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AMERICAN COLLEGE of SURGEONS

JULY 21-24 2018 ORLANDO, FL

ACS QUALITY and SAFETY CONFERENCE

PARTNERING for IMPROVEMENT

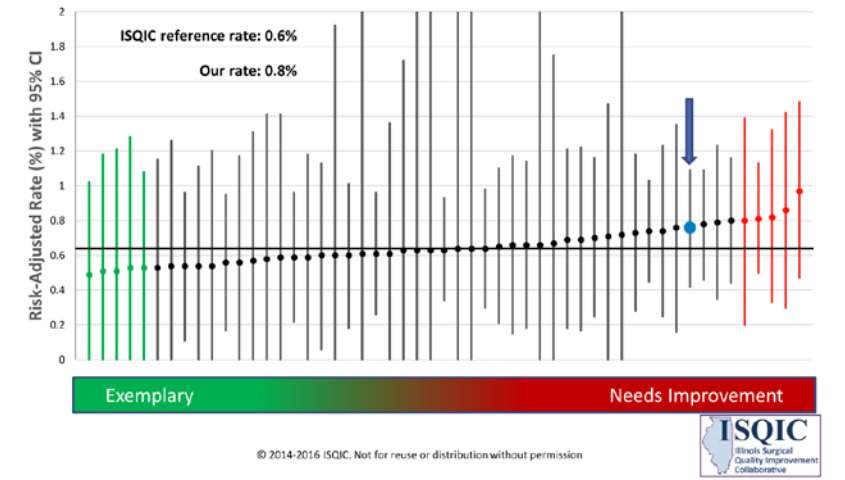
Using Machine Learning Techniques to Develop a Mobile Application to Predict Unplanned Intubations

Anai N. Kothari, MD MS; John Attisha, PH.D; Sarah Brownlee, BA; Adrienne Cobb, MD; Colleen Fairman, Kristen Halvorsen, Leila Saib, William Hopkinson, MD

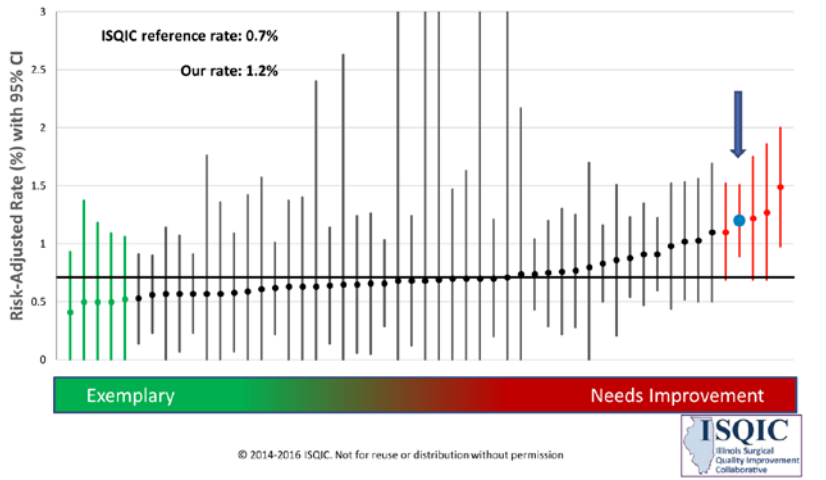
Disclosures

- None

All Cases Unplanned Intubation



All Cases Ventilator > 48hrs



Why unplanned intubations?

Exploring National Surgical Quality Improvement Program respiratory comorbidities: developing a predictive understanding of postoperative respiratory occurrences, Clavien 4 complications, and death

Arielle Hodari, MD,[a,] Athanasios Tsiouris, MD,[a] Michael Eichenhorn, MD,[b] Mathilda Horst, MD,[a] and Ilan Rubinfeld, MD, MBA[a]*

Original Investigation

I COUGH

Reducing Postoperative Pulmonary Complications With a Multidisciplinary Patient Care Program

Michael R. Cassidy, MD; Pamela Rosenkranz, RN, BSN, MEd; Karen McCabe, RN, BSN; Jennifer E. Rosen, MD; David McAneny, MD

Unplanned intubation: When and why does this deadly complication occur?

