

# Neostigmine versus Sugammadex and the Relationship to Reintubation Rates in the PACU

Delanie Urrutia, BSN, RN; Scot Pettey, DNAP, CRNA, APRN; Kenn B. Daratha, PhD  
*Providence Sacred Heart Medical Center & Gonzaga University School of Anesthesia*

## Background

Reintubation in the post-anesthesia care unit (PACU) is a complication that may be related to residual neuromuscular blockade. Neostigmine and sugammadex have different pharmacokinetics that effect speed and completeness of reversal of paralysis. According to Tillquist et al. (2016) reintubation following general anesthesia in the PACU is associated with a 50% increased risk of mortality. Few studies have investigated the incidence rate of PACU reintubation and its possible relationship and choice of reversal medication.

## Methods

- Retrospective Observational Research Study.
- This project was approved by the PSHMC Clinical Innovation and Research Council and deemed human subjects exempt by the Providence Health Care institutional review board.
- Patient data was extracted from Epic electronic medical records and accessed from secured REDCap database.
- Eligibility Criteria:
  - Inclusion* – Patients  $\geq 18$  years of age undergoing general anesthesia, intubated at start of procedure and extubated by out of OR time between 2013 and 2019.
- Descriptive analyses examined baseline group comparability, incidence of reintubation and reintubation risk factors in the study population.
- Additional statistical analyses were conducted: a-priori power analysis, univariate, bivariate, and multivariable.
- Time series examined rates of PACU reintubation over time, with stratification into low risk and high risk patient groups.
- Risk factors associated with reintubation were extrapolated based upon Brueckmann et al. (2013) score for prediction of postoperative respiratory complications (SPORC).

## Findings

**Table 1. Patient Demographic & Clinical Characteristics (N=84,582)**

Variable	Value	Mean	SD	
Age	Years	57	17	
Body Mass Index	Kg/m <sup>2</sup>	30	40	
		N	%	
Gender	Male	37,665	44%	
	Female	46,917	55%	
ASA Score*	1	5,024	6%	
	2	36,210	43%	
	3	34,857	41%	
	4	4,039	5%	
	5-6	34	< 1%	
Reintubation Risk Score**	0	10,479	12%	
	Low Risk (0-2)	1	25,008	30%
	High Risk ( $\geq 3$ )	2	25,936	31%
		3	16,436	19%
	4	5,778	7%	
	5	914	1%	
	6	31	< 1%	
	Intraoperative Reversal	Neostigmine (N)	24,250	29%
Sugammadex (S)		26,582	31%	
Both N+S		110	< 1%	
No Reversal		10,127	12%	
Not Required		23,564	28%	
Case Type	Elective	69,085	82%	
	Non-Elective***	15,326	18%	

\*ASA Score: American Society of Anesthesiology Physical Status Classification;

