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Appendix 1: Candidate predictor variables

Preoperative Patient Characteristics
Age (<8 or ≥8, <10 or ≥10, 12< or ≥12), Gender, Height, Weight, Body Mass Index (Normal or Abnormal, Underweight or Not Underweight, Overweight/Obese or Not Overweight/Obese, Obese or Not obese), Etiology (Idiopathic or Not-Idiopathic, Neuromuscular or Not Neuromuscular, Syndromic or Not Syndromic, Congenital or Not Congenital), Major Coronal Curve (<70 degrees or ≥70 degrees, <90 degrees or ≥90 degrees), Sagittal Curve (Normal or Abnormal, Hypokyphosis or Not Hypokyphosis, Hyper-kyphosis or Not Hyper-kyphosis), ASA (1, 2, 3, 4 or 5, 1 or ≥2, 2 or ≥3), Pulmonary Comorbidity (e.g. asthma, restrictive airway disease), Cardiac Comorbidity (e.g. valve disorders, congenital heart defects), Behavioral Comorbidity (e.g. developmental delay, attention deficit hyperactivity disorder), Endocrine Comorbidity (e.g. diabetes, hypothyroidism), Gastrointestinal Comorbidity (e.g. gastrointestinal reflux disease, hiatal hernia), Immunologic Comorbidity (e.g. eczema, allergies), Musculoskeletal Comorbidity (e.g. myopathies), Neurologic Comorbidity (e.g. myelomeningocele, seizures), Nutritional Comorbidity (e.g. failure to thrive), Gastrostomy Tube, VP Shunt, Neural Axis Abnormality, Ambulatory Status (Ambulator or Non-Ambulator), Diaper Dependent (Independent or Dependent), Hemoglobin(Low: <10 g/dL or not, Normal:10 to 14 g/dL or not, High: >14*f* g/dL or not), Hematocrit (Low:<31% or not, Normal:31% to 48% or not, or High:48% or not), White Blood Cell Count (Low: <3.5/ul or not, Normal: 3.5 to 12/ul or not, or High: >12/ul or not), Prior Hospitalization within 2 Years of Surgery, Prior SSIs from Spine Surgery, Prior Spine Surgeries, Preoperative Halo Traction
Surgical Factors
Type of Surgery (Primary Instrumentation or Not, Definitive Fusion or Not, Revision or Not, Stapling or Not), Pelvic Instrumentation Procedure (not the presence from previous surgery), Intraoperative Skeletal Traction, Transfusion, Use of Cell Saver, Number of Level Instrumented (≥15 or <15), Type of Instrumentation (Hybrid or Screw Only), Spinal Osteotomy, 3-Column Pedicle Subtraction Osteotomy/Vertebral Column Resection, Skin Closure (Staple or Not), Procedure time (≥7 hours or <7 hours surgical time from the incision to the closure)
Hospital Factors
Geographic Region (Northeast or West), Area (Urban or Rural), Academic Health Center, Institutional Pediatric Spine Surgical Volume (<100 or ≥100)

*BMI were calculated using the CDC and the WHO equations for children and adolescents depending on gender and age.

Appendix 2. Method for handling missing data

Multiple imputations, one of the most popular simulation-based methods for incomplete data analysis, were used to handle missing values in candidate predictor variables. The multiple imputation technique was chosen to reserve sample size while minimizing bias and correcting standard errors for uncertainty due to missing data. The missing data for candidate predictive variables were assumed to be missing completely at random (MCAR) since reasons that data were missing were not associated with the surgical site infection (SSI) and the distribution of missing data was balance in those with and without SSI. Variables to be included in multiple imputation model were chosen based on univariable analyses. For each candidate predictive variables with missing values, 20 datasets were imputed.

Number (%) of missing values per candidate predictor variables, and distribution of predictors among subjects without and with missing values (100%:N=3092)

Candidate Predictor Variables		No Missing N (%)	Missing N (%)	Before Imputation [95%CI]	After Imputation N=3,092 [95%CI]	Patterns of Missing Data	Variables Used to Impute	# of Imputed Datasets
Preoperative Patient Characteristics								
Age in years, mean± SD (range)		3,092 (100%)	0 (0%)	13.0±4.1 [12.9; 13.2]	NA	NA	NA	NA
Gender		3,092 (100%)	0 (0%)		NA	NA	NA	NA
	Male			1,207 (39.0%)				
	Female			1,885 (61.0%)				
Height, mean± SD (range)		2,953 (95.5%)	139 (4.5%)	145.1±24.7 [144.2; 146.0]	144.4±25.0 [143.5; 145.3]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation	20

							Geographic Region, SSI	
Weight, mean± SD (range)		3,036 (98.2%)	56 (1.8%)	45.0±20.5 [44.2; 45.7]	44.7±20.6 [44.0; 45.5]	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Pelvic Instrumentation, Type of Surgery, SSI	20
BMI, mean± SD (range)		2,950 (95.4%)	142 (4.6%)	20.4±5.6 [20.2; 20.6]	20.3±5.7 [20.1; 20.5]	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, SSI	20
BMI	Abnormal Normal	3,037 (98.2%)	55 (1.8%)	1,193 (39.3%) 1,844 (60.7%)	1,218 (39.4%) [37.6%; 41.1%] 1,874 (60.6%) [58.9%; 62.4%]	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, SSI	20
BMI	Underweight Not underweight	3,037 (98.2%)	55 (1.8%)	418 (13.8%) 2,619 (86.2%)	427 (13.8%) [12.6%; 15.1%]	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction,	20

					2,665 (86.2%) [84.9%; 87.4%]		Type of Surgery, Pelvic Instrumentation, SSI	
BMI	Overweight/ obese Not overweight/ obese	3,037 (98.2%)	55 (1.8%)	776 (25.6%) 2,261 (74.4%)	792 (25.6%) [24.0%; 27.1%] 2,300 (74.4%) [72.9%; 76.0%]	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, SSI	20
BMI	Obese Not obese	3,037 (98.2%)	55 (1.8%)	402 (13.2%) 2,635 (86.8%)	411 (13.3%) [12.1%; 14.5%] 2,681(86.7%) [85.5%; 87.9%]	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, SSI	20
Etiology	Congenital Neuromuscular Syndromic Idiopathic Others	3,092 (100%)	0 (0%)	474 (15.3%) 806 (26.1%) 284 (9.2%) 1,511 (48.8%) 17 (0.6%)	NA	NA	NA	NA
Major Coronal Curve, mean± SD (range)		2,912 (94.2%)	180 (5.8%)	60.5± 23.3 [59.6; 61.2]	60.5± 24.0 [59.6; 61.3]	Arbitrary	Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction,	20

							Type of Surgery, Geographic Region, Pelvic Instrumentation, SSI	
Sagittal Curve	Hypo-kyphosis Normo-kyphosis Hyper-kyphosis	2,670 (86.4%)	422 (13.6%)	432 (16.4%) 1,358 (50.9%) 875 (32.8)	504 (16.3%) [14.9%; 17.7%] 1,713 (55.4%) [53.6%; 57.2%] 875 (28.3%) [26.7%; 29.9%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Geographic Region, Surgical Volume, Pelvic Instrumentation, SSI	20
Sagittal Curve	Hypo/hyper kyphosis Normal-kyphosis	2,670 (86.4%)	422 (13.6%)	1,313 (49.2%) 1,357 (50.8%)	1,512 (48.9%) [46.9%; 50.8%] 1,580 (51.1%) [49.2%; 53.1%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Geographic Region, Surgical Volume, Pelvic Instrumentation, SSI	20
ASA	1 2	2,999 (97.0%)	93 (3.0%)	644 (21.5%) 1,216 (40.5%)	653 (21.1%) [19.6%; 22.5%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence,	20

