

Improving Transfusion Stewardship in Elective Orthopaedic Surgery: Utilization Patterns and a Predictive Risk Score from a Single-Year Cohort

Olufunmilola Adeleye¹, Romir P. Parmar, Santiago Logan-Baca, Victoria Greenstein, Patrick Saunders, Norman Barrington Chutkan

¹Orthopedic Surgery

INTRODUCTION:

Blood transfusion remains a critical component of orthopaedic perioperative care, particularly in trauma and arthroplasty surgery. However, excessive preoperative ordering and underutilization of red blood cells (RBCs) contribute to waste and strain on healthcare systems. Current tools, such as Maximum Surgical Blood Order Schedules (MSBOS), lack personalization and often overestimate transfusion need. This study aimed to (1) quantify transfusion utilization patterns in elective orthopaedic surgery and (2) develop a practical risk prediction model to guide blood ordering.

METHODS:

We performed a retrospective review of elective orthopaedic surgeries at a Level I trauma center from January to December 2023. In the first analysis, all 1,318 elective cases were assessed for preoperative RBC reservations, transfusions, and additional intra/postoperative RBC orders. In the second phase, a focused cohort of 671 patients (128 joint arthroplasty, 543 elective trauma cases) was analyzed to identify predictors of transfusion. Preoperative variables (hemoglobin, age, BMI), intraoperative details, and demographics were collected. Logistic regression identified independent predictors, and a 3-point transfusion risk score was derived and validated using 10-fold cross-validation.

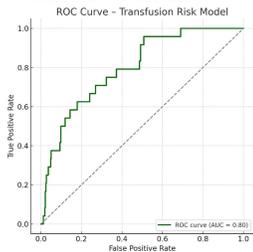
RESULTS:

Across all elective cases, 399 RBC units were held preoperatively for 166 patients; only 31 units (7.8%) were transfused, indicating that 92.2% of preoperative units went unused. Trauma surgery accounted for 85.5% of reserved units, with a 6.2% transfusion rate. An additional 62 units were ordered intra- or postoperatively, 40 (64.5%) of which were transfused. In the 671-patient model cohort, the overall transfusion rate was 3.5%. Transfused patients were older (62.3 vs. 51.4 years), had higher BMI (34.4 vs. 28.1 kg/m²), and lower pre-op hemoglobin (12.1 vs. 13.8 g/dL). Among trauma patients, transfused cases had significantly higher Injury Severity Scores (ISS: 18.2 vs. 9.6; p=0.004). Multivariable analysis identified hemoglobin <11 g/dL, age >65, and BMI >32 as independent predictors, alongside ASA class >2, estimated blood loss >250cc, and multisite/pelvic procedures. These six variables were incorporated into a simplified 6-point risk score. The model demonstrated strong discrimination with an AUC of 0.80 and stratified patients into low (0–2 points) and high (score ≥3 points) transfusion risk groups.

DISCUSSION AND CONCLUSION:

Most preoperative RBCs held for elective orthopaedic cases go unused, especially in trauma surgery, suggesting over-ordering under current MSBOS protocols. A simplified transfusion risk score based on hemoglobin, age, and BMI offers a practical tool for personalized blood planning. Integration of this model into preoperative workflows can reduce unnecessary holds, improve cost-efficiency, and support targeted transfusion stewardship in high-volume orthopaedic centers.

FIGURE 1: ROC CURVE – PREDICTIVE MODEL PERFORMANCE



Demographics of Study Cohort	Demographics of Study Cohort		P
	Pre-Operative Blood Ordered (n=166)	No Pre-Operative Blood Ordered (n=1,152)	
Total	166	1,152	
Age, mean ± SD	59.0 ± 16.2	57.9 ± 17.3	0.44
Gender, n(%)			
Male	101(60.8)	594 (51.6)	0.150
Female	65(39.2)	558 (48.4)	0.128
BMI, mean ± SD	29.4 ± 7.7	29.3 ± 7.8	0.88
Medical Comorbidities, n(%)			
Hypertension	72 (44.0)	509 (44.2)	0.972
Diabetes Mellitus	23 (14.9)	160 (13.9)	0.992
Chronic Kidney Disease	6 (3.6)	70 (6.1)	0.248
Disruptive Heart Failure	4 (2.4)	18 (1.6)	0.460
Chronic Kidney Disease	8 (4.8)	29 (2.5)	0.122
Hypertension	52 (31.3)	281 (24.6)	0.131
Aspirin	14 (8.4)	143 (12.5)	0.801

Total Procedures	Cases with blood ordered pre-op	Pre-op blood actually transfused (units)	Percentage of pre-op blood that were transfused	
Total	1,118	39	3.7%	
Trauma	542 (48.1)	142 (85.5)	21 (85.7)	6.16%
Joint	129 (11.5)	13 (8.5)	1 (2.3)	2.3%
Spine	207 (18.5)	1 (0.6)	4 (1.6)	0.6%
Spine II	11 (1.0)	0 (0)	0 (0)	-
Spine III	127 (11.3)	11 (6.9)	7 (5.5)	14.2%
U/S/Hand	10 (0.9)	0 (0)	0 (0)	-

(%) listed in the subjectivity rows demonstrate the proportion of the total units in that respective data column.

SIMPLIFIED RISK SCORE

- 1 point each for:
 - ✓ Hgb <11 g/dL
 - ✓ Age >65
 - ✓ BMI >32
 - ✓ ASA Class > 2
 - ✓ EBL > 250cc
 - ✓ Pelvis/multisite procedure
- Score 0-2: low risk → **no blood hold**
- Score 2+: high risk → **blood hold + optimize**