Return to Normal: Prioritizing Elective Surgeries With Low Resource Utilization

To the Editor

Suspension of elective surgeries was among the first mitigation efforts in anticipation of a surge in demand for critical care services during the coronavirus disease 2019 (COVID-19) pandemic.[1] As the United States nears the peak of this pandemic, policymakers need to determine the optimal strategy to safely return to "normal" operations while remaining vigilant and prepared for future recurrent outbreaks.

We therefore evaluated intensive care unit (ICU) utilization and mechanical ventilation following common elective surgical procedures to (1) determine which procedures are the least resource intensive and (2) which patient populations are less likely to require postoperative ICU admission or ventilation.

After Institutional Review Board approval (IRB no. 2016-436), we conducted a retrospective analysis of patients captured in the Premier Healthcare database (2006–2016) who underwent common elective inpatient procedures (Supplemental Digital Content, Appendix, http://links.lww.com/AA/D93).[2] For each surgical cohort, we identified ICU admission, length of ICU (and hospital) stay, and use and length of (non-) invasive ventilation (≥96 or <96 hours). Multivariable logistic regression models measured the association between patient age/comorbidity burden as measured by Charlson-Deyo index,[3] and the outcomes of ICU admission and ventilation, to validate the perception that younger and healthier patients are less likely to require these resources.

Of the 15 elective surgeries evaluated, cardiac procedures were the most resource intensive with 83.9% of patients admitted to the ICU and 27.9% requiring ventilation, followed by abdominal procedures that had an average ICU admission rate of 20.3%. Gynecological surgeries and joint arthroplasties appeared to be the least resource intensive with fewer than 5.5% of patients admitted to the ICU and <2% requiring postoperative ventilation (Table). In regression models, greater comorbidity burden was associated with significantly increased odds of ICU admission or any form of ventilation in almost all procedure cohorts; this association was more subdued and sometimes reversed for older age (Figure).

The highest ICU utilization was seen in cardiac, abdominal, and spine surgeries. Outside of cardiac procedures, postoperative ventilation was relatively uncommon, indicating that limiting elective procedures is primarily beneficial in maximizing ICU capacity rather than freeing up ventilators.

In almost all procedure cohorts, younger patients with a low comorbidity burden were less likely to require ICU admission and/or ventilation. Comorbidity burden was a stronger risk factor and thus should be prioritized over age for optimal patient selection. There is a 2-fold impact of restricting these surgeries to younger patients with a low comorbidity burden. These patients are not only less likely to require ICU or ventilation, but they are also at lower risk of developing severe COVID-19 symptoms were they to contact the virus during their hospital stay.[4] However, if patients do not meet these criteria and their health could worsen from delaying surgery, it may be advisable to instead space out surgeries of older patients with underlying conditions to optimize resource utilization.

Limitations of this study include our simplified analysis that only considered patient age and comorbidity burden. While there are a number of other factors associated with ICU admission and ventilation, our findings should provide a useful starting point in strategizing to return to normal operations. Additionally, some procedures classified as elective in this database may not truly be elective; however, given that they will still be performed during the COVID-19 pandemic, we felt valuable information could still be gained from retaining them in our analyses.

These data suggest that, in the transition back to elective surgery, cardiac and abdominal procedures should be limited if possible in favor of "safer" and less resource-intensive surgeries such as gynecological and nontraumatic orthopedic procedures. Across all procedure cohorts, it would be ideal to restrict or at least prioritize younger patients with fewer comorbidities.

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Conflicts of Interest: Stavros G. Memtsoudis is a director on the boards of the American Society of Regional Anesthesia and Pain Medicine (ASRA) and the Society of Anesthesia and Sleep Medicine (SASM). He is a one-time consultant for Sandoz Inc and Teikoku and is currently on the medical advisory board of HATH. He has a pending US Patent application for a Multicatheter Infusion System. US-2017-0361063. He is the owner of SGM Consulting, LLC, and co-owner of FC Monmouth, LLC. None of the above relations influenced the conduct of the present study.

