Machine learning for predicting the duration of surgery and length of stay for total knee arthroplasty

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DATA ANALYTICS & ARTIFICIAL INTELLIGENCE

HUMAN HEALTH

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Background

Total Knee Arthroplasty (TKA) is one of the most resource-intensive, high-volume surgical procedures. The two key drivers of its cost are:

- Duration of surgery (DOS),
- Postoperative inpatient length of stay (LOS).

The ability to predict TKA DOS and LOS has substantial implications for hospital finances, scheduling, and resource allocation.
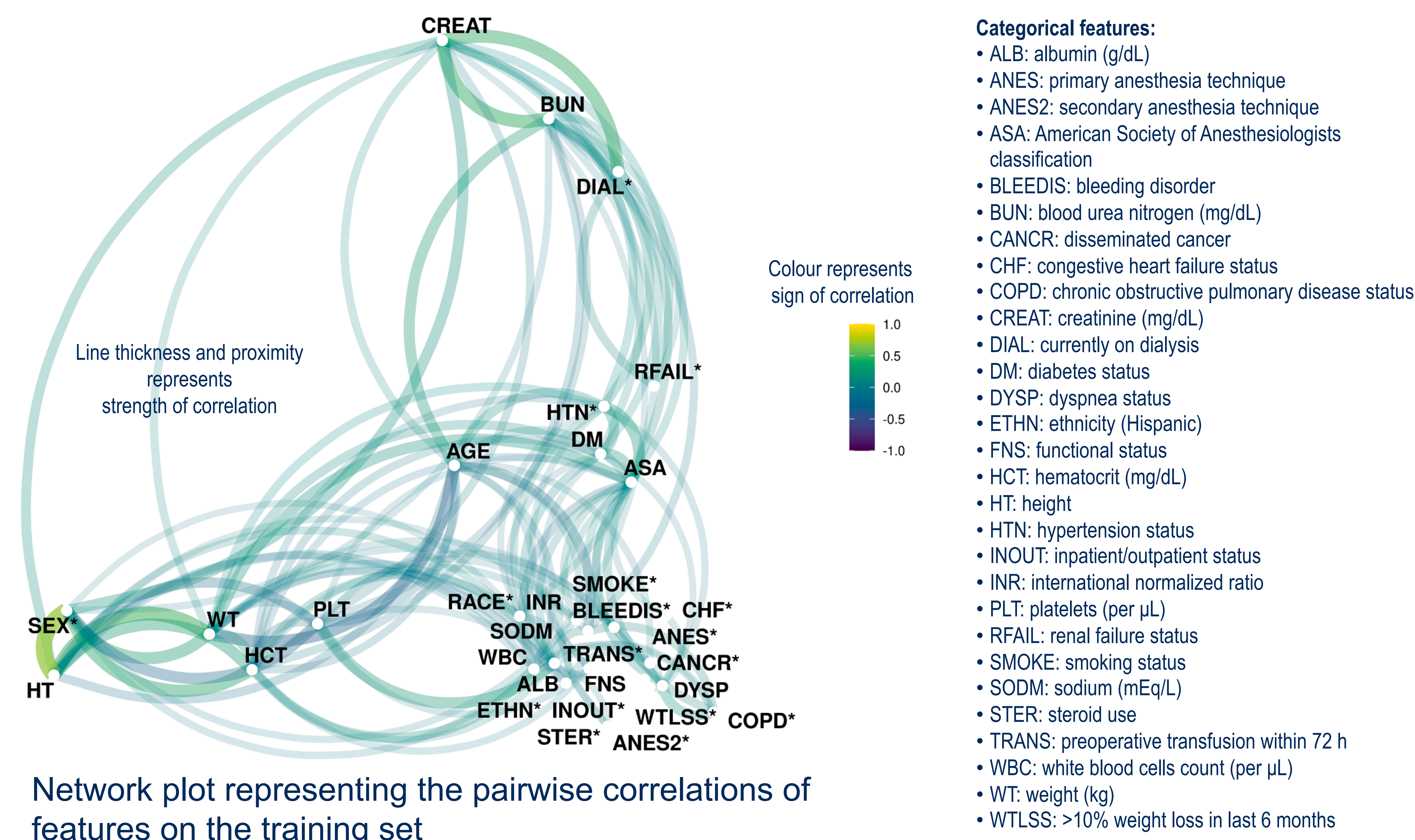
Methodology

Uses data from the American College of Surgeons (ACS) National Surgical and Quality Improvement (NSQIP) database, with a total of 302,300 patient records.