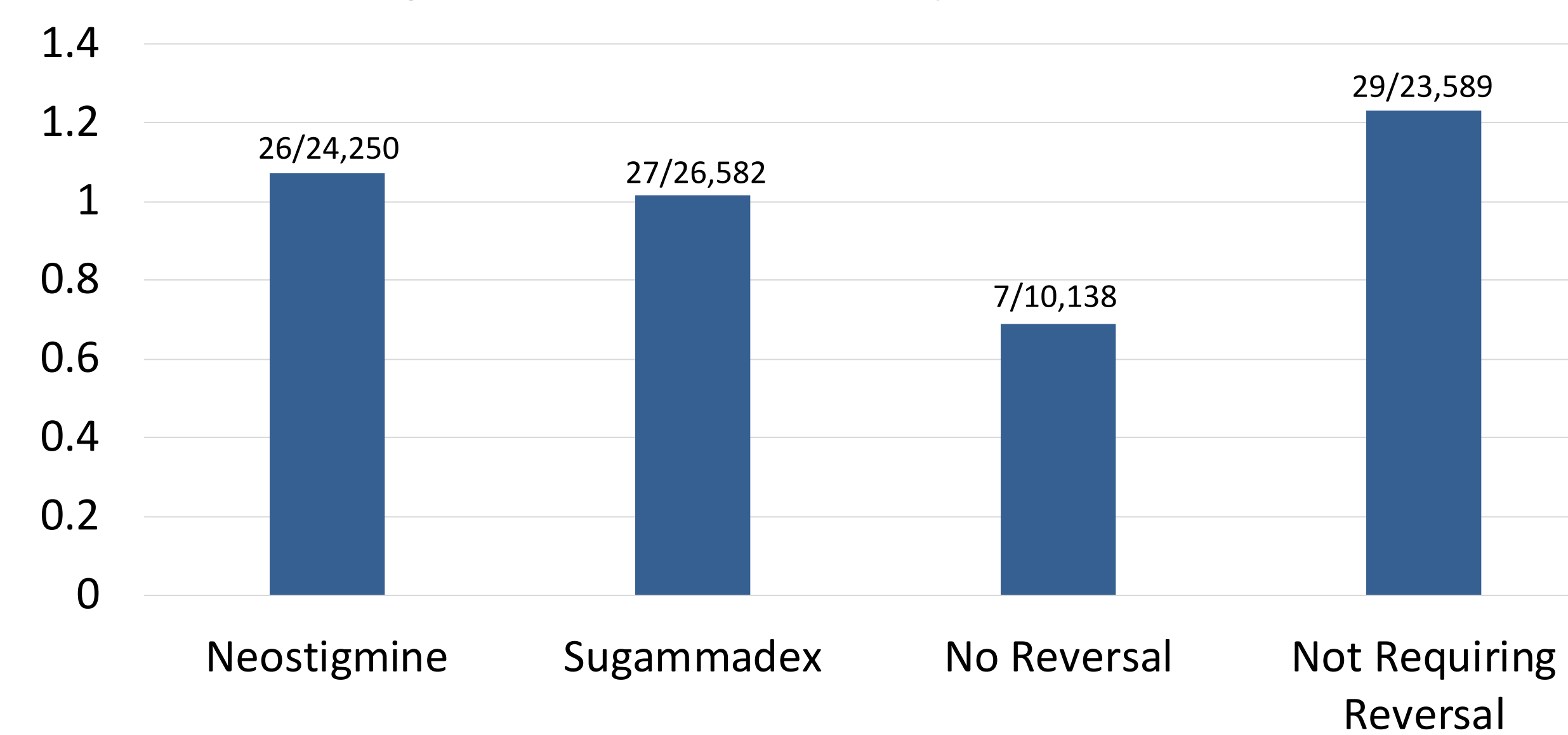
\*\*Patient Risk Score: Age  $\geq 70$ , BMI  $\geq 40$ , ASA  $\geq 3$ , pre-existing respiratory disease, case duration > 180 minutes, and/or administration of opioids within 30 minutes prior to out of OR; \*\*\*Non-Elective: urgent, emergent, trauma, and return to OR.

**Table 2. \*Independent Risk Factors for PACU Reintubation**

	OR (95% CI)	coeff b	P-value
Neostigmine	1.01 (0.61-1.67)	0.01	0.95
Sugammadex	0.92 (0.56-1.52)	-0.07	0.75
High Risk Patients	1.67 (1.08-2.56)	0.51	0.01
Non-Elective Procedure	1.96 (1.25-3.09)	0.67	0.003

