stenosis has been a subject of prolonged debate. The existing literature presents conflicting results, with some studies advocating patch use due to reported improved post-operative outcomes, while others report no significant differences in patient outcomes during the post-operative and follow-up periods. This study aims to contribute to this discourse by investigating the hemodynamic changes associated with patch use and their potential correlation with the risk of artery re-stenosis.

**Methods** A comparative analysis was conducted on two CEA patients: one without a patch with no-restenosis on follow-up, and another with a patch experiencing a stroke 8 years post-CEA due to carotid re-stenosis. Computational flow dynamics were conducted to assess pre- and post-CEA hemodynamics in both cases, using data from MRA, DSA, and NOVA flow reports. The study analysis was performed using patient-specific flow data as well as uniform flow for both patients.

**Results** Our findings revealed distinct hemodynamic profiles between the two patients. In both analyses, the patient treated without a patch exhibited coherent blood flow and higher wall shear stress throughout the carotid artery, resembling patterns typically observed in healthy individuals. In contrast, the patient treated with a patch displayed lower wall shear stress in the patch vicinity, a higher oscillatory index, and non-coherent blood flow- indicative of changes associated with atherosclerosis, endothelial dysfunction, and cellular damage. The region between the carotid bulb formed by the patch and the distal healthy artery demonstrated a high gradient of shear stress, posing a risk of potential cell damage, coinciding with the specific site of re-stenosis.

**Conclusion** The observed hemodynamic alterations suggest that using a patch may not necessarily result in improved flow and more favorable outcomes. Despite the growing literature supporting patch use in reducing post-operative stroke rates, our study sheds light on the hemodynamic implications of this procedure and provides a valuable insight into the ongoing debate surrounding CEA. It also emphasizes the need for further investigations and consideration of alternative factors influencing surgical decisions.

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## E-225 ENDOVASCULAR TREATMENT FOR NONTRAUMATIC CHRONIC SUBDURAL HEMATOMA: SHIFTING TRENDS FROM 2021–2023

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**Introduction/Purpose** Chronic subdural hematomas (cSDH) are conventionally managed with pharmaceutical therapy or open surgeries, including burr-hole evacuation or craniostomy. Middle meningeal artery embolization (MMAE) with helical coils, particle embolic materials, or liquid embolic agents have demonstrated promise as primary or adjunct endovascular therapy for cSDH. Prior population-based analyses examining nationwide data from 2012–2021 have signaled increasing utilization of MMAE in clinical practice. In light of the launches of several clinical trials since 2020, and following the rise of favorable published outcomes from other analyses, we aim to characterize population-level changes in MMAE utilization in comparison to other surgical interventions from 2021 to 2023 for nontraumatic cSDH treatment.

**Materials and Methods** Population-level data used in this study came from Epic Cosmos, a community collaboration of health systems representing over 234000000 patient records from over 1334 hospitals and 28900 clinics. Adult patients with ICD-10 codes for nontraumatic cSDH (I62.00 and I62.03) between January 1, 2021 and December 31, 2023 met inclusion. Patients were subgrouped based on whether they had: 1) a craniotomy or craniectomy, 2) burr-hole evacuation, or 3) embolization procedures. Procedure performed was identified using CPT codes. Number of cSDH patients with each intervention was summarized over time. The incidence of the intervention was normalized by the total cSDH patient population per year to yield population-adjusted percentages with 95% confidence intervals (CI). Linear regressions were performed using R version 4.3.1 (2023).

**Results** A total of 147387 cSDH patients met inclusion between 2021–2023, with an average age of 72 years (95% CI: 71.9–72.1). Over this time period, 7566 patients were treated with craniotomy, 5555 patients were treated with burr hole evacuation, and 6907 patients were treated with MMAE. In 2021, craniotomy was the most common approach (4.1%, 95% CI: 3.9%-4.2%). By 2023, MMAE was the most common approach to cSDH treatment (4.0%, 95% CI: 3.9%-4.1%). There was a significant increase per year in the percent of patients treated with MMAE ($p<0.001$); there was not a significant difference in the rate of craniotomy or burr hole evacuation over time ($p=0.2$ and $p=0.3$, respectively). The average rate of increase in MMAE was 0.6% per year (95% CI: 0.6% to 0.6%). The average rate of decrease in craniotomy was -0.2% per year (95% CI: -0.9% to 0.5%). The average rate of decrease in burr hole evacuation was -0.1% per year (95% CI: -0.8% to 0.6%).

**Conclusions** For nontraumatic cSDH patients, rate of MMAE utilization has significantly increased over the past three years, and it has outpaced craniotomy and burr hole evacuation rates. Our population-level analysis demonstrates that recent clinical practice paradigms have likely shifted more toward incorporating MMAE in cSDH patient treatment.

