

Identification of Multi-Disciplinary Factors Predicting Non-Home Discharge after Open Aortic Repair Using Machine Learning

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Objective

Evaluate the role of clinical factors, initial physical and occupational therapy recommendations in a machine learning algorithm to identify patients likely to have a **non-home discharge (NHD)** following **open abdominal aortic repair (OAR)**.

Methods

- Retrospective review of OAR at a single quaternary center (years 2012-2020)
- Primary endpoint: NHD following OAR
- Preop, intraop, and post-op day 1 variables were evaluated including initial physical and occupational therapy evaluations
- Use of NLP to extract physical therapy evaluation data from PT notes
- A classification tree was used to then predict NHD using the factors above
- Model performance was evaluated by accuracy and F1 score on a random test set representing 20% of the study sample
- Feature importance was determined based on the total decrease in Gini impurity the feature achieved across all nodes in the final decision tree.

Table 1: Select Patient Characteristics by Discharge Outcome (n = 118)			
Variable	Home (n = 85)	Non-Home (n = 33)	P-Value
age	70.83 +/- 9.0 years	73.94 +/- 7.13 years	0.055
gender	64 (75.3%)	20 (60.6%)	0.175
Admission Type	69 (81.2%) Elective	21 (63.6%) Elective	0.077
AAA Type	43 Infraarenal, 32 Juxtarenal, 10 Pararenal	16 Infraarenal, 12 Juxtarenal, 4 Pararenal, 1 Suprarenal	0.568
BMI	26.93 +/- 5.01 kg/m^2	27.2 +/- 6.21 kg/m^2	0.828
History of smoking	22 (25.9%)	11 (33.3%)	0.561
History of MI	8 (9.4%)	8 (24.2%)	0.070
Any prior stroke/TIA	31 (36.5%)	13 (39.4%)	0.934
Overall Cognitive Status	49 (57.6%) Within functional limits	24 (72.7%) Within functional limits	0.007*
Arousal/Alertness	45 (52.9%) WNL	23 (69.7%) WNL	0.007*
Follow Commands	27 (31.8%) WNL	6 (18.2%) WNL	0.018*
Memory	35 (41.2%) WNL	6 (18.2%) WNL	0.014*
Mobility	46 (54.1%) Impaired	21 (63.6%) Impaired	0.466
Safety Judgement	26 (30.6%) WNL	4 (12.1%) WNL	0.368
Expected PT Frequency	48 (56.5%) 5d/week	20 (60.6%) 5d/week	0.729

TABLE 2: PREDICTIVE FACTORS FOR NON-HOME DISCHARGE VIA MACHINE LEARNING		
RANK	Variable	Relative Importance
1.	Memory Impairment on Physical Therapy Evaluation	0.26
2.	Identified Physical Therapy Deficit Types	0.20
3.	Age	0.17
4.	Arousal/Alertness on Physical Therapy Evaluation	0.09
5.	Safety Judgement on Physical Therapy Evaluation	0.09
6.	Command Following Ability on Physical Therapy Evaluation	0.08
7.	Vision Impairment	0.06
8.	History of prior CVA or TIA	0.02
9.	Frequency of PT sessions	0.01
10.	Impaired Mobility on Physical Therapy Evaluation	0.01

Results

- Model Accuracy: 90.6%
- Weighted Macro f1-score: 0.907
- Area Under the curve: 0.96
- The 10 features used for the model are shown in Table 2 in order of impact on the classification accuracy.

Conclusions

This study identified novel risk factors for non-home discharge after OAR successfully using machine learning.

- Machine learning can be used to help identify patients in need of increased resources early in the post operative stay.
- Future studies on the use of task-specific models for clinical decision support in vascular surgery should explore a wide range of multidisciplinary factors.