Trains and tests conventional and deep learning models to predict DOS and LOS for elective unilateral TKSs based on preoperative factors.
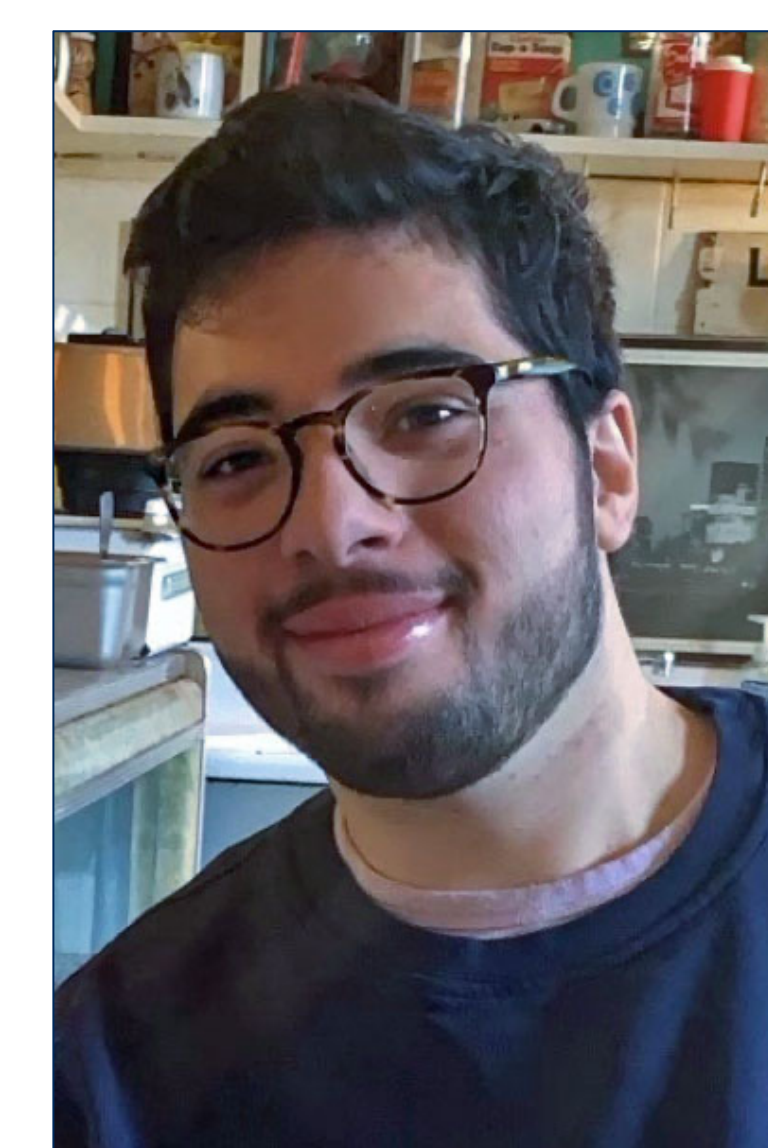
Models evaluated based on Mean Squared Error (MSE), buffer accuracy, and classification accuracy, and compared with mean regressors.

Results

Using preoperative factors, Deep Neural Networks can predict DOS and LOS with higher accuracy than simpler models.

Network plot representing the pairwise correlations of features on the training set

Categorical features:
- ALB: albumin (g/dL)
- ANES: primary anesthesia technique
- ANES2: secondary anesthesia technique
- ASA: American Society of Anesthesiologists classification
- BLEEDIS: bleeding disorder
- BUN: blood urea nitrogen (mg/dL)
- CANCR: disseminated cancer
- CHF: congestive heart failure status
- COPD: chronic obstructive pulmonary disease status
- CREAT: creatinine (mg/dL)
- DIAL: currently on dialysis
- DM: diabetes status
- DYSP: dyspnea status
- ETHN: ethnicity (Hispanic)
- FNS: functional status
- HCT: hematocrit (mg/dL)
- HT: height
- HTN: hypertension status
- INOUT: inpatient/outpatient status
- INR: international normalized ratio
- PLT: platelets (per µL)
- RFAIL: renal failure status
- SMOKE: smoking status
- SODM: sodium (mEq/L)
- STER: steroid use
- TRANS: preoperative transfusion within 72 h
- WBC: white blood cells count (per µL)
- WT: weight (kg)
- WTLSS: >10% weight loss in last 6 months

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