Development of a Risk Severity Score (RSS): What they Tell Us and How We Use Them

Michael G. Vitale MD MPH

Ana Lucia Professor of Pediatric Orthopedic Surgery,

Chief, Pediatric Spine and Scoliosis Surgery

Director, Division of Pediatric Orthopedics

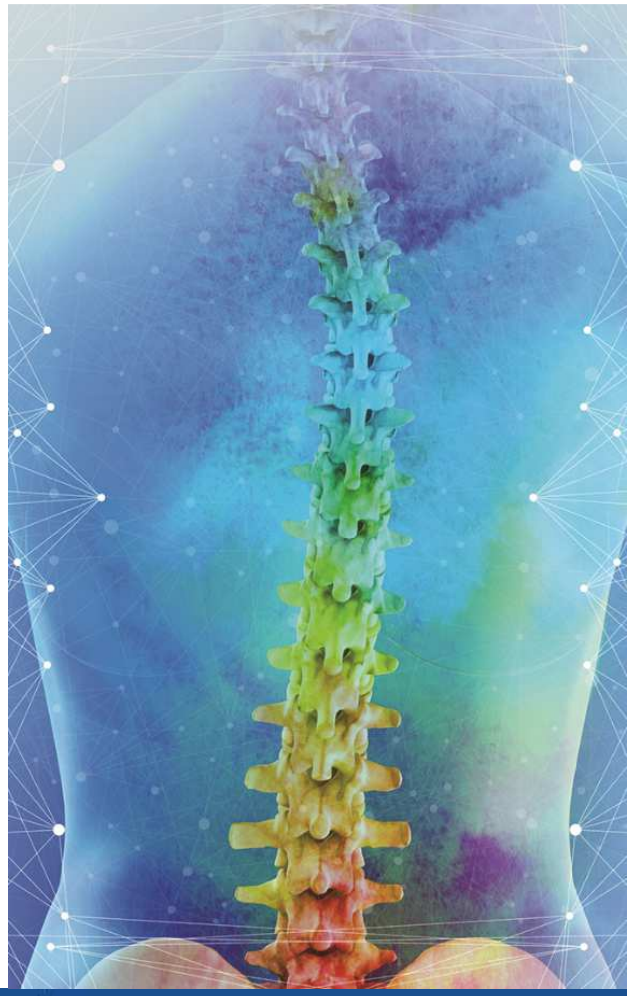
Vice Chief, Quality and Strategy; Department of Orthopedic Surgery

Children's Hospital of New York- Presbyterian; Columbia University Medical Center

NewYork-Presbyterian | COLUMBIA | COLUMBIA UNIVERSITY DEPARTMENT OF ORTHOPEDIC SURGERY

Disclosures

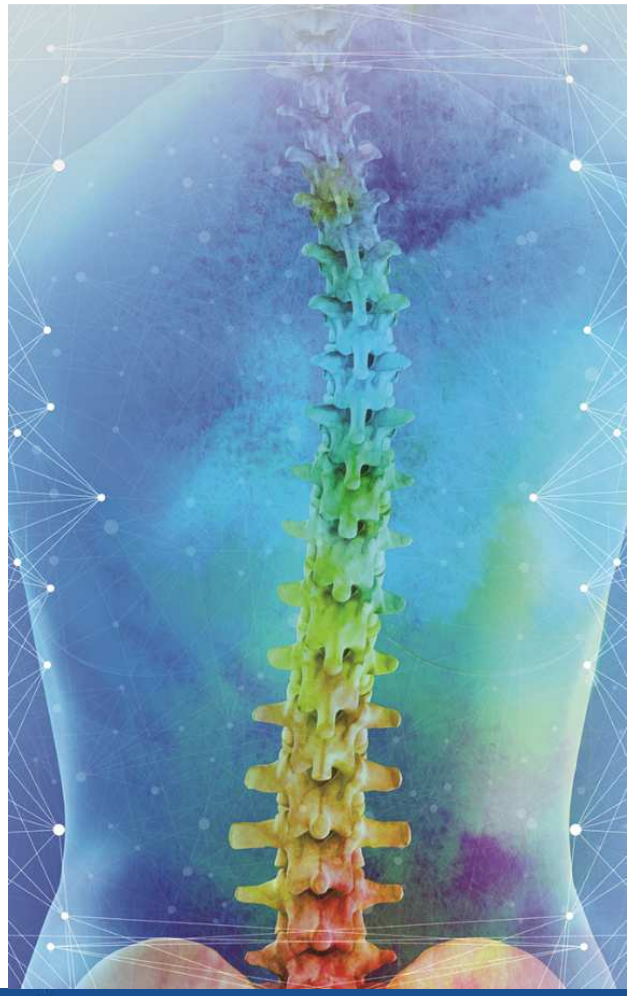
- ***Royalties:*** **Zimmer-Biomet**
- ***Consultant:*** **Stryker, Zimmer-Biomet**
- ***Research Support:*** **PSSG, SRS,POSNA; OREF**
- ***BOD*****: POSNA, PSSG; SP3**



Disclosures

- Hiroko Matsumoto (PhD)