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Table. Patterns in ICU Utilization and Ventilation Across Surgical Cohorts

	Cardiac			Abdominal			Gynecological			Orthopedic					
	Percutaneous Transluminal Coronary Angioplasty	Coronary Artery Bypass Graft	Heart Valve Procedures	Cholecystectomy and Common Duct Exploration	Colorectal Resection	Appendectomy	Tubal Ligation	Hysterectomy	Oophorectomy	Total Hip Arthroplasty	Total Knee Arthroplasty	Spinal Fusion	Laminectomy	Fracture or Dislocation of Hip or Femur	Fracture or Dislocation of Lower Extremity
Elective inpatient procedures, n	73,327	224,215	67,836	60,024	248,121	15,847	20,962	629,895	35,378	564,682	1,131,516	670,195	2927	34,741	14,803
Postoperative ICU admission, n	26,630	215,153	64,735	13,099	50,397	2218	341	18,277	1917	14,886	25,070	68,884	457	3650	512
% of ICU/inpatient admission	36.3	96	95.4	21.8	20.3	14	1.6	2.9	5.4	2.6	2.2	10.3	15.6	10.5	3.5
ICU length of stay, median (IQR)[a]	1 (1–2)	3 (1–5)	3 (2–6)	2 (1–5)	3 (1–5)	2 (1–5)	1 (1–2)	2 (1–3)	2 (1–4)	1 (1–3)	1 (1–3)	2 (1–3)	2 (1–5)	2 (1–4)	2 (1–3)
Any ventilation, n (%)	2707 (3.7)	74031 (33.0)	25111 (37.0)	3741 (6.2)	12974 (5.2)	620 (3.9)	92 (0.4)	5016 (0.8)	583 (1.7)	3961 (0.7)	9697 (0.9)	11079 (1.7)	144 (4.9)	782 (2.3)	208 (1.4)
Noninvasive	303 (11.2)	2878 (3.9)	941 (3.8)	541 (14.5)	1509 (11.6)	72 (11.6)	6 (6.5)	1008 (20.1)	104 (17.8)	2209 (55.8)	6352 (65.5)	2829 (25.5)	22 (15.3)	165 (21.1)	72 (34.6)
Invasive	2287 (84.5)	68,545 (92.6)	23,116 (92.1)	2962 (79.2)	10,625 (81.9)	524 (84.5)	83 (90.2)	3804 (75.8)	463 (79.4)	1620 (40.9)	3013 (31.1)	7830 (70.7)	117 (81.3)	566 (72.4)	120 (57.7)
Both	117 (4.3)	2608 (3.5)	1054 (4.2)	238 (6.4)	840 (6.5)	24 (3.9)	3 (3.3)	204 (4.1)	16 (2.7)	132 (3.3)	332 (3.4)	420 (3.8)	5 (3.5)	51 (6.5)	16 (7.7)
Invasive ventilation duration, n (%)															
Consecutive ≥96 h	613 (25.5)	6891 (9.7)	4020 (16.6)	1057 (33.0)	3742 (32.6)	155 (28.3)	5 (5.8)	576 (14.4)	71 (14.8)	253 (14.4)	448 (13.4)	1440 (17.5)	27 (22.1)	135 (21.9)	38 (27.9)
Consecutive <96 h	1790 (74.5)	64,250 (90.3)	20,144 (83.3)	2141 (66.9)	7709 (67.2)	392 (71.5)	81 (94.2)	3428 (85.5)	407 (84.5)	1498 (85.5)	2894 (86.5)	6805 (82.5)	95 (77.9)	481 (78.0)	98 (72.1)
Hospital length of stay, median (IQR)	1 (1–3)	6 (5–9)	7 (5–11)	4 (2–7)	6 (4–8)	4 (2–7)	3 (2–3)	2 (1–3)	2 (2–3)	3 (2–3)	3 (2–3)	2 (1–4)	4 (2–7)	4 (3–6)	3 (2–4)
Patient age, median (IQR)	68 (60–75)	67 (60–74)	72 (64–79)	62 (50–73)	64 (53–73)	54 (43–65)	32 (28–36)	46 (40–53)	50 (43–61)	65 (57–73)	66 (59–73)	57 (47–67)	60 (49–69)	75 (63–84)	58 (46–68)
Deyo index, n (%)															
0	19,023 (25.9)	45,646 (20.4)	12,062 (17.8)	21,452 (35.7)	81,108 (32.7)	7771 (49.0)	19,044 (90.9)	453,264 (72.0)	20,379 (57.6)	352,137 (62.4)	637,944 (56.4)	407,117 (60.8)	1554 (53.1)	14,095 (40.6)	8329 (56.3)
1	22,846 (31.2)	64,264 (28.7)	17,365 (25.6)	13,321 (22.2)	31,607 (12.7)	2098 (13.2)	1667 (8.0)	81,038 (12.9)	4826 (13.6)	136,237 (24.1)	320,324 (28.3)	171,168 (25.5)	720 (24.6)	8965 (25.8)	3367 (22.8)
2	13,824 (18.9)	47,964 (21.4)	14,609 (21.5)	9276 (15.5)	53,368 (21.5)	2045 (12.9)	194 (0.9)	51,276 (8.1)	4804 (13.6)	46,739 (8.3)	10,8975 (9.6)	57,018 (8.5)	354 (12.1)	5145 (14.8)	1496 (10.1)
3+	17,634 (24.1)	66,341 (29.6)	23,800 (35.1)	15,975 (26.6)	82,038 (33.1)	3933 (24.8)	57 (0.3)	44,317 (7.0)	5369 (15.2)	29,569 (5.2)	64,273 (5.7)	34,892 (5.2)	299 (10.2)	6536 (18.8)	1611 (10.9)

Abbreviations: ICU, intensive care unit; IQR, interquartile range.

