

Supplemental Online Content

Neuman MD, Feng R, Shukla A, et al. Benzodiazepine reduction in anesthesia care for older adults: a randomized clinical trial. *JAMA Netw Open*. 2024;7(10):e2442207. doi:10.1001/jamanetworkopen.2024.42207

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1: Study divisions. “Facilities” include hospitals, outpatient surgery centers, and physician offices. At the time of study planning, we anticipated implementation of the interventions at 423 facilities across 24 practice divisions. Prior to study start, division 11 (4 facilities) and division 18 (4 facilities) de-integrated from the group practice. These divisions were not included in the study and no data were collected on patients treated at these locations.

N	Study division	Number of facilities included
1	USAP Austin	26
2	USAP Colorado A	10
3	USAP Colorado B	14
4	USAP Colorado C	27
5	USAP Dallas A	28
6	USAP Dallas B	21
7	USAP Dallas C	10
8	USAP Dallas D	55
9	USAP Houston A	8
10	USAP Houston B	16
11	USAP Houston C	4 ^a
12	USAP Houston D	26
13	USAP Kansas	2
14	USAP Maryland A	13
15	USAP Maryland B	40
16	USAP Nevada A	7
17	USAP Nevada A	26
18	USAP Oklahoma	4 ^a
19	USAP Florida A	30
20	USAP Florida B	7
21	USAP Florida C	13
22	USAP San Antonio A	11
23	USAP San Antonio B	11
24	USAP Washington	14

a. Division de-integrated prior to study start; no data collected

		Period				
		1	2	3	4	5
Cluster	1		Blue	Blue	Blue	Blue
	2			Blue	Stippled	Stippled
	3			Stippled	Stippled	Stippled
	4		Stippled	Stippled	Stippled	Stippled

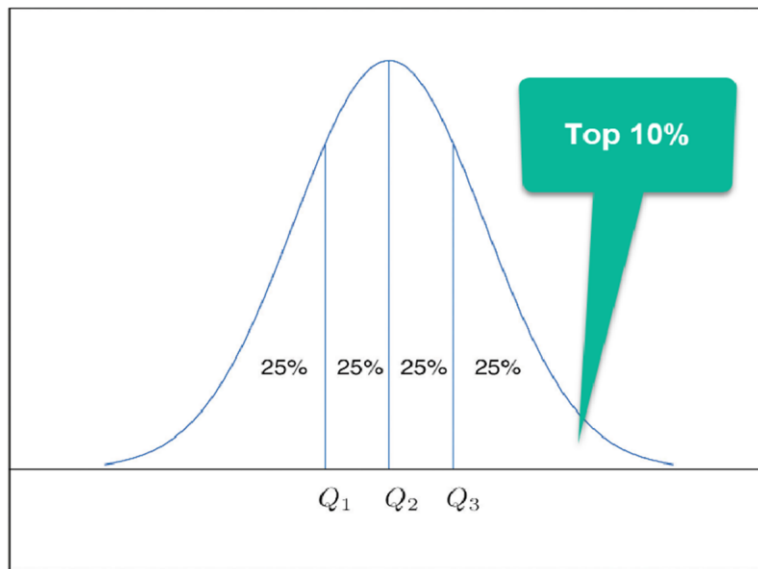
eFigure1. Study randomization scheme. Practices were randomized in clusters of 6 units to one of four study sequences shown above. In the initial period, no divisions received either intervention; each intervention (peer comparison feedback, blue cells; patient informational letter, stippled cells) was subsequently initiated at a new cluster of practices based on the assigned sequence.

Quality Improvement Project Sponsored by USAP's Chief Quality Officer

Top Performer Alert!

You are a top performer. You have a low rate of benzodiazepine administration for older (≥ 65 yrs) surgical patients undergoing general anesthesia.

Please continue to work to limit potentially avoidable medications to older surgical patients.