PEDIATRIC SPINE STUDY GROUP



NewYork-Presbyterian

COLUMBIA | COLUMBIA UNIVERSITY DEPARTMENT OF ORTHOPEDIC SURGERY

Adelina

9 yo with Congenital Myotonic Dytrophy

CEOS N3+P2
EOSQ 37 (68)

Debilitating Head Tilt /Progression of Pelvic Obliquity s/p VEPTR

AR: 9 yo Surgical History

PSH:

- 7/24/09: VEPTR insertion on the right side
- 3/5/10: VEPTR lengthening
- 5/29/10: Right acetabular and femoral osteotomy with extensive soft tissue release; Right hip adductor tenotomy; Right hip arthrogram
- 10/1/10: VEPTR lengthening
- 2/4/11:Revision of proximal hardware of VEPTR and revision of femoral osteotomy
- 6/24/11; 1/6/12: VEPTR lengthenings
- 7/10/12: Revision of VEPTR to proximal hooks; insertion of Left rod
- 10/23/12: Revision and lengthening of VEPTR (migration of s hook)
- 6/13/13; 1/7/14; 6/5/14: VEPTR lengthenings

Plan

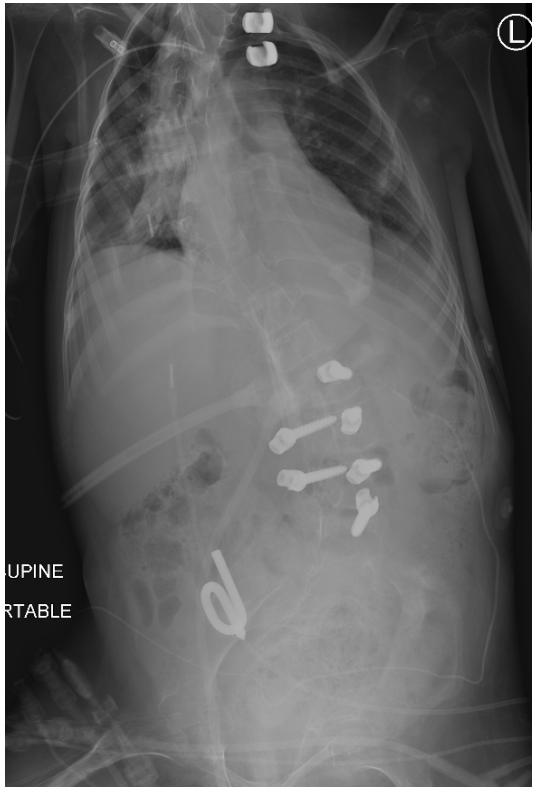
Stage One : HWR; PCO; Traction

Stage Two: ? VCR and PSIF

“Surgical Misadventure”

- BMI 14
- PGY2 assist;
- Hypotensive Soon After Skin Incision
- Acutely Hypotensive during PCO
- Irrepairable Dural Tear; Fat graft Duraseal

ABORT



“Surgical Misadventure”

- Persistent Wound Drainage
- Infection
- 7 weeks in ICU
- 8 surgeries
- $825,000

Root Cause Analysis

[redacted]		PATIENT AGE:	9 yr
MRN:	5074841	GENDER:	F
PRIMARY DIAGNOSIS	scoliosis	SECONDARY DIAGNOSIS:	MD/ryanodine recept.
DATE OF SURGERY:	8/12/2015	DATE OF FIRST POSITIVE CULTUI	9/3/2015
[redacted]			
CULTURE SOURCE/SITE:		ORGANISM:	
	9/3/2015	a.	staph epi
b.		b	
WAS PATIENT DISCHARGED AT HOME	NO	WAS WOUND VAC INITIATED?	YES DATE: (CSF leak)
WAS WOUND NOTED TO DEHISCED?	NO		
WHAT POD DID PATIENT PRESENT TO OFFICE/ER?		POD#	POD 22

PRE-OP RISK FACTORS/PERFORMANCE MEASURES

12 YRS OR OLDER	NO	SUB-OPTIMAL NUTRITIONAL STATUS	BMI=14
NON-AMBULATORY	YES	INCONTINENT	YES
PRE-OP BOWEL PREP DONE	NO	PRE-OP URINE CULTURE DONE	YES ; RESULT= Neg
CHG SKIN PREP DONE (HOME NIGHT BEFORE SURGERY)	YES		

INTRA-OP RISK FACTORS/PERFORMANCE MEASURES

SURGICAL INCISION TO PELVIS	YES	ESTIMATED BLOOD LOSS cell.PRBC	AMOUNT= 400mL
RECEIVED BLOOD PRODUCTS	YES	PROLONGED OR TIME YES	SURGERY TIME=
PLASTIC SURGICAL CLOSURE	YES	INTRA-OP BETADINE SOAK X 3 MIN	YES
VANCOMYCIN POWDER USED IN BONE GRAFT	YES		
INTRA-OP WOUND IRRIGATION WITH NS AND BETADINE	YES		