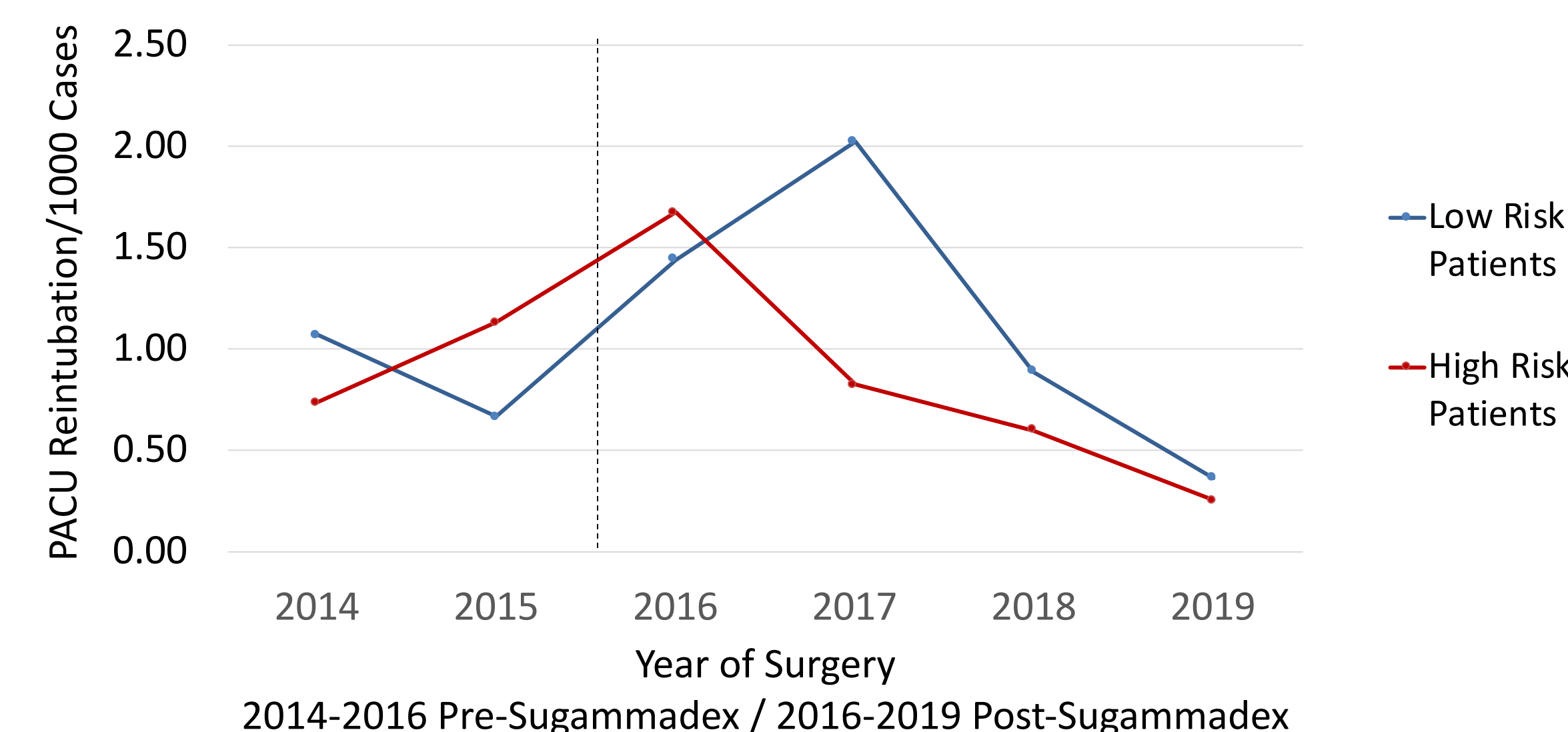
\*Multivariable Binary Logistic Regression Analysis

**Figure 1. Reintubation Rates per 1,000 Patients**



- Reintubation in the PACU is rare and there are no significant differences in reintubation rate among patients receiving neostigmine or sugammadex. (P = 0.57)
- No reversal = received a non-depolarizing neuromuscular blocker, but did not receive reversal agent
- Not requiring reversal = received either a depolarizing neuromuscular blocker or none, and subsequently did not require reversal agent

**Figure 2. Time Series of Reintubation Rates PSHMC and PHFH - PACU Reintubation Rates over Time**



## Discussion

Reintubation in the PACU is rare. Rates of reintubation increased in the years 2016 and 2017. Rates in 2019 were below levels observed in 2014. Patients were stratified into low risk (reintubation risk score 0-2) and high risk ( $\geq 3$ ) groups. Reintubation rates peaked for high risk patients in 2016 and peaked for low risk patients in 2017. A reduction of reintubation in PACU was not associated with the utilization of sugammadex in comparison to neostigmine.

Due to the lack of current research evidence investigating the relationship between reintubation rates and reversal medication, this retrospective observational research study aims to serve as a foundation for generating hypotheses for future randomized control trials that may inform treatment decisions in clinical practice.

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