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## E-226 MACHINE LEARNING PREDICTS NON-HOME DISCHARGE IN PATIENTS TREATED FOR UNRUPTURED CEREBRAL ANEURYSMS

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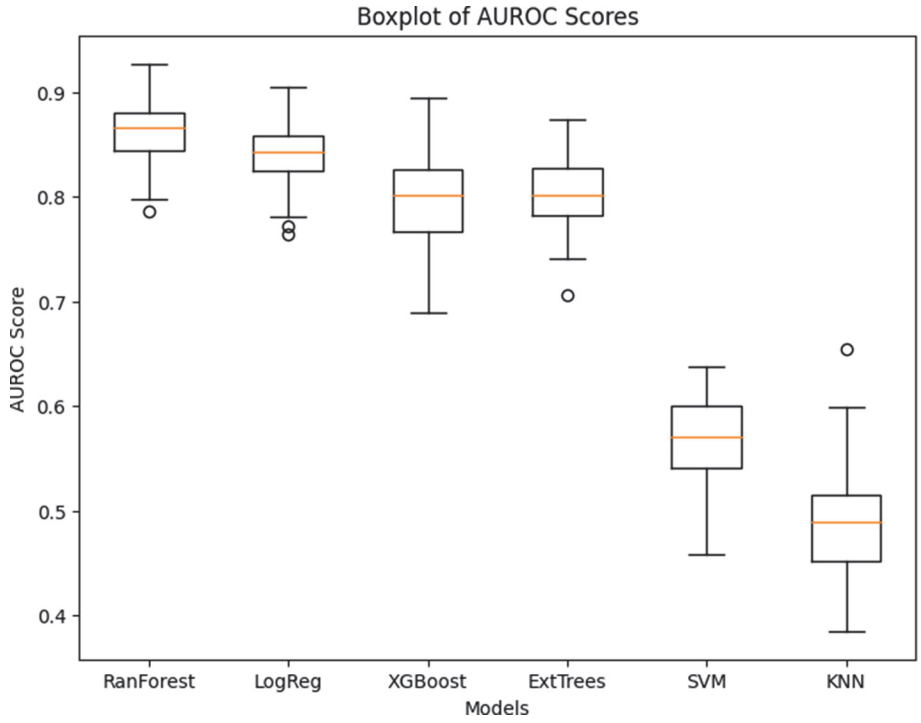
**Introduction** Non-home discharge (NHD) is an important metric of quality care and patient outcomes, as well as an




**Abstract E-226 Figure 1**

important reimbursement criterion. We assess the feasibility of machine learning to preoperatively predict NHD after unruptured intracranial aneurysm (UIA) treatment. Identifying patients at risk for NHD after UIA treatment could help guide providers that plan on counseling patients and help plan discharges for NHD patients.

**Methods** From a prospectively maintained database, all patients (n=547) treated for UIA between 2017 and 2022 was retrospectively reviewed. 21 baseline characteristics were collected, including age, sex, and underlying medical conditions. 7 UIA and treatment characteristics were also collected, including aneurysm morphology, location, modality of treatment (open surgery vs endovascular), and endovascular access route (radial, femoral). The data was randomly divided into training and testing sets with an 80:20 ratio. Given the unbalanced classes, Synthetic Minority Over-sampling TEchnique (SMOTE) was applied to the training set. Logistic regression and five machine learning algorithms were trained: Random Forest, Extremely Randomized Trees, Extreme Gradient Boosting (XGBoost), Support Vector Machine (SVM), and k-nearest neighbors (KNN).

**Results** 520 (95%) of eligible patients had no missing data and were selected for analysis. The rate of NHD was 3.8% (n=20). Random Forest was the best discriminant of NHD and had the highest mean AUROC of 0.86 (s.d. ±0.03) and accuracy of 0.93 (±0.01). Random Forest narrowly but significantly (Mann-Whitney U-test; p = 0.002) outperformed logistic regression which had AUROC = 0.84 (±0.03) and accuracy = 0.94 (±0.01). XGBoost (AUROC: 0.80±0.04, accuracy: 0.91±0.02) and Extremely Randomized Trees (AUROC: 0.80± 0.03; accuracy: 0.93±0.01) were sufficient as well. SVM (AUROC: 0.55±0.05); accuracy: 0.91±0.01) and KNN (AUROC: 0.49±0.05; Accuracy: 0.74±0.03) performed no better than random chance, however.

**Discussion** We demonstrate that well-designed models trained on a small dataset can successfully predict non-home discharges in unruptured intracranial aneurysm treatment. Tree-based models (Random Forest, Extremely Randomized Trees, and XGBoost) outperformed SVM and KNN, indicating that future studies may want to consider tree-based models for similar tasks. We prove that our models, and more generally, machine learning, can be used to provide precise and personalized neurosurgical care.

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## E-227 DELAYED DIAGNOSIS OF CAROTID CAVERNOUS FISTULA IN PATIENTS WITH OCULAR SYMPTOMS: A CASE SERIES AND LITERATURE REVIEW

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**Introduction** Carotid-Cavernous Fistulas (CCF) can be diagnostically challenging due to their diverse clinical presentations. Due to its anatomical location and the critical structures housed within the cavernous sinus, patients often present with nonspecific ocular symptoms. These presenting symptoms can mimic other ophthalmic and infectious conditions, leading to initial misdiagnosis. Highlighting this diagnostic complexity, we present a case series of three patients who initially presented