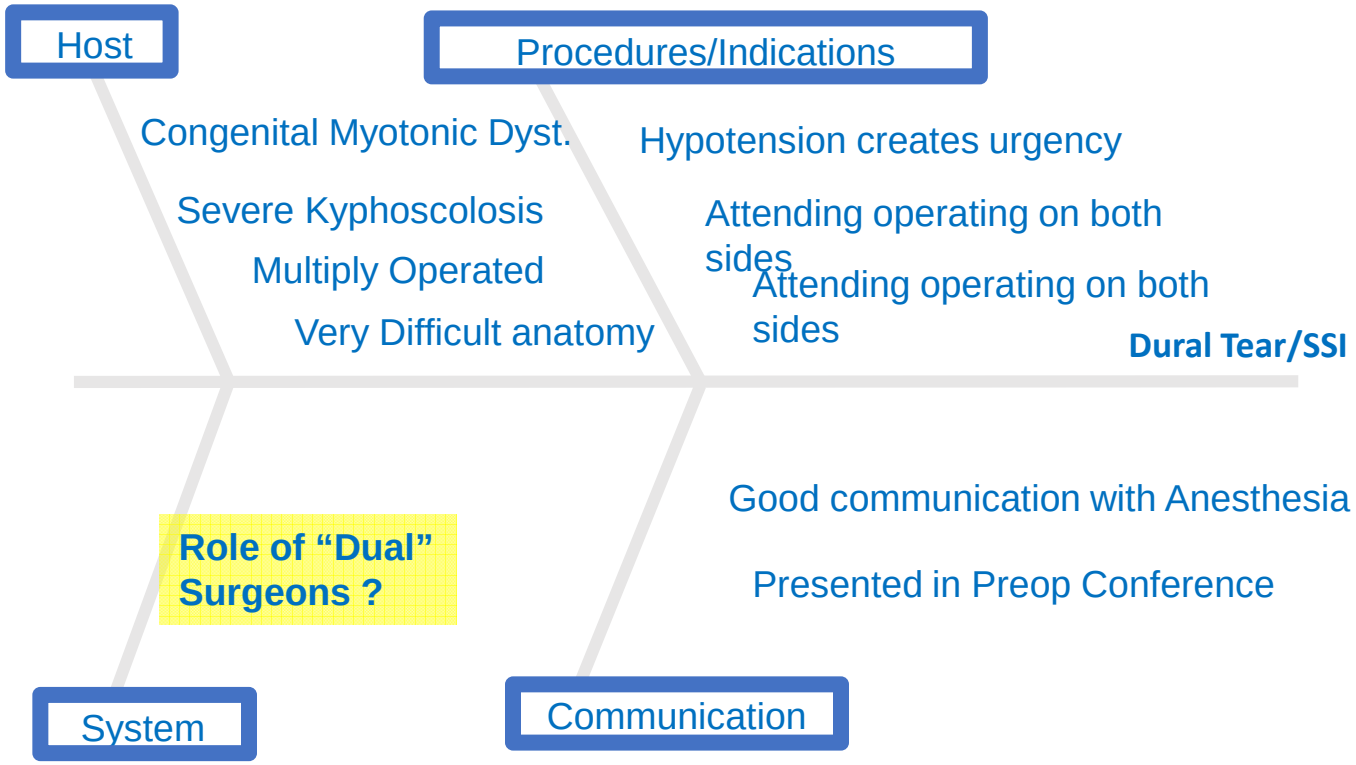
ACCURATE SSI INTRA-OP ANTIBIOTIC COMPLIANCE	was on abx	CORRECT DOSE:	CEFAZOLIN - Y/N	TOBRAMYCIN - Y/N
		CORRECT INTERVAL:	CEFAZOLIN - Y/N	TOBRAMYCIN - Y/N
	NTR-OP REDOSE OF ANTIBIOTICS INDICATED:		CEFAZOLIN - Y/N	TOBRAMYCIN - Y/N

POST-OP RISK FACTORS/PERFORMANCE MEASURES

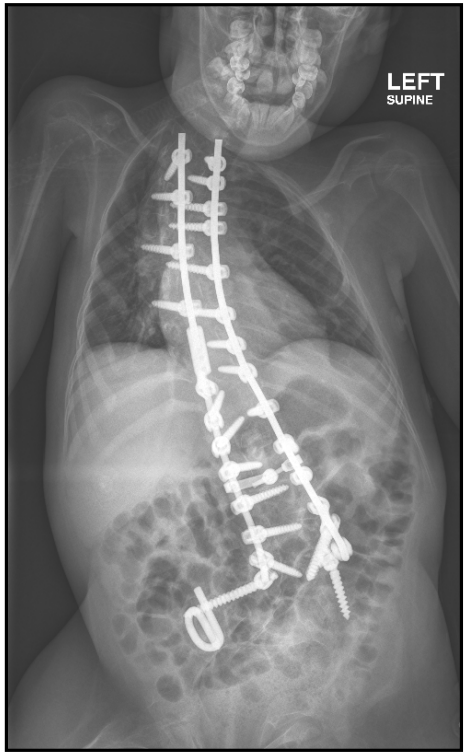
DISRUPTION TO IOBAN POST-OP SPINE DRESSING	Y / N	FECAL SOILING?	Y / N
DISRUPTION TO AQUACELL POST-OP SPINE DRESSING	Y / N	FECAL SOILING?	Y / N

ACCURATE SSI POST-OP ANTIBIOTIC COMPLIANCE		CORRECT DOSE:	CEFAZOLIN - Y/N	TOBRAMYCIN - Y/N
		CORRECT INTERVAL:	CEFAZOLIN - Y/N	TOBRAMYCIN - Y/N
				LOS 61 days