	3 4 5			996 (33.2%) 66 (2.2%) 77 (2.6%)	1,249 (40.4%) [38.6%; 42.1%] 1,042 (33.7%) [32.0%; 35.4%] 68 (2.2%) [1.7%; 2.8%] 80 (2.6%) [2.1%; 3.2%]		Halo Traction, Type of Surgery, Geographic Region, Surgical Volume, Pelvic Instrumentation, SSI	
Pulmonary Comorbidity	Present Absent	3,046 (98.5%)	46 (1.5%)	586 (19.2%) 2,460 (80.8%)	600 (19.4%) [18.0%; 20.8%] 2,492 (80.6%) [79.2%; 82.0%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Surgical Volume, Pelvic Instrumentation, SSI	20
Cardiac Comorbidity	Present Absent	3,046 (98.5%)	46 (1.5%)	227 (7.5%) 2,819 (92.5%)	232 (7.5%) [6.5%; 8.4%] 2,860 (92.5%) [91.6%; 93.5%]		Age, Gender, Etiology, Halo Traction, SSI	20
Behavioral Comorbidity	Present Absent	3,046 (98.5%)	46 (1.5%)	527 (17.3%) 2,519 (82.7%)	538 (17.4%) [16.0%; 18.7%] 2,554 (82.6%) [81.2%; 84.0%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Pelvic Instrumentation, Type of Surgery,	20

							Surgical Volume, SSI	
Endo Comorbidity	Present Absent	3,045 (98.5%)	47 (1.5%)	133 (4.4%) 2,912 (95.6%)	136 (4.4%) [3.7%; 5.1%] 2,956 (95.6%) [94.9%; 96.3%]	Arbitrary	Etiology, Ambulatory Status, Diaper Dependence, Type of Surgery, Surgical Volume, SSI	20
GI Comorbidity	Present Absent	3,045 (98.5%)	47 (1.5%)	379 (12.5%) 2,666 (87.6%)	390 (12.6%) [11.4%; 13.8%] 2,702 (87.4%) [86.2%; 88.6%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Pelvic Instrumentation, Type of Surgery, Surgical Volume, SSI	20
Immunology Comorbidity	Present Absent	3,046 (98.5%)	46 (1.5%)	37 (1.2%) 3,009 (98.8%)	37 (1.2%) [0.8%; 1.6%] 3,055 (98.8%) [98.4%; 99.2%]	Arbitrary	Etiology, Ambulatory Status, Geographic Region, Surgical Volume, SSI	20
Nutritional Comorbidity	Present Absent	3.045 (98.5%)	47 (1.5%)	132 (4.3%) 2,913 (95.7%)	136 (4.4%) [3.7%; 5.2%] 2,956 (95.6%) [94.8%; 96.3%]	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Pelvic Instrumentation, Type of Surgery,	20

							Surgical Volume, SSI	
MSK Comorbidity	Present Absent	3,046 (98.5%)	46 (1.5%)	438 (14.4%) 2,608 (85.6%)	442 (14.3%) [13.1%; 15.6%] 2,650 (85.7%) [84.4%; 86.9%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, Geographic Region, SSI	20
Neurologic Comorbidity	Present Absent	3,046 (98.5%)	46 (1.5%)	698 (22.9%) 2,348 (77.1%)	708 (22.9%) [21.4%; 24.4%] 2,384 (77.1%) [75.6%; 78.6%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, Geographic Region, SSI	20
G-Tube	Present Absent	3,051 (98.7%)	41 (1.3%)	358 (11.7%) 2,693 (88.3%)	368 (11.9%) [10.7%; 13.0%] 2,724 (88.1%) [87.0%; 89.3%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation Geographic	20

							Region, Surgical Volume, SSI	
VP Shunt	Present Absent	2,998 (97.0%)	94 (3.0%)	92 (3.1%) 2,906 (96.9%)	102 (3.3%) [2.6%; 3.9%] 2,990 (96.7%) [96.1%; 97.4%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependent, Pelvic Instrumentation, Type of Surgery, SSI	20
Neural Axis	Present Absent	3,039 (98.3%)	53 (1.7%)	266 (8.8%) 2,773 (91.2%)	272 (8.8%) [7.8%; 9.8%] 2,820 (91.2%) [90.2%; 92.2%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependent, Type of Surgery, Pelvic Instrumentation, Geographic Region, SSI	20
Ambulatory Status	Non-ambulator Ambulator	3,092 (100%)	0 (0%)	735 (23.8%) 2,357 (76.2%)	NA	NA	NA	NA
Diaper Dependence	Dependent Independent	3,092 (100%)	0 (0%)	701 (22.7%) 2,391 (77.3%)	NA	NA	NA	NA
HGB in g/dl, mean± SD (range)		2,874 (92.9%)	218 (7.1%)	13.2 ± 1.5 (6.6; 19.9)	13.2 ± 1.6 [13.2; 13.3]	Arbitrary	Gender, Etiology, Ambulatory Status, Halo Traction, Type of Surgery, Pelvic	20

							Instrumentation, Geographic Region, SSI	
HCT in %, mean± SD (range)		2,823 (91.3%)	269 (8.7%)	39.2 ± 4.2 (21.5; 58.0)	39.3 ± 4.3 [39.1; 39.4]	Arbitrary	Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, Geographic Region, SSI	20
WBC in #/ul, mean± SD (range)		2,823 (91.3%)	269 (8.7%)	7.1 ± 3.0 (1; 26.2)	7.1 ± 3.2 [6.9; 7.2]	Arbitrary	Gender, Etiology, Ambulatory Status, Diaper Dependence, Pelvic Instrumentation, Halo Traction, Type of Surgery, SSI	20
Hospitalization within 2 years	Yes No	2,995 (96.9%)	97 (3.1%)	653 (21.8%) 2,342 (78.2%)	680 (22.0%) [20.5%; 23.4%] 2,412 (78.0%) [76.6%; 79.5%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, Geographic Region, Surgical Volume, SSI	20

Prior SSI	Yes No	3,003 (97.1%)	89 (2.9%)	129 (4.3%) 2,874 (95.7%)	136 (4.4%) [3.6%; 5.1%] 2,956 (95.6%) [94.9%; 96.4%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, Surgical Volume, SSI	20
Prior Spine SSI	Yes No	3,003 (97.1%)	89 (2.9%)	101 (3.4%) 2,902 (96.6%)	102 (3.3%) [2.7%; 4.0%] 2,990 (96.7%) [96.0%; 97.3%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependent, Pelvic Instrumentation, Type of Surgery, Surgical Volume, Prior Spine Surgery, SSI	20
Prior Spine Surgery	Yes No	3,092 (100%)	0 (0%)	710 (23.0%) 2,382 (77.0%)	NA	NA	NA	NA
Preoperative Halo Traction	Yes No	3,092 (100%)	0 (0%)	143 (4.6%) 2,949 (95.4%)	NA	NA	NA	NA
Surgical Factors								
Type of Surgery		3,092 (100%)	(0) 0%	1,434 (46.4%)	NA	NA	NA	NA

	Primary Instrumentation Definitive Fusion Revision Others			1,220 (39.4%) 427 (13.8%) 11 (0.4%)				
Surgical Approach	 Anterior Posterior Combined	3,002 (97.1%)	90 (2.9%)	 42 (1.4%) 2,835 (94.4%) 125 (4.2%)	 43 (1.4%) [1.0%; 1.8%] 2,929 (94.4%) [93.5%; 95.2%] 130 (4.2%) [3.5%;5.0%]	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Halo Traction, Type of Surgery, Pelvic Instrumentation, Surgical Volume, SSI	20
Pelvic Instrumentation	 Yes No	3,092 (100%)	0 (0%)	 637 (20.6%) 2,455 (79.4%)	NA	NA	NA	20
Intraoperative Skeletal Traction	 Yes No	3,004 (97.2%)	88 (2.8%)	 257 (8.6%) 2,747 (91.4%)	 263 (8.5%) [7.5%; 9.5%] 2,829 (91.5%) [90.5%; 92.5%]	Arbitrary	Gender, Etiology, Ambulatory Status, Diaper Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, Geographic Region, Surgical Volume, SSI	20
Instrumented Levels in #, mean± SD (range)		2,798 (90.5%)	294 (9.5%)	10.9 ± 4.8 [10.8; 11.1]	11.0 ± 5.1 [10.9; 11.2]	Arbitrary	Gender, Etiology, Ambulatory Status, Diaper Dependence,	20