Questions? Email Richard.Dutton@usap.com

eFigure 2: Physician peer comparison message: high-performer alert

MIDAZOLAM ADMINISTRATION SCORECARD

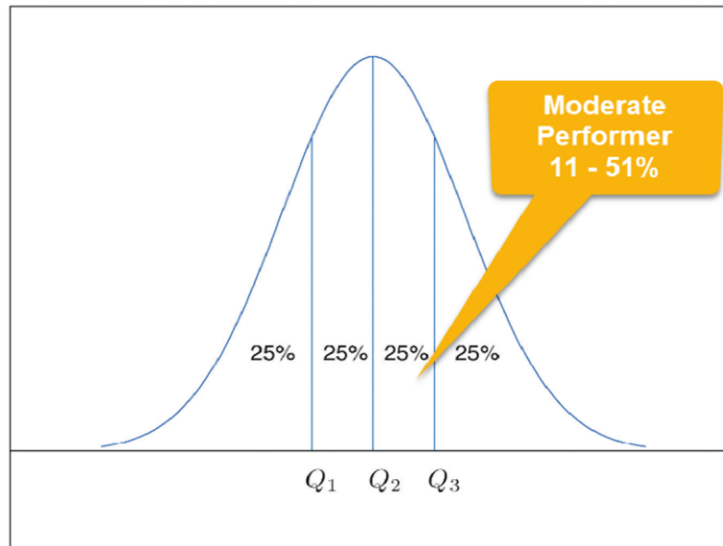
Quality Improvement Project Sponsored by USAP's Chief Quality Officer

Moderate Performer Alert!

Your benzodiazepine administration rate for older (≥ 65 yrs) surgical patients undergoing general anesthesia falls between 11-51%. Top performer rate is $\leq 10\%$

You may be administering midazolam to too many older adults; this is known to contribute postoperative cognitive dysfunction.

Please continue to work to limit potentially avoidable medications to older surgical patients.



Questions? Email Richard.Dutton@usap.com

eFigure 3: Physician peer comparison message: moderate-performer alert

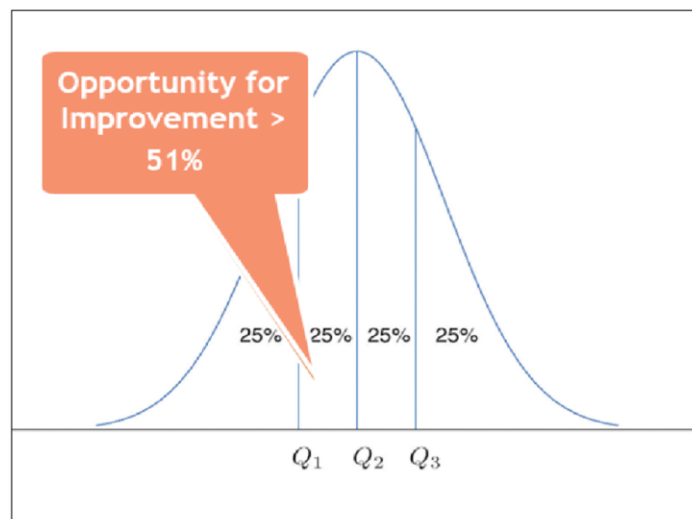
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Opportunity for Improvement Alert!

Your benzodiazepine administration rate for older (>= 65 yrs) surgical patients undergoing general anesthesia is greater than 51%, which falls below the median USAP performance.

You may be administering midazolam to too many older adults; this is known to contribute postoperative cognitive dysfunction.

Please continue to work to limit potentially avoidable medications to older surgical patients.



Questions? Email Richard.Dutton@usap.com

eFigure 4: Physician peer comparison message: low-performer alert

Dear Patient:

Thank you for trusting US Anesthesia Partners with your upcoming medical procedure. We look forward to caring for you.

As your anesthesia team, USAP is committed to keeping you healthy during and after surgery. We understand that many people have questions about their anesthesia care, as well as the potential implications of anesthesia for brain health.

As the Chief Quality Officer of USAP, I encourage you to ask about the anesthesia plan--including care you will receive before, during, and after surgery--when you see us before your procedure. This will help us find the best choice of medicines for you and your specific situation.