AR- Dural Tear/SSI

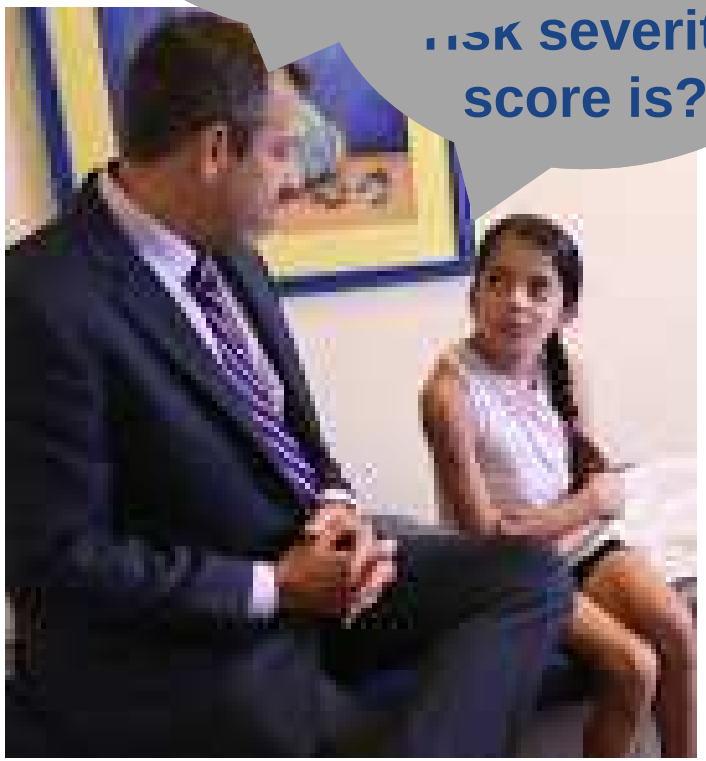


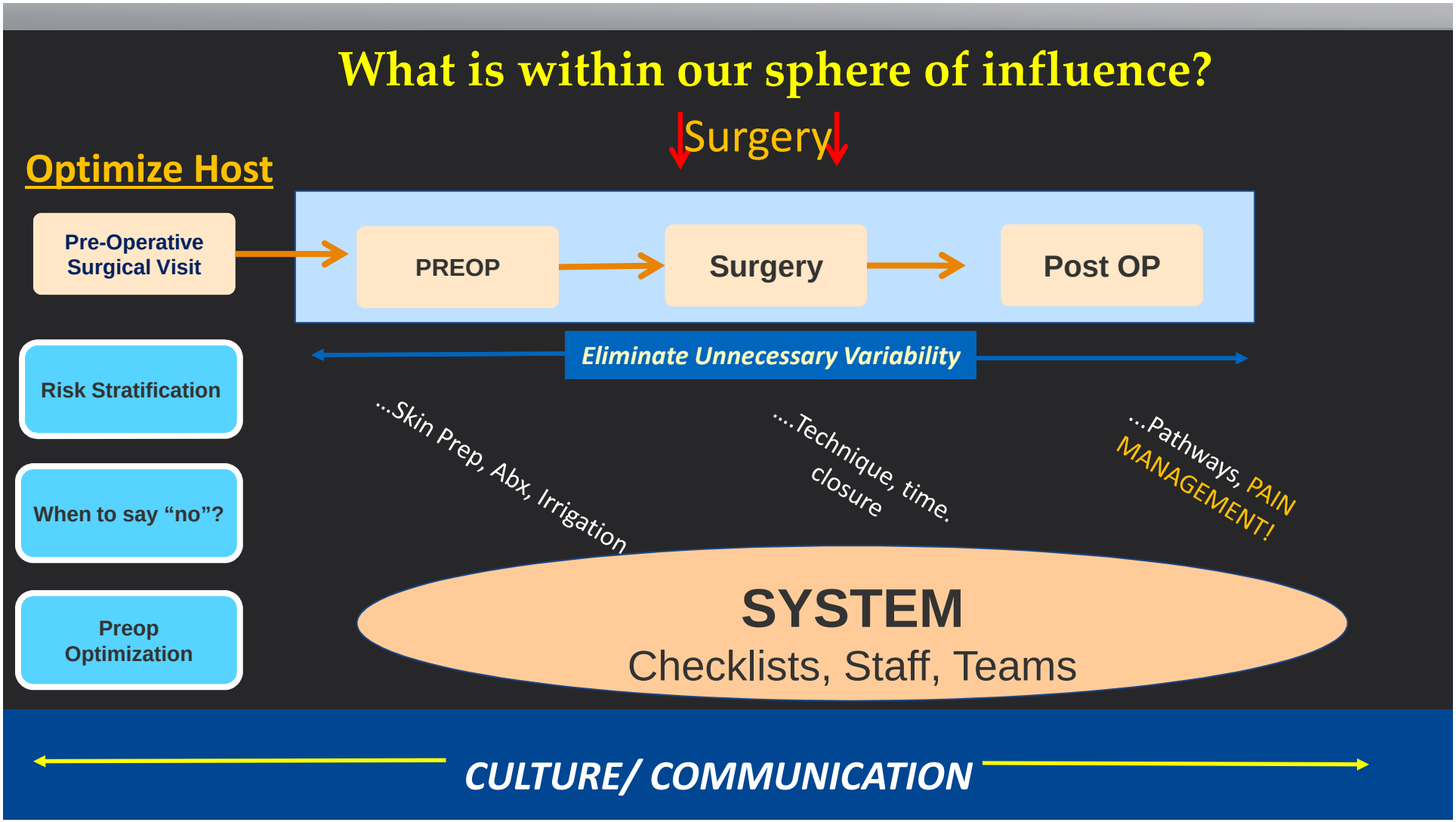
POD 71



Beautiful Little Kid ?.... Or Hand Grenade?