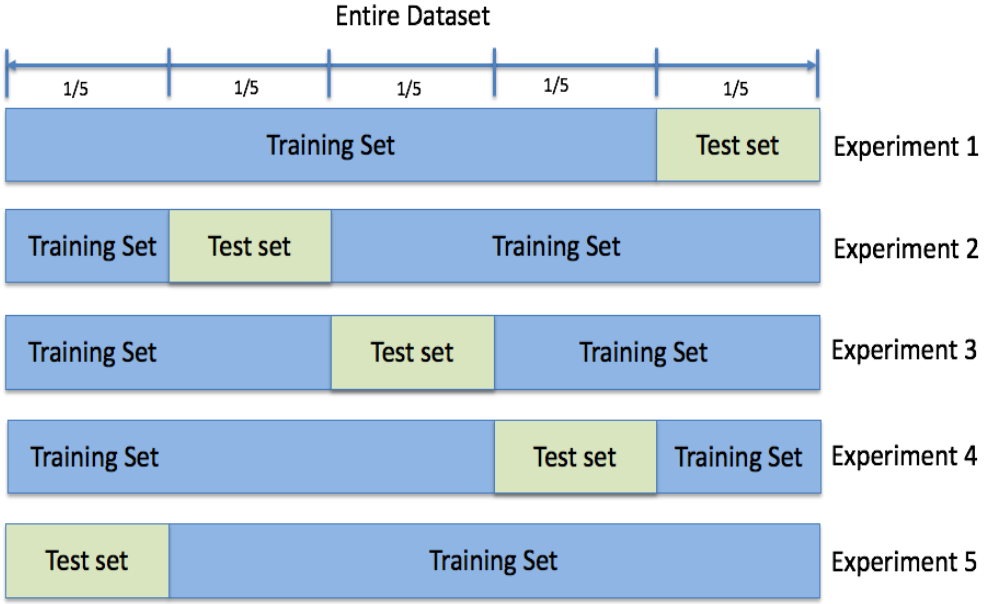
							Prior Spine Surgery, Halo Traction, Type of Surgery, Pelvic Instrumentation, Region, SSI	
Type of Instrumentation	Hybrid Screws Only	2,816 (91.1%)	276 (8.9%)	784 (27.8%) 2,032 (72.2%)	931 (30.1%) 2,161 (69.9%)	Arbitrary	Age, Gender, Etiology, Ambulatory Status, Diaper Dependence, Prior Spine Surgery, Halo Traction, Type of Surgery, Pelvic Instrumentation, Region, Surgical Volume, SSI	20
Spinal Osteotomies	Yes No	3,090 (99.9%)	2 (0.1%)	1,125 (36.4%) 1,965 (63.6%)	1,125 (36.4%) 1,967 (63.6%)	Arbitrary	Age, Etiology, Halo Traction, Type of Surgery, Pelvic Instrumentation, Surgical Volume, SSI	20
VCR	Yes No	2,816 (91.1%)	276 (8.9%)	94 (3.3%) 2,722 (96.7%)	108 (3.5%) 2,984 (96.5%)	Arbitrary	Age, Gender, Etiology, Halo Traction, Type of Surgery, Region, Surgical Volume, SSI	20
Transfusion		2,427 (78.5%)	665 (21.5%)			Arbitrary	Age, Etiology, Ambulatory Status, Diaper	20

	Yes No			868 (35.8%) 1,559 (64.2%)	1,132 (36.6%) 1,960 (63.4%)		Dependence, Halo Traction, Type of Surgery, Pelvic Instrumentation, Region, Surgical Volume, SSI	
Cell Saver	 Yes No	2,432 (78.7%)	660 (21.3%)	 1,405 (57.8%) 1,027 (42.2%)	 1,592 (51.5%) 1,500 (48.5%)	Arbitrary	Age, Etiology, Ambulatory Status, Diaper Dependence, Prior Spine Surgery, Type of Surgery, Pelvic Instrumentation, Region, Surgical Volume, SSI	20
Staples Skin Closure	 Yes No	2,818 (91.1%)	274 (8.9%)	 12 (0.4%) 2,806 (99.6%)	 12 (0.4%) 3,078 (99.6%)	Arbitrary	Diaper Dependence, Halo Traction, Type of Surgery, Surgical Volume	20
Procedure Time in hours, mean± SD [95% CI]		2,416 (78.1%)	676 (21.9%)	5.9 ± 2.3 [5.8; 6.0]	5.8 ± 2.6 [5.7; 5.9]	Arbitrary	Gender, Etiology, Ambulatory Status, Diaper Dependence, Prior Spine Surgery, Halo Traction, Type of Surgery, Pelvic Instrumentation, Region, SSI	20
Hospital Characteristics								

Geographic Region	Northeast West	3,092 (100%)	0 (0%)	2,346 (75.9%) 746 (24.1%)	NA	NA	NA	NA
Area	Urban Rural	3,092 (100%)	0 (0%)	3,092 (100%) 0 (0%)	NA	NA	NA	NA
Academic Health Center	Yes No	3,092 (100%)	0 (0%)	3,084 (99.7%) 8 (0.3%)	NA	NA	NA	NA
Surgical Volume/Year, mean± SD (range)		3,092 (100%)	0 (0%)	73.8 ± 74.0 (1.6; 220)	NA	NA	NA	NA

Appendix 3. Five-fold cross validation

Since the model were likely to have a large number of parameters, it was possible that the model overfits the data. Therefore, five-fold cross-validation was performed to determine the presence of overfit, which is indicated by within-sample error being considerably smaller than out-of-sample error. The five-fold cross-validation allowed us to estimate the out-of-sample error by dividing data into a training set which fits the model and a test set which evaluates performance (estimates error). First, the entire dataset was divided into five equal sized subsets (see below figure). For each of five experiments, we utilized four folds as training set to fit the model and produce parameter estimates. Then an AUC and standard error for the training set were calculated. Next, use the fitted model on the remaining one-fold to produce AUC and standard error in the testing set. The within-sample error was estimated as the average error on training set and the out-of-sample error was estimated as the average error on test sets. This five-fold cross validation was performed on each of ten models.



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Appendix 4: Description and Interpretation of Discrimination and Calibration Testing of the Final Model

	Type of Testing	Description [47]	Training Set N=2,474 (80% of N=3,092)	Testing Set N=618 (20% of N=3,092)	Interpretation
Discrimination	Area Under Curve, % (mean, SE) [95% CI]	C-statistics using the receiver operating characteristic (ROC) curve plotting sensitivity vs 1-specificity and calculating area under the curve (AUC) (adequate AUC:>70%)	77.31, 2.20 [73.00;81.62]	76.40, 4.38 [67.60;84.77]	A patient with the SSI was given higher probability of SSI by the model than a randomly chosen patients without SSI 76.4% of the time.
	Discrimination Plot and Slope (mean, SE) [95% CI]	The absolute difference in average predictions for those with and without the SSI (larger value of adequate discrimination slope is better but depends on frequency of the outcome)	0.05, 0.004 [0.04; 0.06]	0.04, 0.01 [0.03; 0.05]	The difference in means of prediction for those with and those without SSI was approximately 4%.
	Lorenz Curve, % (p25, p50, p75)	The proportion of patients developing SSI against the cumulative proportion of the population ranked by probability of SSI risk predicted by the model. (smaller proportion below 75% and larger proportion above 75% is better)	2.93, 14.43, 39.02	3.77, 13.85, 37.86	When patients were ranked in order of SSI probability calculated by the model, only 3.77% of patients with SSI were ranked below 25%, about 13.85% with SSI were ranked below 50% and approximately 37.86% with SSI were ranked below 75%. Approximately 62.14% of patients with SSI were above 75% when ranked in order of SSI probability yielded by the model.
Calibration	Expected/Observed Ratio	The ratio of the average expected to the average observed (closer to 1 the better)	0.99	0.99	The ratio of the average expected SSI to the averaged observed SSI was 1.
	Calibration-in-the-Large (CITL)	The difference between the average of the observed SSI and the average of the predictions (closer to 0 the better)	0.01	0.01	The difference between the average of the observed SSI and the average of prediction is 0.01 which means they are almost the same.
	Calibration Slope	The average effect reductions of predictors to improve the calibration of models for new sets of patients (closer to 1 the better)	1.04	0.98	The reduction of the effects of predictors on average to make the model well calibrated for new patients from the underlying population is 0.01.
	Hosmer-Lemeshow Goodness-of-Fit (HL GOF)	The ability of a model to fit a given set of data (adequate HL GOF: p value: >0.05)	0.01	0.44	Since p=0.44, there is no evidence to reject the null hypothesis that predicted probabilities of SSI is not different from the observed SSI.