Daniel P. Milgrom, BS,[a] Victor C. Njoku, MD,[a] Alison M. Fecher, MD,[a] E. Molly Kilbane, RN,[a] *and* Henry A. Pitt, MD,[b] *Indianapolis, IN, and Philadelphia, PA*

A Scoring System to Predict Unplanned Intubation in Patients Having Undergone Major Surgical Procedures

May Hua, MD
Department of Anesthesiology, Columbia University College of Physicians and Surgeons, New York, New York

Can this be improved?

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YES!

1) Predicting high risk patients is feasible

2) Multidisciplinary interventions can reduce unplanned intubation rates

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OBJECTIVE

The overarching goal of this project is to develop and implement a targeted, patient-centered reintubation avoidance protocol (RAP) to decrease unplanned postoperative intubations.

30,000 Foot View

1) **Measure score on daily rounds with mobile application – to assess risk of unplanned intubation. RAP Score.**
2) If RAP score meets HIGH RISK threshold, initiate RAP for patient.
3) Re-assess risk daily while in ICU.

STEP 1: CREATING A PREDICTIVE MODEL

Total of 24,198 surgical encounters meeting NSQIP criteria identified

4,487 patients with care in SICU (2012 – 2015)

Reintubation
N=294 (6.6%)

No Reintubation
N=4,193

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Modeling Unplanned Intubations

Exploratory Data Analysis (184 variables in dataset):

- **Patient Demographics**
- **Vital Signs**
- **Comorbid Diseases**
- **Surgical Diagnoses**
- **Medications**

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Algorithm	Test Accuracy	Sensitivity	Specificity
Decision Tree	74%	76%	82%
Multilayer Ensemble	91%	92%	91%
Naïve Bayes	86%	81%	74%
KNN (Optimized for Accuracy)	87%	88%	82%
LDA	69%	69%	69%
Logistic Regression (Accuracy)	70%	68%	69%
Logistic Regression (Recall)	70%	69%	69%
SVM (Optimizing for Accuracy)	90%	86%	82%
SVM (Optimizing for Recall)	89%	89%	84%