Emma- RSS 42%


Yes. I got this.
I'm calling in the
reinforcements.
sure
ow
h my
isk severity
score is?


What is within our sphere of influence?
Surgery
Optimize Host
Pre-Operative Surgical Visit
PREOP
Surgery
Post OP
Risk Stratification
When to say "no"?
Preop Optimization
Eliminate Unnecessary Variability
…Skin Prep, Abx, Irrigation
….Technique, time, closure
…Pathways, PAIN MANAGEMENT!
SYSTEM
Checklists, Staff, Teams
CULTURE/ COMMUNICATION

Preoperative Screening Tool to Identify High-Risk Patients

Clinical Factors

Etiology:

- ☐ Neuromuscular
- ☐ Syndromic
- ☐ Congenital

Co-morbidities:

- ☐ Cardiopulmonary disease
- ☐ Neural axis abnormality
- ☐ Skeletal dysplasia

Symptoms:

- ☐ High rate of symptom progression

Imaging Factors

X-ray:

- ☐ Large Coronal Cobb Angle
- ☐ Large Kyphosis
- ☐ Upper thoracic curve
- ☐ High Deformity Angular Ratio (DAR=°kyphosis/# levels)
- ☐ Stiff curve (low flexibility index)

MRI:

- ☐ Decreased AP cord diameter
- ☐ Decreased transverse area of

Surgical Factors

- ☐ Revision surgery
- ☐ Combined anterior and posterior approach
- ☐ High number of fusion levels
- ☐ Inability to obtain baseline neuromonitoring
- ☐ Vertebral column resection
- ☐ Pedicle subtraction osteotomy

30 Risk Factors Were Investigated

- **Age**
- **Gender**
- **Height**
- **Weight**
- **BMI**
- **Scoliosis etiology**
  - Congenital
  - Syndromic
  - Idiopathic
  - Neuromuscular (SB, CP, SMA)
- **Presence of fused ribs**
- **Presence of comorbidities**
  - Cardiac
  - Developmental Delay
  - Endocrine
  - Gastrointestinal
  - Immunologic
  - Musculoskeletal
  - Neurologic
  - Nutrition
  - Pulmonary
  - Urinary incontinence
- **Use of assistive devices**
  - VP shunt
  - G-tube
  - Assistive ventilation
- **Ambulatory status**
- **Surgery type**
  - Index surgery
  - Fusion
  - Revision
- **Cobb angle**
- **Kyphosis**

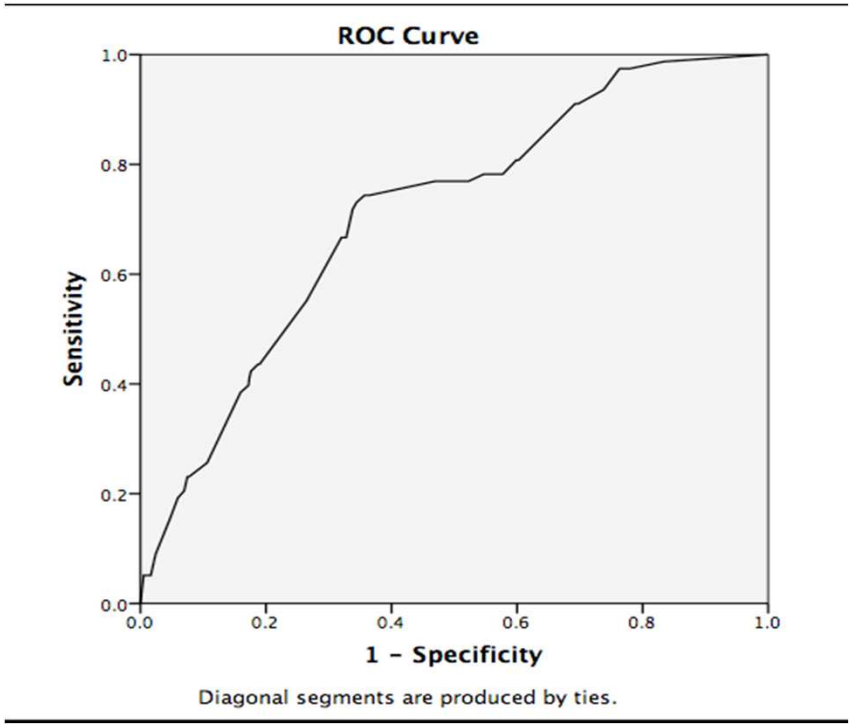
A Multiple Logistic Regression Model was Utilized to Develop the EOS Risk Severity Score Model

80 patients had SSI (6.7%)