Appendix 5. Power analysis

Model Validations

Sample Size (Procedures)	% of SSI									
	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
	Number of SSI									
1,500	45	60	75	90	105	120	135	150	165	180
2,000	60	80	100	120	140	160	180	200	220	240
2,500	75	100	125	150	175	200	225	250	275	300
3,000	90	120	150	180	210	240	270	300	330	360
3,500	105	140	175	210	245	280	315	350	385	420
4,000	120	160	200	240	280	320	360	400	440	480
4,500	135	180	225	270	315	360	405	450	495	540
5,000	150	200	250	300	350	400	450	500	550	600

Model Comparisons

Alpha	Sample Size (Procedures)	Power							
		AUC Difference -/+0.02				AUC Difference -/+0.03			
		0.72	0.76	0.80	0.84	0.72	0.76	0.80	0.84
0.05	1,055	0.41	0.41	0.42	0.45	0.74	0.74	0.76	0.79
0.05	1,060	0.41	0.41	0.42	0.45	0.74	0.74	0.76	**0.80**
0.05	1,150	0.44	0.44	0.45	0.48	0.77	0.77	0.79	**0.83**
0.05	1,175	0.45	0.45	0.46	0.49	0.78	0.78	**0.80**	**0.84**
0.05	1,200	0.45	0.45	0.47	0.50	0.79	0.79	**0.81**	**0.84**
0.05	1,225	0.46	0.46	0.48	0.51	**0.80**	**0.80**	**0.82**	**0.85**
0.05	1,250	0.47	0.47	0.48	0.52	**0.80**	**0.81**	**0.82**	**0.86**
0.05	1,500	0.54	0.54	0.56	0.59	**0.87**	**0.87**	**0.89**	**0.91**
0.05	2,000	0.66	0.66	0.68	0.72	**0.95**	**0.95**	**0.96**	**0.97**

0.05	2,400	0.74	0.74	0.76	**0.80**	**0.97**	**0.98**	**0.98**	**0.99**
0.05	2,500	0.76	0.76	0.78	**0.81**	**0.98**	**0.98**	**0.98**	**0.99**
0.05	2,600	0.77	0.78	0.79	**0.83**	**0.98**	**0.98**	**0.99**	**0.99**
0.05	2,650	0.78	0.78	**0.80**	**0.83**	**0.98**	**0.98**	**0.99**	**0.99**
0.05	2,750	**0.80**	**0.80**	**0.81**	**0.85**	**0.99**	**0.99**	**0.99**	**0.99**

Bolded numbers: power> 0.8

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Appendix 6. Descriptive statistics for candidate predictors before multiple imputations

The distribution of study participants was examined before the imputation for each candidate predictive variables. The 95% confidence intervals for mean value or proportionality was presented for each imputed candidate predictor variables.

		Descriptive Analyses				Univariable Regression	
Candidate Predictor Variables		**Observed N (% of Total N=3092)**	**All Patients**	**Patients without SSI (N=2,960)**	**Patients with SSI (N=132)**	**Beta Coefficient [95% CI]**	**p value**
Preoperative Patient Characteristics							
Age in years, mean± SD [95% CI]		3,092 (100%)	13.0±4.1 [12.9; 13.2]	13.0±4.1 [12.9; 13.2]	12.9±4.6 [12.1; 13.7]	-0.01 [-0.05; 0.03]	0.638
Age		3,092 (100%)				0.39 [0.32; 0.75]	**0.033**
	<12		957 (31.0%)	905 (94.6%)	52 (5.4%)		
	≥12		2,135 (69.0%)	2,055 (96.2%)	80 (3.8%)		
Gender		3,086 (99.8%)				0.63 [0.28; 0.98]	**<0.001**
	Male		1,204 (39.0%)	1,133 (94.1%)	71 (5.9%)		
	Female		1,882 (61.0%)	1,821 (96.8%)	61 (3.2%)		
Height, mean± SD [95% CI]		2,953 (95.5%)	145.1±24.7 [144.2; 146.0]	145.3±24.5 [144.4; 146.2]	138.9±26.8 [134.0; 143.8]	-0.01 [-0.02; -0.002]	**0.006**
Weight, mean± SD [95% CI]		3,036 (98.2%)	45.0±20.5 [44.2; 45.7]	45.0±20.3 [44.3; 45.7]	44.2±24.7 [39.9; 48.5]	-0.002 [-0.01; 0.01]	0.667
BMI		3,037 (98.2%)				0.50 [0.15; 0.86]	**0.005**
	Abnormal		1,193 (39.3%)	1,127 (94.5%)	66 (5.5%)		
	Normal		1,844 (60.7%)	1,781 (96.6%)	63 (3.4%)		
BMI		3,037 (98.2%)				0.48 [0.04; 0.93]	**0.033**
	Underweight		418 (13.8%)	392 (93.8%)	26 (6.2%)		
	Not underweight		2,619 (86.2%)	2,516 (96.1%)	103 (3.9%)		

BMI	Overweight/ obese Not overweight/ obese	3,037 (98.2%)	776 (25.5%) 2,261 (74.5%)	735 (94.7%) 2,173 (96.1%)	41 (5.3%) 88 (3.9%)	0.32 [-0.06; 0.70]	0.099
BMI	Obese Not obese	3,037 (98.2%)	402 (13.2%) 2,635 (86.8%)	379 (94.3%) 2,529 (96.0%)	23 (5.7%) 106 (4.0%)	0.37 [-0.09; 0.83]	0.118
Etiology	Non-idiopathic Idiopathic	3,092 (100%)	1,582 (51.2%) 1,510 (49.7%)	1,479 (93.5%) 1,481 (98.1%)	103 (6.5%) 29 (1.9%)	1.27 [0.85; 1.69]	**<0.001**
Etiology	Congenital Non-congenital	3,092 (100%)	474 (15.3%) 2,618 (84.7%)	459 (96.8%) 2,501 (95.5%)	15 (3.2%) 117 (4.5%)	-0.36 [-0.91; 0.19]	0.198
Etiology	Neuromuscular Non-neuromuscular	3,092 (100%)	807 (26.1%) 2,285 (73.9%)	730 (90.5%) 2,230 (97.6%)	77 (9.5%) 55 (2.4%)	1.45 [1.10; 1.81]	**<0.001**
Etiology	Syndromic Non-syndromic	3,092 (100%)	284 (9.2%) 2,808 (90.8%)	273 (96.1%) 2,687 (95.7%)	11 (3.9%) 121 (4.3%)	-0.11 [-0.74; 0.52]	0.729
Major Coronal Curve, mean± SD [95% CI]		2,910 (94.1%)	60.5± 23.3 [59.6; 61.2]	60.3±23.1 [59.5; 61.2]	63.7±27.4 [58.8; 68.7]	0.01 [-0.001; 0.014]	0.117
Major Coronal Curve	≥70 <70	2,910 (94.1%)	779 (26.8%) 2,133 (73.2%)	733 (94.1%) 2,059 (96.5%)	46 (5.9%) 74 (3.5%)	0.56 [0.18; 0.93]	**0.004**
Major Coronal Curve		2,910 (94.1%)				0.59 [0.08; 1.11]	**0.025**