Sincerely,

Richard P. Dutton, MD, MBA
Chief Quality Officer, USAP

Adjunct Professor of Anesthesiology
Texas A&M University College of Medicine

eFigure 5: Patient informational mailing text

eTable 2: Race and ethnicity information for study participants providing data				
	No intervention	Peer comparisons only	Patient mailing only	Peer comparisons + patient mailing
Race				
White	11,858 (88.3%)	2,314 (88.3%)	2,581 (89.1%)	2,721 (88.1%)
Black or African American	917 (6.8%)	156 (6.0%)	201 (6.9%)	220 (7.1%)
American Indian or Alaskan Native	151 (1.1%)	17 (0.7%)	12 (0.4%)	13 (0.4%)
Asian	318 (2.4%)	46 (1.8%)	37 (1.6%)	48 (1.6%)
Other	136 (1.0%)	58 (2.2%)	39 (1.6%)	49 (1.6%)
More than one race	49 (0.36%)	30 (1.14%)	28 (1.3%)	39 (1.3%)
Total reporting	13,429	2,621	2,898	3,090
Hispanic ethnicity				
Yes	984 (7.2%)	153 (5.9%)	196 (6.7%)	230 (7.5%)
No	12,725 (92.8%)	2,441 (94.1%)	2,709 (93.2%)	2,857 (92.5%)
Total reporting	13,709	2,594	2,905	3,087

eTable 3: Standardized differences for individual study covariates versus control group			
Characteristic	Peer comparisons only	Patient mailing only	Peer comparisons + patient mailing
Age in years	0.071	0.044	0.087
Male sex	0.014	-0.008	0.008
Female sex	-0.014	0.008	-0.008
Case duration in minutes	0.006	-0.061	0.0003
American Society of Anesthesiologists Physical Status			
I: No systemic disease	0.005	-0.014	-0.014
II: Mild systemic disease	-0.034	-0.003	-0.051
III: Severe systemic disease	0.004	0.030	0.038
IV or V: Severe systemic disease that is a constant threat to life or moribund patient	0.037	-0.037	0.016
Surgery type			
Endoscopic	-0.030	0.025	-0.022
General/abdominal	-0.031	-0.040	-0.017
Orthopedic	0.051	0.046	0.021
Urologic	-0.015	-0.098	-0.009
Neurosurgery/Spine	-0.025	0.043	-0.012
Cardiology	0.039	0.030	0.007
Vascular	0.017	-0.002	0.007
Cardiac	0.016	0.009	-0.001
Ear, nose, and throat	-0.006	-0.033	-0.004
Gynecology	-0.038	-0.005	-0.022
Thoracic	0.011	-0.014	0.019
Ophthalmology	0.012	0.002	-0.015
Cosmetic	-0.013	-0.046	-0.015

eTable 3: Standardized differences for individual study covariates versus control group				
Characteristic		Peer comparisons only	Patient mailing only	Peer comparisons + patient mailing
	Radiology	0.007	-0.017	-0.010
	Other	0.051	0.055	0.091
Insurance type				
	Commercial	0.004	0.026	0.013
	Government	-0.001	-0.013	-0.006
	Other	-0.006	-0.030	-0.017
Years in practice		0.031	0.055	-0.034
Care mode				
	Solo	0.083	0.021	-0.139
	Team	-0.083	-0.021	0.139
Service location				
	Inpatient hospital/Emergency Department	-0.081	0.056	-0.011
	Other	0.081	-0.056	0.011
Race				
	White	0.000	0.025	-0.006
	Black or African American	-0.033	0.004	0.012
	American Indian or Alaskan Native	-0.042	-0.081	-0.081
	Asian	-0.042	-0.082	-0.057
	Other	0.095	0.028	0.053
	More than one race	0.090	0.078	0.104
Hispanic ethnicity				
	Yes	-0.052	-0.016	0.011
	No	0.052	0.016	-0.011

Supplementary methods: information on mixed-effects logistic model

The mixed-effects logistic model can be written as:

$$\text{Logit}(P(Y_{ijk}=1)) = \beta_0 + \beta_1 * \text{treatmentA} + \beta_2 * \text{treatmentB} + \beta_3 * \text{treatmentA \& treatmentB} + \beta_4 * \text{age} + \beta_5 * \text{male} + \beta_6 * \text{surgery duration} + \beta_7 * \text{severe ASA (III or IV)} + \beta_8 * \text{surgery type 1} + \dots + \beta_{21} * \text{surgery type 15} + \beta_{22} * \text{private insurance} + \beta_{23} * \text{period 2} + \dots + \beta_{26} * \text{period 5} + \gamma_{1j} + \gamma_{2j}^k$$