Variable	Beta	95% CI for Beta		Odds Ratio
		Lower	Upper	
Neuromuscular Etiology	**0.828**	0.148	1.508	**2.289**
***Spina Bifida**	**0.376**	-0.727	1.479	**1.456**
***Spinal Muscular Atrophy**	**0.304**	-0.778	1.386	**1.355**
Urinary Incontinence	**0.287**	-0.354	0.928	**1.332**
VP Shunt	**0.387**	-0.240	1.014	**1.473**
Developmental Delay	**0.347**	-0.198	0.892	**1.415**
Endocrine Comorbidity	**1.499**	0.881	2.017	**4.259**
Gastrointestinal Comorbidity	**0.276**	-0.273	0.825	**1.318**
Pulmonary Comorbidity	**0.19**	-0.398	0.778	**1.209**

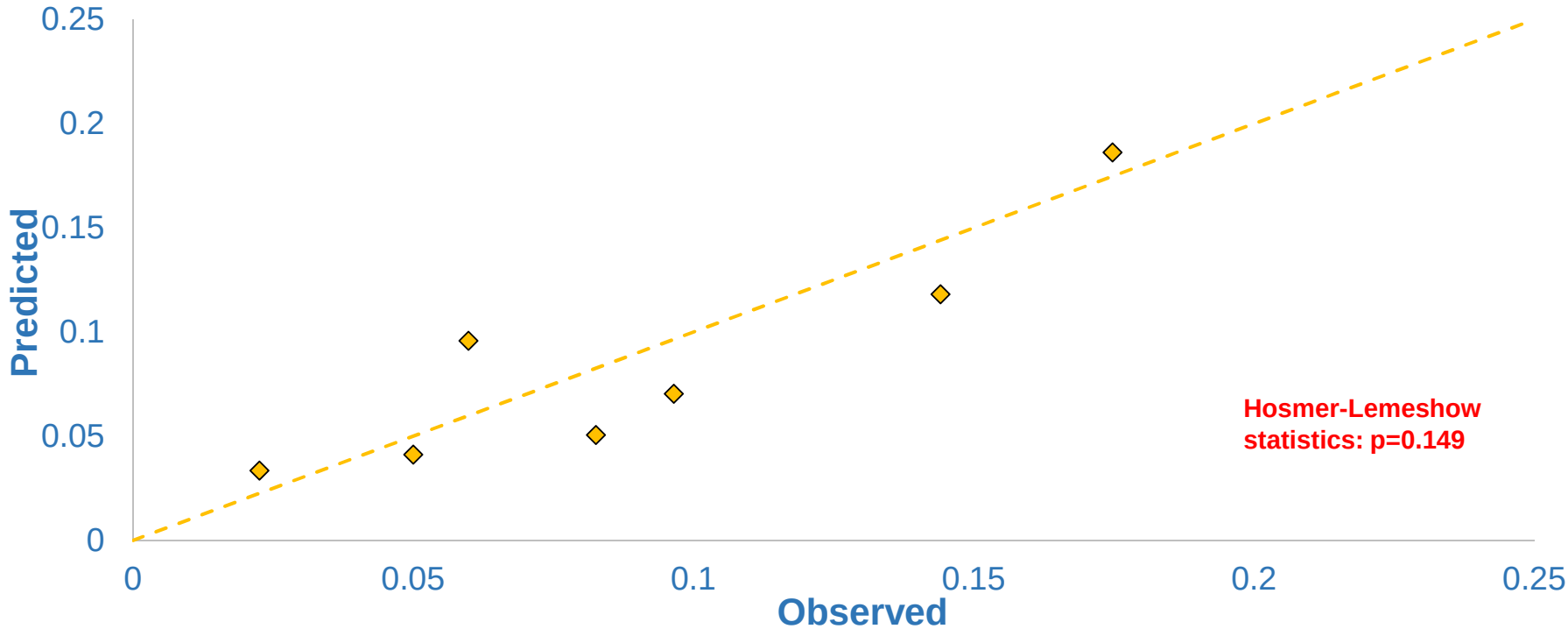
***SMA or SB presence necessitates Neuromuscular etiology presence**

Receiver Operating Characteristic (ROC) curve demonstrates good discrimination of those with and without SSI