	≥90 <90		266 (9.1%) 2,646 (90.9%)	248 (93.2%) 2,544 (91.1%)	18 (6.8%) 102 (3.9%)		
Sagittal Curve		2,910 (86.4%)					
	Normo-kyphosis		1,358 (50.9%)	1,309 (96.4%)	49 (3.6%)	reference	
	Hypo-kyphosis		437 (16.4%)	415 (95.0%)	22 (5.0%)	0.35 [-0.17; 0.86]	0.185
	Hyper-kyphosis		875 (32.8)	837 (95.7%)	38 (4.3%)	0.19 [-0.24; 0.63]	0.382
Sagittal Curve		2,910 (86.4%)				0.25 [-0.14; 0.63]	0.212
	Hypo/hyper kyphosis		1,313 (49.2%)	1,253 (95.4%)	60 (4.6%)		
	Normal-kyphosis		1,357 (50.8%)	1,308 (96.4%)	49 (3.6%)		
ASA		2,996 (96.9%)					
	1		644 (21.5%)	638 (99.1%)	6 (0.9%)	reference	
	2		1,215 (40.5%)	1,180 (97.1%)	35 (2.9%)	1.15 [0.28; 2.02]	**0.010**
	3		994 (33.2%)	916 (92.2%)	78 (7.9%)	2.20 [1.37; 3.04]	**<0.001**
	4		66 (2.2%)	60 (90.9%)	6 (9.1%)	2.36 [1.20; 3.53]	**<0.001**
	5		77 (2.6%)	75 (97.4%)	2 (2.6%)	1.04 [-0.58; 2.66]	0.207
ASA		2,996 (96.9%)				1.75 [0.93; 2.58]	**<0.001**
	>1		2,352 (78.5%)	2,231 (94.9%)	212 (5.1%)		
	1		644 (21.5%)	638 (99.1%)	6 (0.9%)		
ASA		2,996 (96.9%)					
	>2		1,137 (37.9%)	1,051 (92.4%)	86 (7.6%)	1.29 [0.91; 1.67]	**<0.001**
	1-2		1,859 (62.1%)	1,818 (97.8%)	41 (2.2%)		
Pulmonary Comorbidity		3,034 (98.1%)				0.65 [0.27; 1.04]	**0.001**
	Present		586 (19.3%)	546 (93.2%)	40 (6.8%)		
	Absent		2,448 (80.7%)	2,358 (96.3%)	90 (3.7%)		
Cardiac Comorbidity		3,034 (98.1%)				0.42 [-0.15; 0.99]	0.148
	Present		227 (7.5%)	213 (93.8%)	14 (6.2%)		
	Absent		2,807 (92.5%)	2,691 (95.9%)	116 (4.1%)		

Behavioral Comorbidity		3,037 (98.2%)				0.59 [0.19; 0.99]	**0.004**
	Present		527 (17.4%)	492 (93.4%)	35 (6.6%)		
	Absent		2,510 (82.6%)	2,415 (96.2%)	95 (3.8%)		
Endo Comorbidity		2,987 (96.4%)				-0.15 [-0.06; 0.76]	0.748
	Present		133 (4.5%)	128 (96.2%)	5 (3.8%)		
	Absent		2,849 (95.5%)	2,725 (95.7%)	124 (4.3%)		
GI Comorbidity		3,034 (98.1%)				0.72 [0.27; 1.17]	**0.002**
	Present		326 (10.7%)	301 (9.2%)	25 (7.7%)		
	Absent		2,708 (89.3%)	2,603 (96.1%)	105 (3.9%)		
Immunology Comorbidity		2,983 (96.5%)				0.24 [-1.20; 1.67]	0.746
	Present		37 (1.2%)	35 (94.6%)	2 (5.4%)		
	Absent		2,946 (98.8%)	2,819 (95.7%)	127 (4.3%)		
Nutritional Comorbidity		2,883 (93.2%)				0.45 [-0.47; 1.38]	0.338
	Present		5 (2.6%)	70 (93.3%)	5 (6.7%)		
	Absent		2,808 (97.4%)	2,686 (95.7%)	122 (4.3%)		
MSK Comorbidity		3,034 (98.1%)				0.6244 [0.2030; 1.0458]	**0.004**
	Present		432 (14.2%)	402 (93.1%)	30 (6.9%)		
	Absent		2,602 (85.5%)	2,502 (96.2%)	100 (3.8%)		
Neurologic Comorbidity		3,034 (98.1%)				0.96 [0.60; 1.32]	**<0.001**
	Present		692 (22.8%)	637 (92.1%)	55 (7.9%)		
	Absent		2,342 (77.2%)	2,267 (96.8%)	75 (3.2%)		
G-Tube		3,009 (97.3%)				0.85 [0.43; 1.27]	**<0.001**
	Present		358 (11.9%)	328 (91.6%)	30 (8.4%)		
	Absent		2,651 (88.1%)	2,557 (96.2%)	100 (3.8%)		
VP Shunt		2,883 (93.2%)				1.14 [0.48; 1.80]	**0.001**

	Present Absent		92 (3.2%) 2,791 (96.8%)	81 (88.0%) 2,675 (95.8%)	11 (22.0%) 116 (4.2%)		
Neural Axis		3,010 (97.3%)				0.31 [-0.24; 0.87]	0.269
	Present Absent		266 (8.8%) 2,744 (91.2%)	251 (94.4%) 2,629 (95.8%)	15 (5.6%) 115 (4.2%)		
Ambulatory Status		3,076 (99.5%)				1.56 [1.20; 1.93]	**<0.001**
	Non-ambulatory Ambulatory		731 (23.8%) 2,345 (76.2%)	655 (89.6%) 2,289 (97.6%)	76 (10.4%) 56 (2.4%)		
Diaper Dependence		2,607 (84.3%)				1.36 [0.95; 1.77]	**<0.001**
	Dependent Independent		436 (16.7%) 2,171 (83.3%)	394 (90.4%) 2,113 (97.3%)	42 (9.6%) 58 (2.8%)		
HGB in g/dl, mean± SD [95% CI]		2,874 (92.9%)	13.2 ± 1.5 [13.2; 12.3]	13.2 ± 1.5 [13.1; 13.3]	13.2 ± 1.7 [12.9; 13.5]	-0.02 [-0.13; 0.10]	0.784
HGB in g/dl		2,874 (92.9%)				0.79 [0.04; 1.53]	**0.040**
	Low: <10 Not Low: ≥10		89 (3.1%) 2,785 (96.9%)	81 (91.0%) 2,665 (95.7%)	8 (9.0%) 120 (4.3%)		
HGB in g/dl		2,874 (92.9%)				0.52 [0.16; 0.89]	**0.004**
	Abnormal: <10 or >14 Normal: 10-14		882 (30.7%) 1,992 (69.3%)	828 (93.9%) 1,918 (96.3%)	54 (6.1%) 74 (3.7%)		
HGB in g/dl		2,874 (92.9%)				0.41 [0.04; 0.78]	**0.032**
	High >14 Not High: ≤14		793 (27.6%) 2,081 (72.4%)	747 (94.2%) 1,999 (96.1%)	46 (5.8%) 82 (3.9%)		
HCT in %, mean± SD [95% CI]		2,823 (91.3%)	39.2 ± 4.2 [39.1; 39.4]	39.2 ± 4.2 [39.1; 39.4]	39.4 ± 4.7 [38.6; 40.2]	0.01 [-0.03; 0.05]	0.695
HCT in %		2,823 (91.3%)				0.07 [-0.84; 0.99]	0.877
	Low: <31		104 (3.7%)	99 (95.2%)	5 (4.8%)		