Where

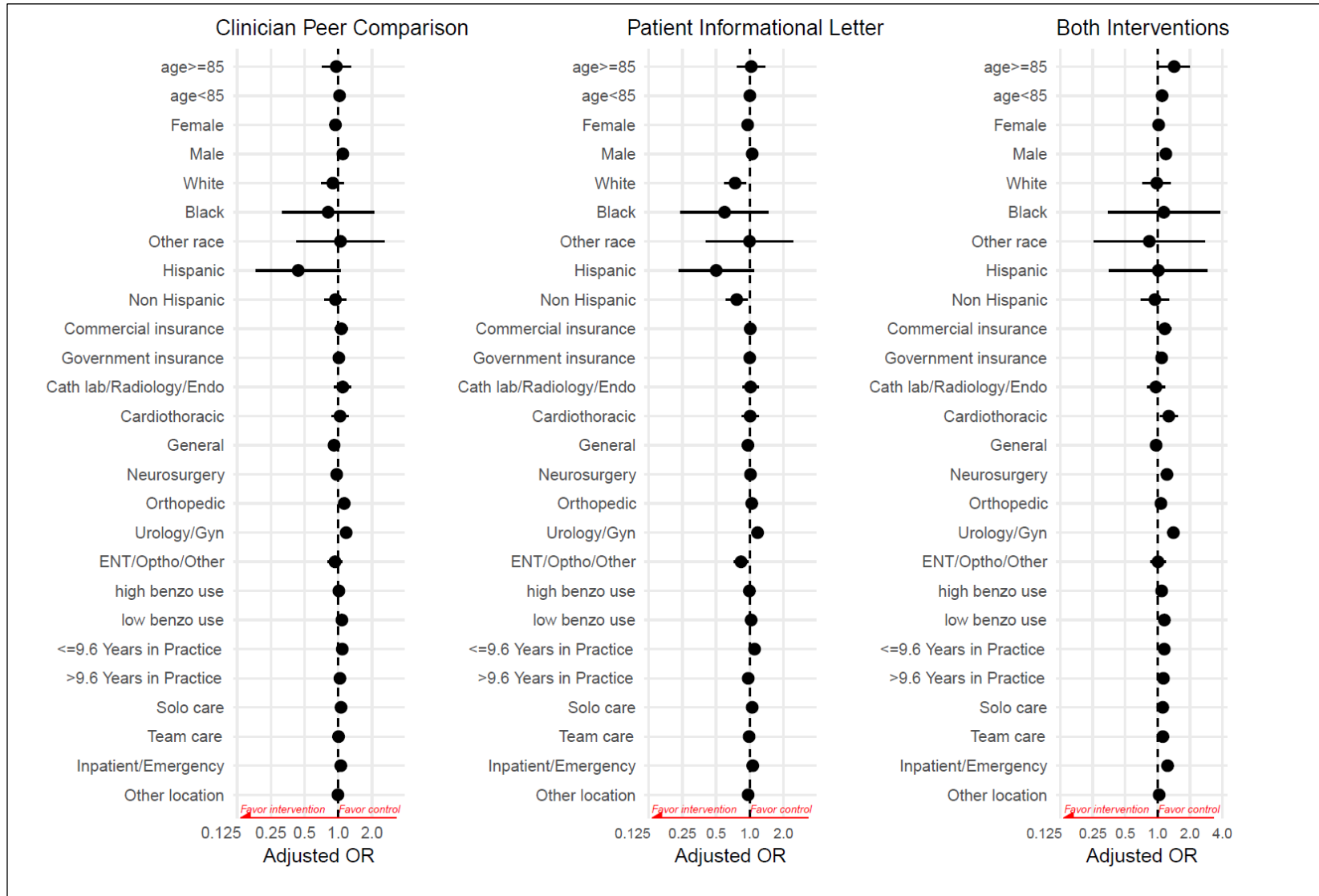
- i is the index for subject, j is the index for assigned cluster for subject i , k index for the center within each cluster.
- β_0 is the fixed intercept
- β_1 , β_2 , and β_3 , are the fixed treatment and interaction effects
- β_4 , \dots , β_{26} are the fixed covariate effects of age, gender, ASA status, surgery type, and time period.
- γ_{1j} represents the random effect for the j -th cluster (e.g., cluster-specific intercept) and is assumed to follow normal distributions with mean zero and variances σ^2_1 .
- γ_{2j}^k represents the random effect for the k -th hospital nested within the j -th cluster, and is assumed to follow normal distributions with mean zero and variances σ^2_{2j} .

eTable 4: Simplified regression model results for primary outcome.

