The project objectives are met and post-intervention measures producing promising results. The department has since the onset of the COVID-19 pandemic adopted to call **all MRI outpatients** instead of the top 25% of patients generated from the predictive model.

➢ By calling all MRI outpatients, the monthly tabulated data (2020-early 2021) showed **further decreased no-show rates ranging between 8%-13%.** Nevertheless, the data may be affected by COVID-19 surge and measures.

➢ In the future, this predictive model can be readily adaptable to other diagnostic imaging modalities such as CT or US to manage patient scan appointment attendance.