	Not Low: ≥31		2,719 (96.3%)	2,597 (95.5%)	(122 (4.5%)		
HCT in %	Abnormal: <31 or >48 Normal: 31-48	2,823 (91.3%)	138 (4.9%) 2,685 (95.1%)	6 (4.4%) 121 (4.5%)	132 (95.7%) 2,564 (95.5%)	-0.04 [-0.87; 0.80]	0.930
HCT in %	High: >48 Not High: ≤48	2,823 (91.3%)	34 (1.2%0 2,789 (98.8%)	33 (97.1%) 2,663 (95.5%)	1 (2.9%) 126 (4.5%)	-0.45[-2.44; 1.55]	0.662
WBC in #/ul, mean± SD [95% CI]		2,853 (92.3%)	7.1 ± 3.0 [7.0; 7.2]	7.1 ± 3.1 [7.0; 7.2]	6.4 ± 2.4 [6.0; 6.9]	-0.08 [-1.152; -0.0149]	**0.017**
WBC in #/ul	Low: <3.5 Not Low: ≥3.5	2,853 (92.3%)	206 (7.2%) 2,647 (92.8%)	201 (97.6%) 2,525 (95.4%)	5 (2.4%) 122 (4.6%)	-0.66 [-1.597; 0.24]	0.151
WBC in #/ul	Abnormal:<3.5 or >12 Normal: 3.5-12	2,853 (92.3%)	363 (12.7%) 2,490 (87.3%)	346 (95.3%) 2,380 (95.6%)	17 (4.7%) 110 (4.4%)	0.06 [-0.46; 0.58]	0.819
WBC in #/ul	High: >12 Not High: ≤12	2,853 (92.3%)	157 (5.5%) 2,696 (94.5%)	145 (92.4%) 2,581 (95.7%)	12 (7.6%) 115 (4.3%)	0.62 [0.002; 1.24]	**0.049**
Hospitalization within 2 years	No Yes	2,995 (96.9%)	2,342 (78.2%) 653 (21.8%)	2,250 (96.1%) 615 (94.2%)	92 (3.9%) 38 (5.8%)	0.41 [0.02; 0.80]	**0.037**
Prior SSI	No Yes	3,003 (97.1%)	2,874 (95.7%) 129 (4.3%)	2,753 (95.8%) 120 (93.0%)	121 (4.2%) 9 (7.0%)	0.53 [-0.17; 1.24]	0.135

Prior Spine SSI		3,003 (97.1%)				0.52 [-0.27; 1.21]	0.196
	No		2,902 (96.6%)	2,779 (95.8%)	123 (4.2%)		
	Yes		101 (3.4%)	94 (93.1%)	7 (6.9%)		
Prior Spine Surgery		2,912 (94.2%)				0.38 [-0.01; 0.76]	0.055
	No		2,210 (75.9%)	2,122 (96.0%)	88 (4.0%)		
	Yes		702 (24.1%)	662 (94.3%)	40 (5.7%)		
Preoperative Halo Traction		3,092 (100%)				0.15 [-0.63; 0.93]	0.705
	No		2,949 (95.4%)	2,824 (95.8%)	125 (4.2%)		
	Yes		143 (4.6%)	136 (95.1%)	7 (4.9%)		
Surgical Factors							
Type of Surgery		3,092 (100%)					
	Primary instrumentation		1,437 (46.5%)	1,389 (96.9%)	45 (3.1%)	Reference	
	Definitive Fusion		1,220 (39.5%)	1,165 (95.5%)	55 (4.5%)	0.38 [-0.23; 0.78]	0.065
	Revision		427 (13.8%)	395 (92.5%)	32 (7.5%)	0.92 [0.45; 1.39]	<**0.001**
	Stapling		8 (0.2%)	11 (100%)	0 (0%)	--	--
Type of Surgery		3,092 (100%)				0.73 [0.32; 1.14]	**0.001**
	Revision		427 (13.8%)	395 (92.5%)	32 (7.5%)		
	Not Revision		2,665 (86.2%)	2,565 (96.2%)	100 (3.8%)		
Surgical Approach		3,002 (97.1%)					
	Combined		125 (4.2%)	115 (92.0%)	10 (8.0%)	reference	
	Posterior		2,835 (94.4%)	2,715 (95.8%)	120 (4.2%)	0.68[0.01; 1.35]	**0.048**
	Anterior		42 (1.4%)	42 (100%)	0 (0%)	--	--
Pelvic Instrumentation		3,050 (91.1%)				1.38 [1.03; 1.74]	<**0.001**
	No		2,429 (79.6%)	2,361 (97.2%)	68 (2.8%)		
	Yes		621 (20.4%)	557 (89.7%)	64 (10.3%)		

Intraoperative Skeletal Traction		3,004 (97.2%)				0.35 [-0.02; 0.90]	0.216
	Yes		257 (8.6%)	242 (94.2%)	15 (5.8%)		
	No		2,747 (91.4%)	2,632 (95.8%)	115 (4.2%)		
Instrumented Levels in #, mean± SD [95% CI]		2,798 (90.5%)	10.9 ± 4.8 [10.8; 11.1]	10.9 ± 4.8 [10.8; 11.1]	12.8 ± 5.2 [11.8; 13.7]	0.004 [0.002; 0.005]	**<0.001**
Instrumented Levels		2,798 (90.5%)				1.30 [0.94; 1.67]	**<0.001**
	≥15		705 (25.2%)	638 (90.5%)	67 (9.5%)		
	<15		2,093 (74.8%)	2,035 (97.2%)	58 (2.8%)		
Type of Instrumentation		2,816 (91.1%)				0.50 [0.13; 0.87]	**0.008**
	Hybrid		784 (27.8%)	736 (93.9%)	48 (6.1%)		
	Screws Only		2,032 (72.2%)	1,955 (96.2%)	77 (3.8%)		
Spinal Osteotomies		3,090 (100%)				-0.11 [-0.47; 0.26]	0.572
	Yes		1,125 (36.4%)	1,080 (96.0%)	45 (4.0%)		
	No		1,965 (63.6%)	1,878 (95.6%)	87 (4.4%)		
VCR		2,816 (91.1%)				-1.49 [-3.47; 0.49]	0.140
	Yes		94 (3.3%)	93 (98.9%)	1 (1.1%)		
	No		2,722 (96.7%)	2,598 (95.450	124 (4.6%)		
Transfusion		2,427 (78.5%)				0.57 [0.17; 0.97]	**0.005**
	Yes		868 (35.8%)	819 (94.4%)	49 (5.7%)		
	No		1,559 (64.2%)	1,508 (96.7%)	51 (3.3%)		
Cell Saver		2,432 (78.7%)				0.14 [-0.27; 0.55]	0.505
	Yes		1,405 (57.8%)	1,344 (95.7%)	61 (4.3%)		
	No		1,027 (42.2%)	988 (96.2%)	39 (3.8%)		
Staples Skin Closure		2,818 (91.1%)					
	Yes		12 (0.4%)	12 (100%)	0 (0%)	--	--

	No		2,806 (99.6%)	2,681 (95.6%)	125 (4.4%)		
Procedure Time in hours, mean± SD [95% CI]		2,416 (78.1%)	5.9 ± 2.3 [5.8; 6.0]	5.9 ± 2.3 [5.8;6.0]	7.1 ± 2.7 [6.6;7.6]	0.01 [0.005; 0.012]	**<0.001**
Procedure Time		2,416 (78.1%)				1.10 [0.70; 1.51]	**<0.001**
	≥7 Hours		704 (29.1%)	650 (92.3%)	54 (7.7%)		
	<7 Hours		1,712 (70.9%)	1,666 (97.3%)	46 (2.7%)		
Hospital Characteristics							
Geographic Region		3092 (100%)				0.25 [-0.13; 0.64]	0.202
	West		746 (24.1%)	708 (94.9%)	38 (5.1%)		
	Northeast		2,346 (75.9%)	2,252 (96.0%)	94 (4.0%)		
Area		3092 (100%)				--	--
	Urban		3,092 (100%)	2,960 (95.7%)	32 (4.3%)		
	Rural		0 (0%)	0 (0%)	0 (0%)		
Academic Health Center		3092 (100%)				--	--
	Yes		3,084 (99.7%)	2,952 (95.7%)	132 (4.3%)		
	No		8 (0.3%)	8 (100%)	0 ()%)		
Surgical Volume/Year, mean± SD (range)		3092 (100%)	73.8 ± 74.0 [71.2; 76.4]	74.4 ± 74.4 [71.8; 77.1]	58.9 ± 62.5 [48.2; 69.7]	-0.003 [-0.006; -0.001]	**0.019**
Surgical Volume/Year		3092 (100%)				0.39 [0.02; 0.76]	**0.039**
	<100		1,815 (58.7%)	1,726 (95.1%)	89 (4.9%)		
	≥100		1,277 (41.3%)	1,234 (96.6%)	43 (3.4%)		