Step 2: “Operationalize” the model

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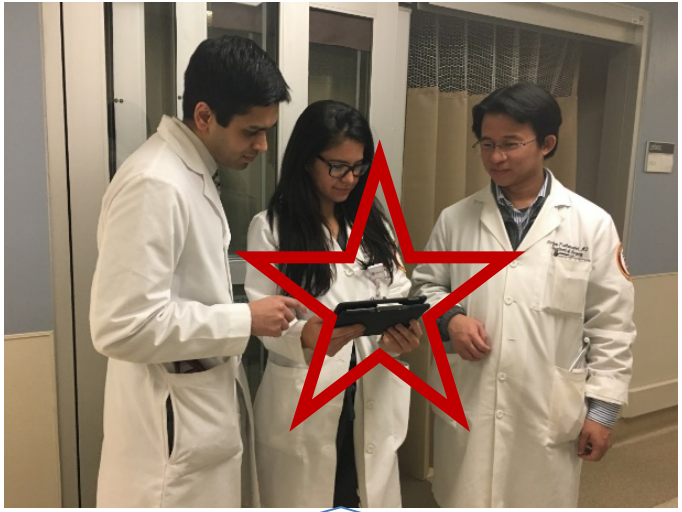
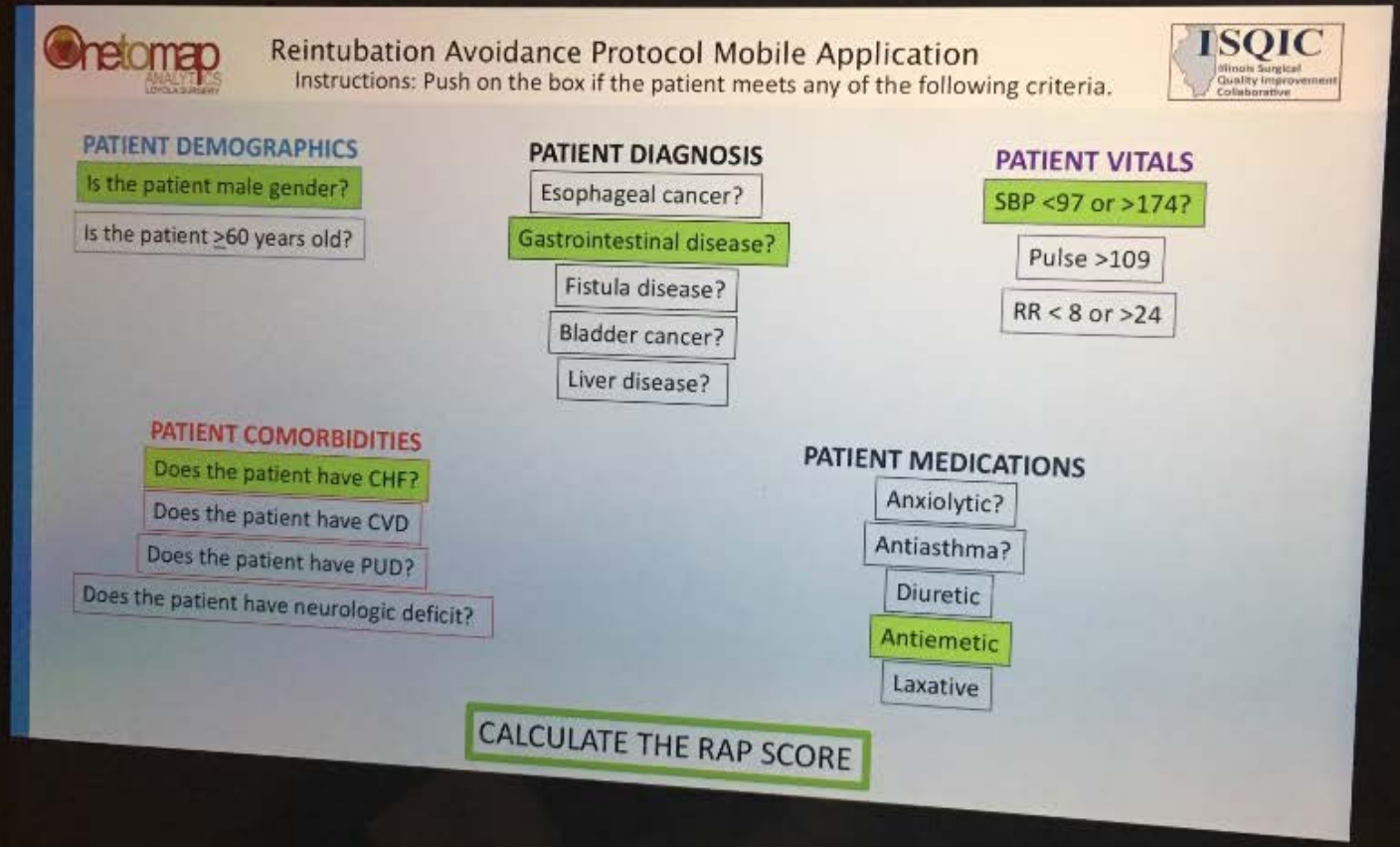
On daily rounds, RAP score calculated for each patient:



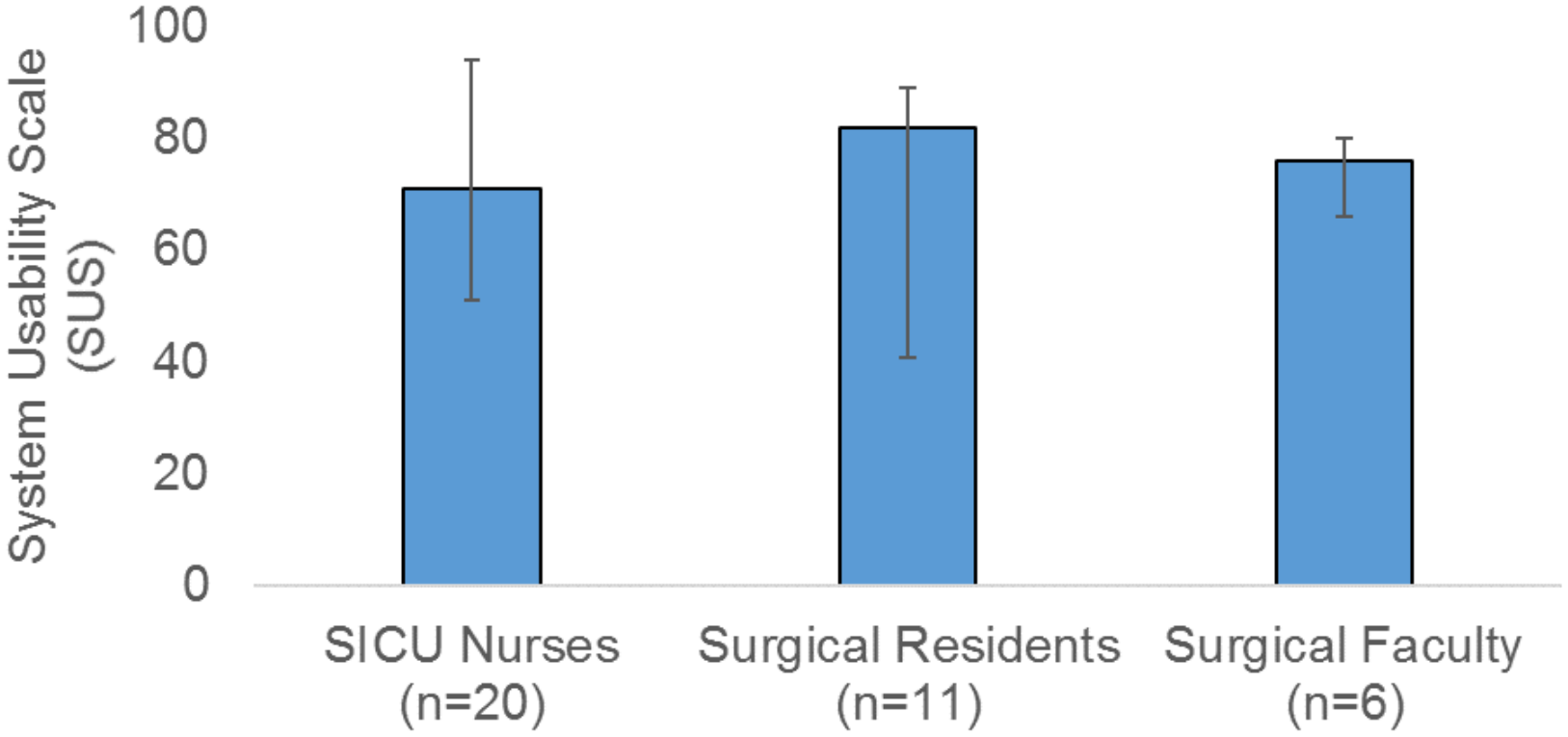
High Risk Patient

Institute Reintubation Avoidance Protocol

Low Risk Patient


Onetomap ANALYTICS
Reintubation Avoidance Protocol Mobile Application
Instructions: Push on the box if the patient meets any of the following criteria.
ISQIC Illinois Surgical Quality Improvement Collaborative
PATIENT DEMOGRAPHICS
Is the patient male gender?
Is the patient ≥60 years old?
PATIENT DIAGNOSIS
Esophageal cancer?
Gastrointestinal disease?
Fistula disease?
Bladder cancer?
Liver disease?
PATIENT VITALS
SBP <97 or >174?
Pulse >109
RR < 8 or >24
PATIENT COMORBIDITIES
Does the patient have CHF?
Does the patient have CVD
Does the patient have PUD?
Does the patient have neurologic deficit?
PATIENT MEDICATIONS
Anxiolytic?
Antiasthma?
Diuretic
Antiemetic
Laxative
CALCULATE THE RAP SCORE

Assessment of Usability



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Conclusions

- The use of machine learning algorithms can create a high-performing predictive tool
- A user-friendly mobile application can be built to apply in real-time
- This strategy may allow personalized interventions

What's Next

- Validation of algorithm (on-going)
- Pilot implementation
- Scalability assessment