The choice of neuromuscular blockade reversal agents impacts cost and operating room time. Currently, the two medications used to reverse neuromuscular blockade are Neostigmine and Sugammadex. These medications differ in both cost and pharmacologic profiles which effect the time and predictability of reversal (Currow, Zarantonello, Tellaroli, & Ori, 2016). Evaluating cost and time differences in reversal using Sugammadex and Neostigmine helps anesthesia providers select the appropriate medication. This evidence based practice project examined the differences in case length and operating room and reversal agent costs in cases using Sugammadex and Neostigmine at Providence Sacred Heart Medical Center.

### Methods

- Retrospective, observational, evidence-based practice project
- Facility-approval and IRB exemption determination granted
- Extracted case data deidentified and securely extracted into a HIPPA compliant REDCap database
- 11,944 cases evaluated from January 1, 2015 to December 31, 2018
- Inclusion criteria: ASA rating I, II, III; age <70; BMI <40; no diagnosed reduced pulmonary reserve conditions; no diagnosed pre-existing neuromuscular disease
- Cases removed: Surgical case duration not calculated; Neostigmine units <1 mg; Neostigmine units >5 mg; Sugammadex units >1000 mg; Sugammadex units <50 mg; Neither Neostigmine or Sugammadex used; Neostigmine and Sugammadex both used; Neostigmine given without Glycopyrrolate; Surgical procedures labeled ‘50’
- Analytical plan: Categorical variables described by frequency distributions; skewed continuous variables described by median and inter-quartile range. Average medication costs, operating room minutes, and estimated operating room costs/case reported by reversal agent.
- Simulation: Total operating room and reversal agent costs were projected using an estimated operating room rate. Sensitivity analysis was completed in which the estimated operating room rate was varied.

The choice of Sugammadex over Neostigmine as a neuromuscular blockade reversal agent resulted in lower operating room time and reversal agent costs in simulated analyses in which the operating room cost per minute was varied.

### Findings

#### Table 1: Baseline Demographic and Clinical Characteristics (N=11,944)

| Characteristic | Sugammadex | Neostigmine | Stat
|----------------|------------|-------------|------|
| Gender Male (%) | 54.9 | 56.9 | 0.058
| Female (%) | 45.1 | 43.1 | 0.058
| ASA Rating I (%) | 15.0 | 18.5 | 0.002
| II (%) | 59.3 | 60.0 | 0.088
| III (%) | 25.7 | 21.5 | 0.002
| Injury (%) | 14.8 | 15.9 | 0.088
| Blood loss (%) | 27.8 | 27.0 | 0.088
| Polymer (%) | 21.8 | 22.7 | 0.088
| Blood loss (%) | 7.2 | 7.0 | 0.088

#### Table 2: Neuromuscular Blockade Reversal Agent Cost Analysis (N=11,944)

| Metric | Sugammadex (n=7,829) | Neostigmine (n=4,115) | Stat
|----------------|---------------------|---------------------|------|
| Average Reversal Agent Medication Cost/Case* | $37,812 | $28,753 | 0.058
| Average Operating Room Time (minutes) | 90 | 160 | 0.058
| Estimated Operating Room Cost/Case** | $1,577 | $2,544 | 0.058

#### Table 3: Operating Room Cost Per Minute Sensitivity Analysis

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<th>OR Cost/Min</th>
<th>Sugammadex</th>
<th>Neostigmine</th>
<th>Cost of Sugammadex</th>
<th>Cost of Neostigmine</th>
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</table>

### Discussion

Operating room (OR) time and cost of neuromuscular blockade reversal agents were compared among cases in which either reversal agent could be used. The average reversal agent cost per case using Sugammadex was $99.13 compared to cases using Neostigmine/Glycopyrrolate at $32.55 per case. A side by side comparison between Sugammadex and Neostigmine for like surgeries found that Sugammadex shortens surgical case duration for most procedures. Across all project cases the average surgical case duration for cases reversed using Sugammadex was 150 minutes (estimated operating room costs $14,623 per case). Neostigmine reversed cases averaged 153 minutes for surgical case duration (estimated operating room costs $14,901 per case).

In simulated models, exclusive use of Sugammadex across all cases for the past four years would have resulted in cost savings across a range of estimated OR costs per minute. The findings of this observational project showed an average of more than three minutes were saved in OR time when using Sugammadex versus Neostigmine. Surgical case duration is complex and multi-factorial. The results of this observational project signal a difference in OR time and agent costs as the result of reversal agent choice.

Further randomized investigations are warranted.