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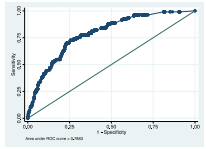
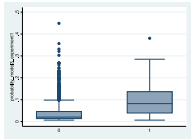
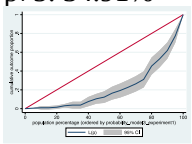
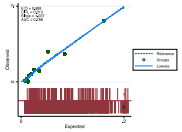
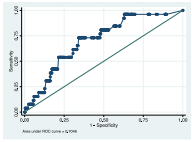
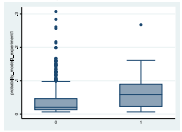
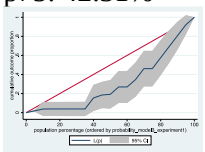
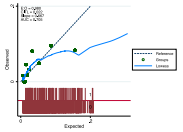
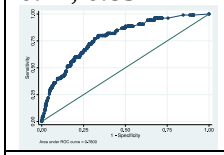
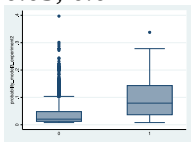
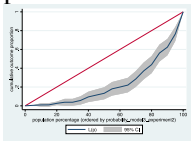
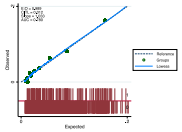
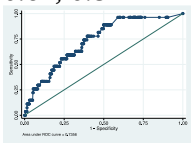
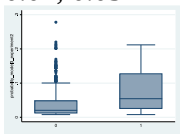
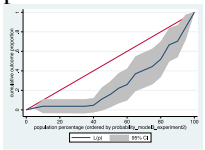
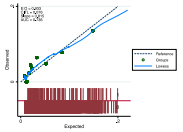
Appendix 7. Candidate prediction models and average values of discrimination and calibration abilities from five-fold cross validation

Candidate Prediction Models							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age: <12	X			X	X	X	X
Male	X			X			X
BMI Abnormal							
BMI Overweight/Obese	X	X	X	X	X	X	X
Neuromuscular Etiology	X	X	X	X	X	X	X
Major Coronal Curve: ≥70 °							
ASA >2	X	X	X	X	X	X	X
Pulmonary Comorbidity	X			X	X		
Behavioral Comorbidity							
MSK Comorbidity	X						
Neurologic Comorbidity							
G-Tube							
Non-Ambulatory	X	X	X	X	X	X	X
Diaper Dependent	X	X		X	X	X	X
Abnormal HGB: <10 or >14g/dL	X	X	X	X	X	X	X
Hospitalization within 2 years							
Prior Spine Surgery							
Revision Surgery	X	X	X	X	X	X	X
Pelvic Instrumentation	X	X	X	X	X	X	X
Instrumented Levels: ≥15							
Transfusion							
Procedure Time: ≥7 hours	X	X	X	X	X	X	X
Spine Surgical Volume: <100 cases	X	X	X	X	X	X	X
Training Set N=2,474 (80% of N=3,092)							

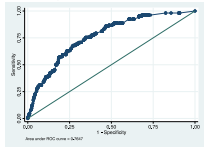
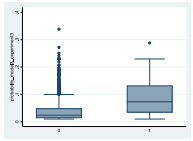
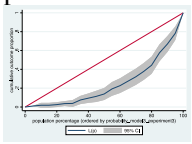
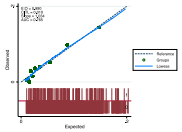
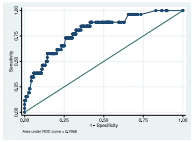
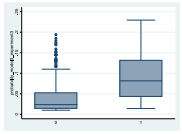
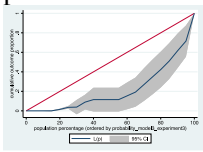
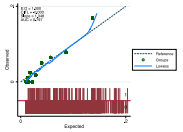
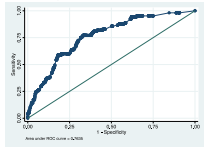
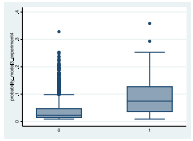
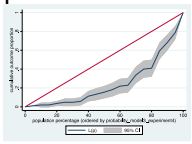
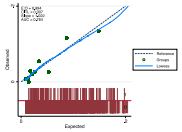
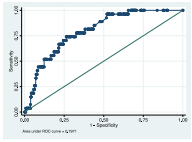
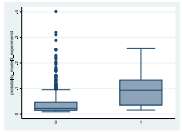
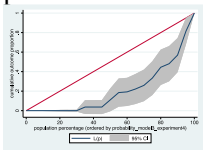
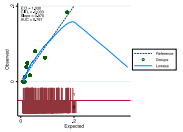
Area Under Curve, % (mean, SE) [95% CI]	77.54, 2.18 [73.27;81.80]	77.44, 2.19 [73.15;81.74]	77.31, 2.20 [73.00;81.62]	77.59, 2.16 [73.36;81.83]	77.54, 2.17 [73.29;81.81]	77.50, 2.18 [73.24;81.77]	77.50, 2.17 [73.30;81.80]
Discrimination Slope (mean, SE) [95% CI]	0.05, 0.004 [0.04; 0.06]	0.05, 0.004 [0.04; 0.06]	0.05, 0.004 [0.04; 0.06]	0.05, 0.004 [0.04; 0.06]	0.05, 0.004 [0.04; 0.06]	0.05, 0.004 [0.04; 0.06]	0.05, 0.004 [0.04; 0.06]
Lorenz Curve, % (p25, p50, p75)	3.31, 14.77, 38.07	3.63, 14.02, 38.07	2.93, 14.43, 39.02	341, 14.39, 38.02	3.22, 14.71, 38.07	3.20,13.95, 37.88	3.65, 14.02, 37.88
Expected/Observed Ratio	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Calibration-in-the-Large	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Calibration Slope	1.04	1.03	1.04	1.04	1.04	1.04	1.04
Hosmer-Lemeshow Goodness-of-Fit	0.03	0.01	0.01	0.01	0.01	0.003	0.01
Testing Set N=618 (20% of N=3,092)							
Area Under Curve, % (mean, SE) [95% CI]	0.74.97, 4.51 [66.12;83.82]	76.15, 4.35 [67.62;84.69]	76.40, 4.38 [67.60;84.77]	75.19, 4.46 [66.45;80.50]	75.49, 4.43 [66.81;84.18]	75.86,4.40 [67.24;84.48]	75.59, 4.43 [66.92;84.27]
Discrimination Slope (mean, SE) [95% CI]	0.04, 0.01 [0.02; 0.06]	0.04, 0.02 [0.03; 0.06]	0.04, 0.01 [0.03; 0.05]	0.04, 0.01 [0.02; 0.06]	0.05 0.01 [0.03; 0.06]	0.04, 0.01 [0.03; 0.06]	0.04, 0.01 [0.02; 0.06]
Lorenz Curve, % (p25, p50, p75)	3.05, 15.93, 41.68	3.67, 13.54, 36.54	3.77, 13.85, 37.86	9.43, 13.77, 39.37	3.05, 15.16, 39.37	3.05, 13.50, 38.82	3.05, 13.55, 39.37
Expected/Observed Ratio	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Calibration-in-the-Large	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Calibration Slope	0.91	0.98	0.98	0.93	0.94	1.04	0.95
Hosmer-Lemeshow Goodness-of-Fit	0.29	0.44	0.44	0.32	0.40	0.36	0.31
Deviance	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Pearson Residuals	0.99	0.99	0.99	0.99	0.99	0.99	0.99