Predictive ability (c-statistic) = 70.6%

Model has excellent calibration consistent with observed values

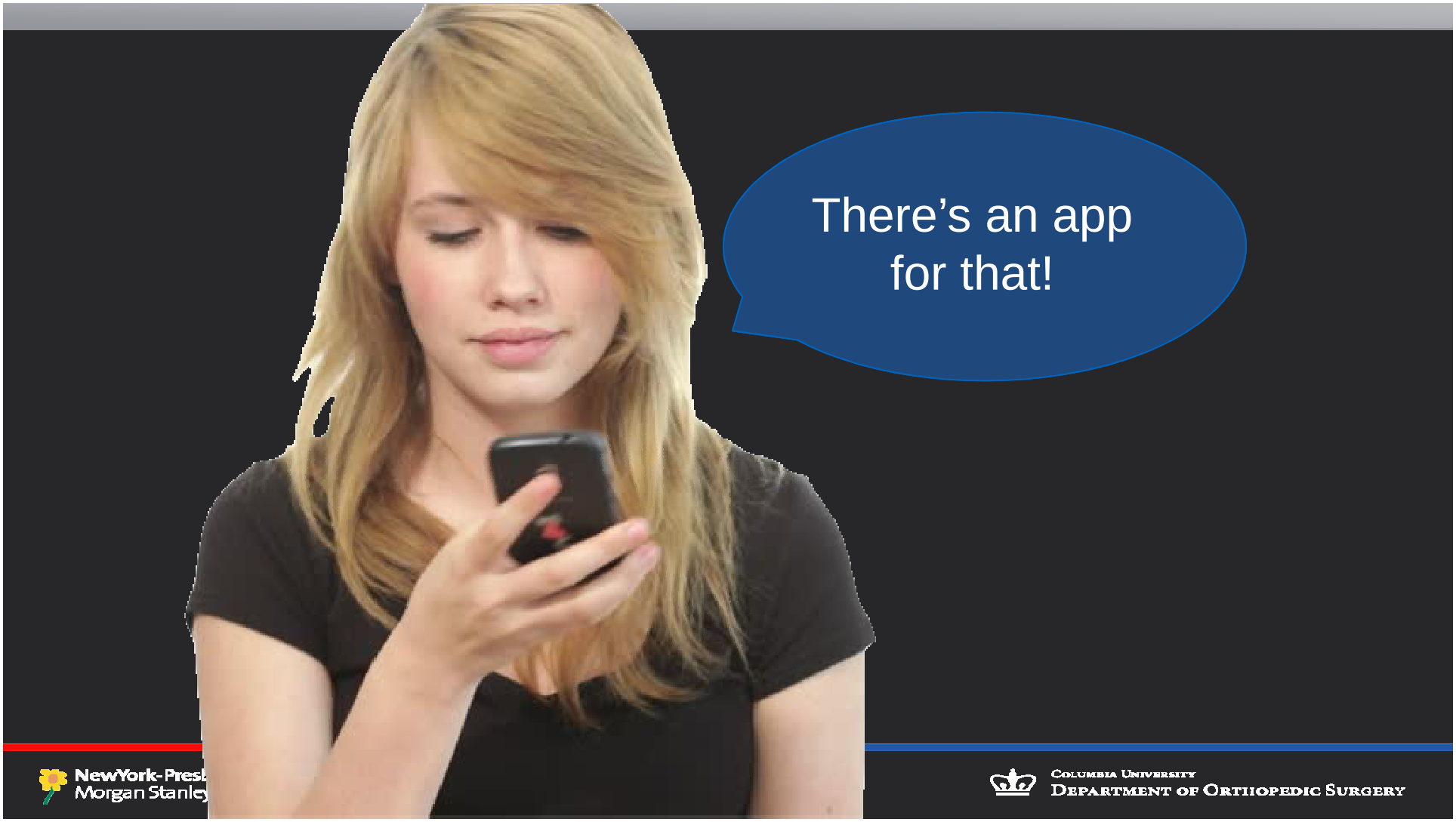


Development of a Risk Severity Score for EOS

	Beta	Odds Ratio
Congenital Etiology	0.969	2.636
Syndromic Etiology	0.157	1.169
Cobb > 70°	0.818	2.267
Hypokyphosis	0.477	1.611
G-Tube	1.468	4.343
Non-ambulatory Status	1.067	2.906
Pulmonary Comorbidity	0.299	1.349

$$\text{Probability} = \frac{\exp[-4.481 + 0.969(\text{Congenital Etiology}) + 0.157(\text{Syndromic Etiology}) + 0.818(\text{Cobb}>70°) + 0.477(\text{Hypokyphosis}) + 1.468(\text{G-Tube}) + 1.067(\text{Non-ambulatory}) + 0.299(\text{Pulmonary Comorbidity})]}{1 + \exp[-4.481 + 0.969(\text{Congenital}) + 0.157(\text{Syndromic}) + 0.818(\text{Cobb}>70°) + 0.477(\text{Hypokyphosis}) + 1.468(\text{G-Tube}) + 1.067(\text{Non-ambulatory}) + 0.299(\text{Pulmonary Comorbidity})]}$$

Predictive Ability 78.4%


There’s an app
for that!
NewYork-Presb
Morgan Stanley
Columbia University
Department of Orthopedic Surgery

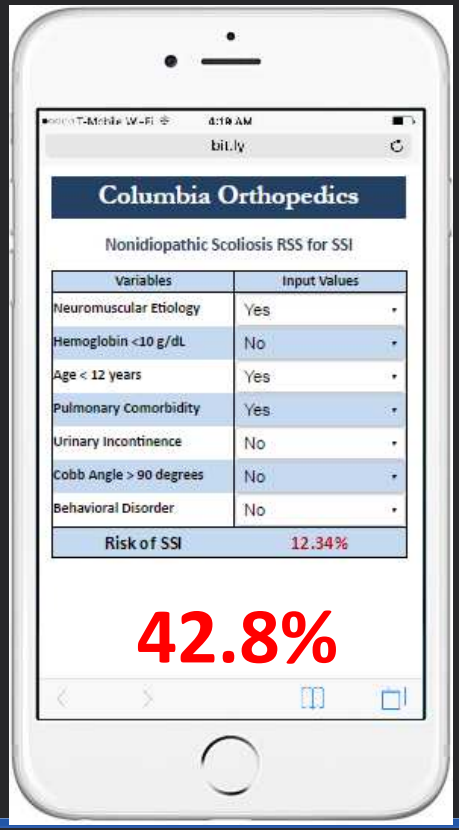
Online Risk Severity Score

APP STORE **“SSI RSS”**

- EOS, NMS, AIS

- Also available at

www.safetyinspinesurgery.org



All pre-operative patients receive an RSS score during weekly indications conference