	Odds Ratio, 95% Confidence Interval^a
Physician peer comparisons only	1.00 (0.96-1.04)
Patient mailing only	1.00 (0.96-1.04)
Peer comparisons plus patient mailing	1.09 (1.04-1.14)

a. Adjusted for study period only

eFigure 6: Subgroup analyses



eTable 5: Patient satisfaction item responses.					
		No intervention (N=159674)	Intervention A only(N=81363)	Intervention B only(N=98520)	Intervention A+B(N=169712)
Your options for anesthesia were explained before your surgery.	Disagree, disagree strongly, or neutral	1,576 (9.95%)	305 (5.77%)	349 (6.08%)	267 (5.67%)
	Agree or agree strongly	14,271 (90.05%)	4,983 (94.23%)	5,394 (93.92%)	4,439 (94.33%)
Your questions about anesthesia, the process, risks, and possible after effects were answered.	Disagree, disagree strongly, or neutral	1,127 (7.42%)	238 (4.98%)	224 (4.35%)	177 (4.14%)
	Agree or agree strongly	14,056 (92.58%)	4545 (95.02%)	4,920 (95.65%)	4,102 (95.86%)
You were well prepared to make informed decisions.	Disagree, disagree strongly, or neutral	878 (5.33%)	282 (5.11%)	327 (5.38%)	226 (4.45%)
	Agree or agree strongly	1,5596 (94.67%)	5,233 (94.89%)	5,754 (94.62%)	4,847 (95.55%)
Your anesthesia provider helped ease any anxiety you were feeling.	Disagree, disagree strongly, or neutral	936 (6.15%)	294 (5.51%)	302 (5.20%)	238 (4.99%)
	Agree or agree strongly	14,277 (93.85%)	5,039 (94.49%)	5,503 (94.80%)	4,531 (95.01%)

eTable 5: Patient satisfaction item responses.

		No intervention (N=159674)	Intervention A only(N=81363)	Intervention B only(N=98520)	Intervention A+B(N=169712)
On a scale of 1 to 5, where 1 indicates the worst anesthesia experience and 5 indicates the best anesthesia experience, how would you rate your overall anesthesia experience?	Score 1, 2, or 3	812 (4.28%)	268 (4.00%)	308 (4.16%)	204 (3.61%)
	Score 4 or 5	18,144 (95.72%)	6,424 (96.00%)	7,098 (95.84%)	5,447 (96.39%)
Using a number from 5 to 1, where 5 is the best anesthesiologist possible and 1 is the worst, please rate your anesthesiologist.	Score 1, 2, or 3	462 (2.90%)	171 (3.03%)	167 (2.70%)	147 (2.91%)
	Score 4 or 5	15,495 (97.10%)	5,466 (96.97%)	6,011 (97.30%)	4,900 (97.09%)
Your anesthesia provider did his or her best to respect your privacy.	Disagree, disagree strongly, or neutral	527 (3.37%)	236 (4.33%)	263 (4.40%)	142 (2.88%)
	Agree or agree strongly	15,101 (96.63%)	5,211 (95.67%)	5,709 (95.60%)	4,794 (97.12%)
Your anesthesia provider ensured your comfort during the surgical experience.	Disagree, disagree strongly, or neutral	712 (4.36%)	240 (4.33%)	259 (4.26%)	178 (3.58%)
	Agree or agree strongly	15,633 (95.64%)	5,308 (95.67%)	5,827 (95.74%)	4,794 (96.42%)

eTable 6: Adverse events by study group				
Category	No intervention	Clinician peer comparison feedback	Patient mailing	Peer comparison + patient mailing
Bleeding/transfusion	5	4	5	2
Cardiac complications	178	110	93	163
Death	10	7	11	13
Hyper/Hypoglycemia	4	2	0	2
Hyper/hypothermia	34	7	10	29
Injury/medication reaction/procedural complications	35	15	14	34
Neurological disorders	13	10	6	5
Other	107	69	57	118
Pain	81	17	62	80
Postoperative nausea/vomiting	177	0	139	386
Respiratory/airway	158	89	76	132
Vascular complications	1	1	1	1
Total	803	331	474	965