http://dx.doi.org/10.2106/JBJS.21.00751

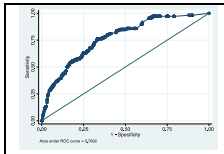
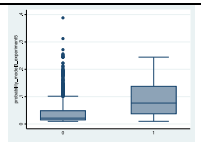
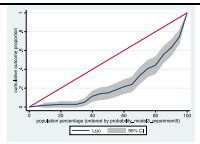
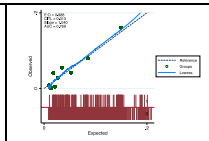
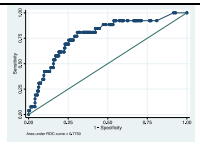
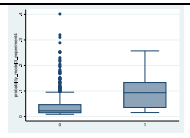
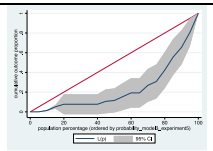
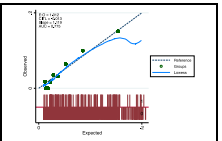
Appendix 8. Predictive discrimination and calibration abilities in the training and testing sets using five-fold cross validations

<table>
<tr><td colspan="8">MODEL 3</td></tr>
<tr><td colspan="8">Experiment 1</td></tr>
<tr><td colspan="4">Training Sample (N=2,474)</td><td colspan="4">Testing Sample (N=618)</td></tr>
<tr><td colspan="3">Discrimination</td><td>Calibration</td><td colspan="3">Discrimination</td><td>Calibration</td></tr>
<tr><td>ROC Curve</td><td>Slope and Box Plot</td><td>Lorenz Curve</td><td>Calibration Plot</td><td>ROC Curve</td><td>Slope and Box Plot</td><td>Lorenz Curve</td><td>Calibration Plot</td></tr>
<tr><td>AUC: 0.79
SE: 0.02
95%CI:
0.75; 0.83
  </td><td>Slope: 0.06
SE: 0.01
95% CI:
0.05; 0.07
  </td><td>p25: 2.51%
p50: 12.77%
p75: 34.91%
  </td><td>E:O=0.99
 
HL GOF: 0.001
CITL: 0.01
Slope: 1.04</td><td>AUC: 0.71
SE: 0.05
95% CI:
0.61; 0.80
  </td><td>Slope: 0.03
SE: 0.01
95% CI:
0.01; 0.05
  </td><td>p25: 3.85%
p50: 23.08%
p75: 42.31%
  </td><td>E:O=0.97
 
HL GOF: 0.19
CITL: 0.03
Slope: 0.67</td></tr>
<tr><td colspan="8">Experiment 2</td></tr>
<tr><td colspan="4">Training Sample (N=2,474)</td><td colspan="4">Testing Sample (N=618)</td></tr>
<tr><td colspan="3">Discrimination</td><td>Calibration</td><td colspan="3">Discrimination</td><td>Calibration</td></tr>
<tr><td>ROC Curve</td><td>Slope and Box Plot</td><td>Lorenz Curve</td><td>Calibration Plot</td><td>ROC Curve</td><td>Slope and Box Plot</td><td>Lorenz Curve</td><td>Calibration Plot</td></tr>
<tr><td>AUC: 0.78
SE: 0.02
95% CI:
0.74; 0.83
  </td><td>Slope: 0.06
SE: 0.01
95% CI:
0.05; 0.07
  </td><td>p25: 2.86%
p:50: 14.29%
p75: 38.10%
  </td><td>E:O=0.99
 
HL GOF: 0.02
CITL: 0.01
Slope: 1.04</td><td>AUC: 0.73
SE: 0.05
95% CI:
0.64; 0.82
  </td><td>Slope: 0.03
SE: 0.01
95% CI:
0.02; 0.05
  </td><td>p25: 3.70%
p50: 17.08%
p75: 48.15%
  </td><td>E:O=0.92
 
HL GOF: 0.05
CITL: 0.10
Slope: 0.78</td></tr>
<tr><td colspan="8">Experiment 3</td></tr>
<tr><td colspan="4">Training Sample (N=2,474)</td><td colspan="4">Testing Sample (N=618)</td></tr>
<tr><td colspan="3">Discrimination</td><td>Calibration</td><td colspan="3">Discrimination</td><td>Calibration</td></tr>
</table>

http://dx.doi.org/10.2106/JBJS.21.00751

ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot	ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot
AUC: 0.76 SE: 0.02 95% CI: 0.72; 0.81 	Slope: 0.04 SE: 0.004 95% CI: 0.04; 0.05 	p25: 3.57% p50: 15.09% p75: 40.57% 	E:O=0.99  HL GOF: 0.01 CITL: 0.01 Slope: 1.04	AUC: 0.81 SE: 0.04 95% CI: 0.73; 0.89 	Slope: 0.06 SE: 0.01 95% CI; 0.04; 0.07 	p25: 0.00% p50: 11.54% p75: 34.62% 	E:O=1.00  HL GOF: 0.68 CITL: -0.01 Slope: 1.36
Experiment 4							
Training Sample (N=2,474)				Testing Sample (N=618)			
Discrimination			Calibration	Discrimination			Calibration
ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot	ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot
AUC: 0.77 SE: 0.02 95% CI: 0.72; 0.81 	Slope: 0.05 SE: 0.004 95%CI: 0.04; 0.06 	p25: 3.81% p50: 15.87% p75: 40.00% 	E:O=0.99  HL GOF: 0.001 CITL: 0.01 Slope: 1.02	AUC: 0.80 SE: 0.04 95% CI: 0.73; 0.87 	Slope: 0.05 SE: 0.01 95% CI: 0.03; 0.07 	p25: 0.00% p50: 12.50% p75: 33.33% 	E:O=1.04  HL GOF: 0.12 CITL: -0.04 Slope: 1.00
Experiment 5							
Training Sample (N=2,474)				Testing Sample (N=618)			
Discrimination			Calibration	Discrimination			Calibration
ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot	ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot
AUC: 0.77 SE: 0.02 95% CI: 0.73; 0.81	Slope: 0.05 SE: 0.004 95% CI: 0.04; 0.06	p25: 1.89% p50: 14.15% p75: 41.51%	E:O=0.99	AUC: 0.77 SE: 0.05 95% CI; 0.68; 0.87	Slope: 0.05 SE: 0.01 95% CI: 0.03; 0.07	p25: 7.69% p50: 11.54% p75: 34.62%	E:O=1.01

http://dx.doi.org/10.2106/JBJS.21.00751

			 HL GOF: <0.001 CITL: 0.01 Slope: 1.04				 HL GOF: 0.34 CITL: -0.01 Slope: 1.12
Average of Five Experiments							
Training Sample (N=2,474)				Testing Sample (N=618)			
Discrimination			Calibration	Discrimination			Calibration
ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot	ROC Curve	Slope and Box Plot	Lorenz Curve	Calibration Plot
AUC: 0.77 SE: 0.02 95% CI: 0.73; 0.82	Slope: 0.05 SE: 0.004 95% CI: 0.04; 0.06	p25: 2.93% p50: 14.43% p75: 39.02%	E:O=0.99 HL GOF: 0.01 CITL: 0.01 Slope: 1.04	AUC: 0.76 SE: 0.04 95% CI: 0.68; 0.85	Slope: 0.04 SE: 0.01 95% CI: 0.03; 0.06	p25: 3.05% p50: 15.15% p75: 38.60%	E:O=0.99 HL GOF: 0.360 CITL: 0.01 Slope: 0.99

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