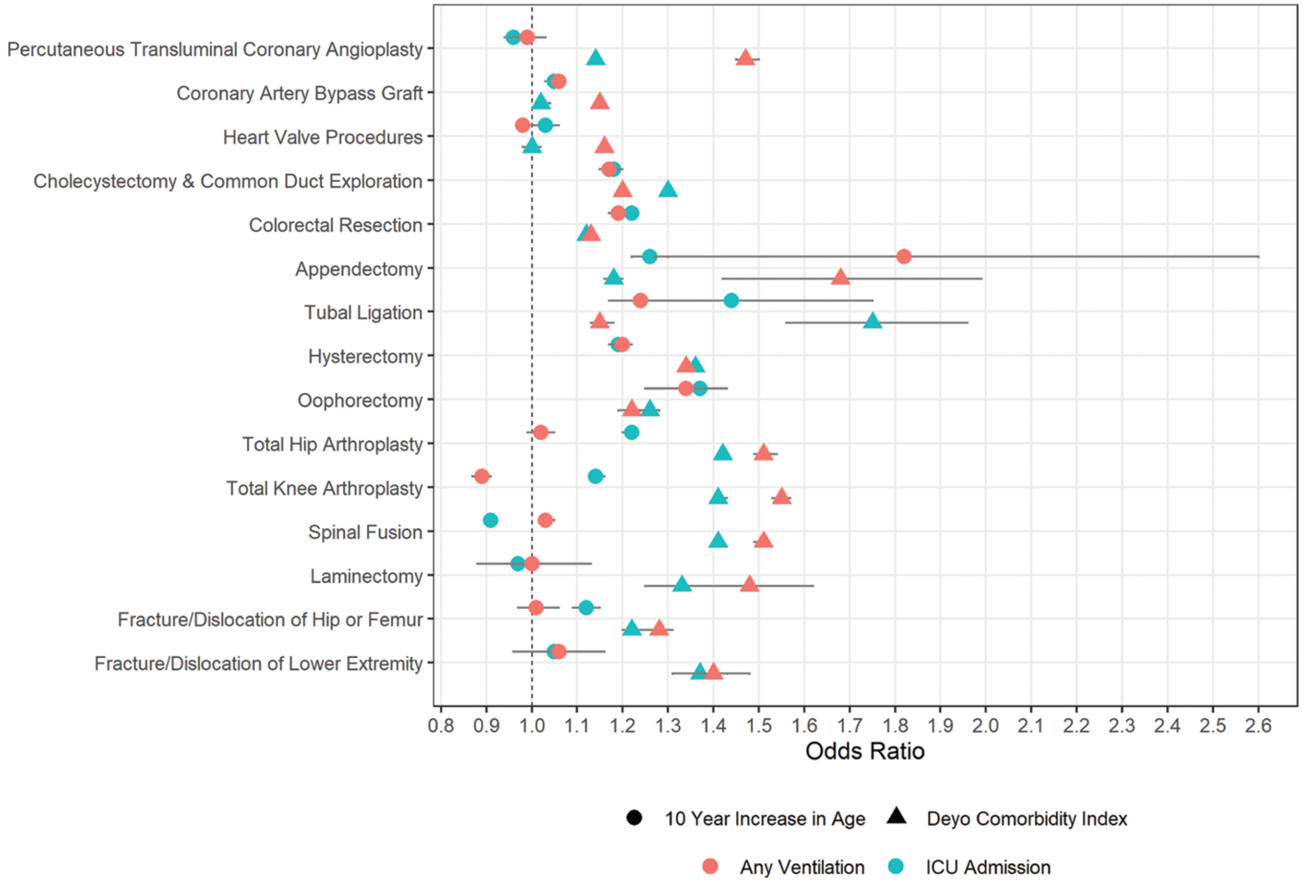

Figure. Plot of adjusted odds ratios and 95% confidence intervals for the association between patient age/Deyo comorbidity index and the 2 outcomes of postoperative ICU admission and any ventilation, stratified by surgical cohort. ICU indicates intensive care unit.

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