Beauchamp, Eduardo Lenke, Lawrence G.; Vitale, Michael G.; + 26 1

CHONY Spine Cases Week Mar 12-16, 2018

26

Spine Cases wk Mar 12-16.docx
3 MB

Good afternoon,

CHONY Spine cases for next week. Please feel free to co
questions or concerns. Thank you

-Eduardo

Eduardo C. Beauchamp, MD
Advanced Pediatric Spine Deformity Fellow
Department of Orthopedic Surgery
Columbia University Medical Center
NewYork, NY
eb3138@cumc.columbia.edu

Classification:
Kyphoscoliosis

HPI: 11M with kyphoscoliosis s/p VEPTR (11/24/2009) which was transitioned to MAGEC (6/26/2015). This was complicated by wound issues and prominent hardware, and subsequent ROH (9/28/2016). He has had very slow or no correction since that point. He is active, plays baseball and has no complaints.

PMH:
Scoliosis
Asthma

Meds: None

Physical Exam:
131cm 28.6kg BMI: 16.7
Incisions healed
Kyphotic deformity
Quite thin

Imaging:
Thoracic curve: 80°
Kyphosis is 100°

RSS: 3.34%

Diagnosis: Kyphoscoliosis

Plan: Halo placement

Equipment: OSI, halo

To What Degree Does Surgeon Experience Matter? Predicting Risk of Surgical Site Infection in Early Onset Scoliosis

Study Objectives

- To compare predictive abilities between RSS and surgeons

Methods

- Experienced pediatric spine surgeons were surveyed to assess risk of SSI in 15 EOS patient vignettes
- Aggregated prediction was compared to RSS calculator

Results

- Surgeons' averaged input and RSS predictions were similar in most cases
- However, there was wide variability among surgeons, suggesting that some surgeons were inaccurately estimating SSI risk

Case #	1	2	3	4	5	6	7	8	9	10
RSS (%)	57.7	5.5	7.2	8.0	24.3	11.4	8.0	30.0	7.6	3.9
Surgeon Prediction, Average (%)	21.6	6.8	7.1	10.7	25.5	9.1	8.3	20.7	9.2	6.1
Surgeon Prediction, Range (%)	**5-50**	1-20	2-16	3-25	**3-50**	3-20	3-19	10-41	2-19	2-19

Plastic Multilayered Closure in Nonidiopathic Scoliosis

Purpose

- To assess the effect of PMC on SSI and wound complications in patients with non-idiopathic scoliosis undergoing primary or revision instrumentation or fusion.

Methods

- **Compare wound complications in standard and plastic multilayered closures to *expected risk calculated by RSS***

Compared to standard closure, PMC decreased a patient's risk of SSI by 7.1%

	PMC	Standard Closure
Observed SSI	1.7%	8.9%
Expected SSI (from RSS) *	5.6%	5.7%
Expected vs Observed SSI	**-3.9%**	**+3.2%**
(Expected SSI – Observed SSI) $_{PMC}$ **– (Expected SSI – Observed SSI)** $_{standard}$	**-7.1%**	

RSS: Next Steps

- **Add modifiers to the RSS**
  - Surgical characteristics
  - Antibiotic prophylaxis regimens
  - Hospital characteristics
  - “Subjective” surgeon adjustment
- **Validity studies**
  - Apply RSS to new sets of patient cohort
  - Compare predictive ability with other models (e.g. NSQIP)

Conclusion: RSS in EOS

- Will allow much more “real” informed consent with family
- Allows us to “slow the line”, and optimize patient preop
- Allows consideration of different surgical approach (2 surgeons, limited goals, consider saying no)

Visit Us in NYC!

SafetyinSpineSurgery.com

SAVE THE DATE

5TH ANNUAL

Safety IN SPINE SURGERY SUMMIT

Transforming Patient Care and Optimizing Outcomes

FRIDAY
MARCH 13
2020

NEW YORK CITY
NEW YORK

CHAIR:
Michael G. Vitale, MD, MPH

CO-CHAIRS:
John M. Flynn, MD
Roger Härtl, MD
Lawrence G. Lenke, MD
Rajiv K. Sethi, MD

An **ESSENTIAL** program for:

- Spine surgeons
- Surgical spine team members
- Hospital execs responsible for patient safety

▶ Registration will open in fall 2019

JOINTLY PROVIDED BY:

MEDICAL EDUCATION RESOURCES

BROADWATER

NewYork-Presbyterian

COLUMBIA | COLUMBIA UNIVERSITY DEPARTMENT OF ORTHOPEDIC SURGERY

On Behalf of Our Patients,
THANK YOU!

NewYork-Presbyterian

COLUMBIA | COLUMBIA UNIVERSITY DEPARTMENT OF ORTHOPEDIC SURGERY