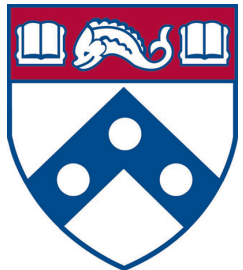


Pathways in Spine Surgery



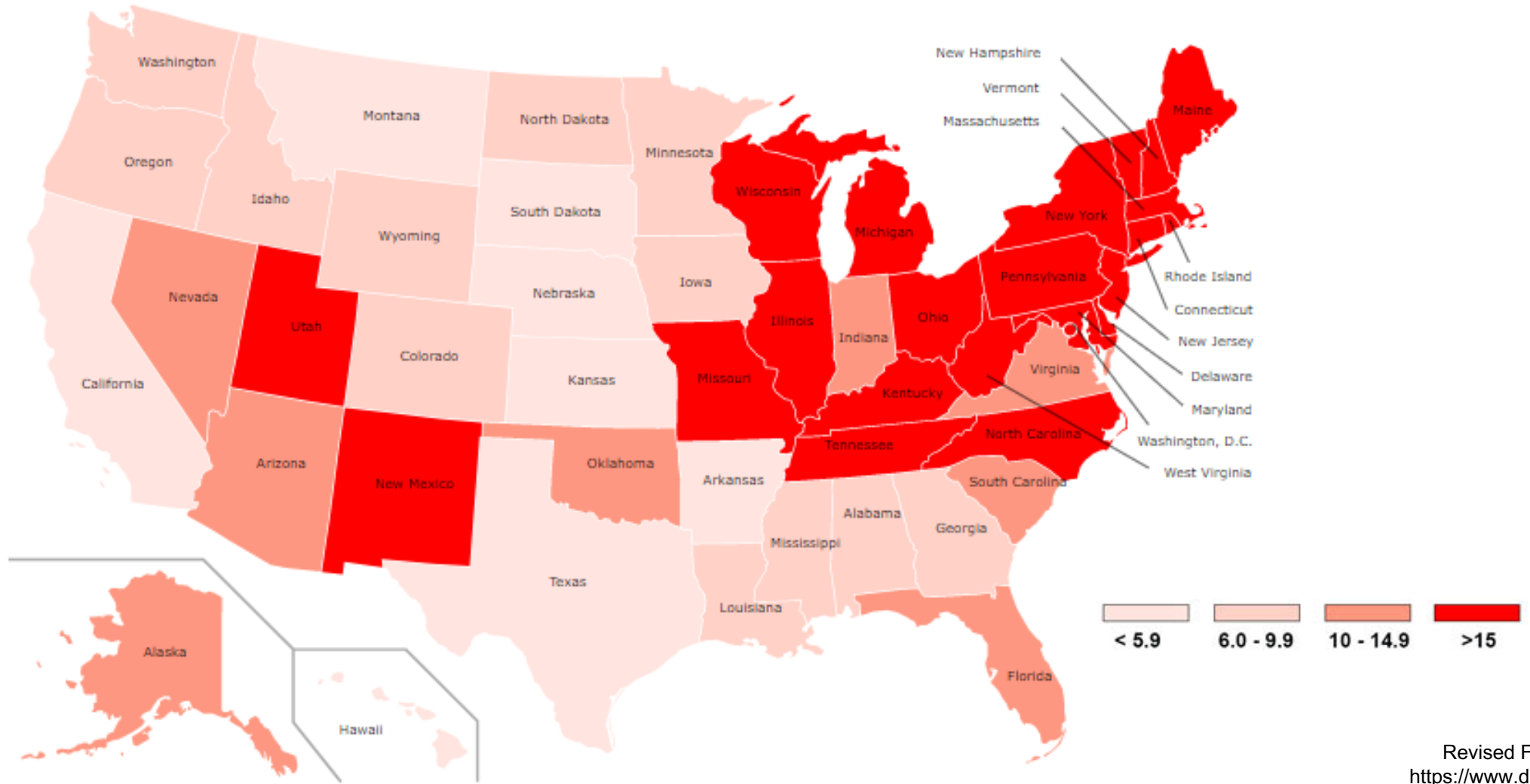
Ali K. Ozturk, MD, FAANS

Assistant Professor of Neurosurgery
Pennsylvania Hospital
University of Pennsylvania
Department of Neurosurgery

◆ Disclosures

- Depuy Synthes

Opioid-Related Overdose Death Rates (per 100,000 people) ¹



Revised February 2018
<https://www.drugabuse.gov>



Prescribing Guidelines for Pennsylvania

Revised: April 20, 2018

TREATING CHRONIC NON-CANCER PAIN



Incidence of and Risk Factors for Chronic Opioid Use Among Opioid-Naive Patients in the Postoperative Period

Eric C. Sun, MD, PhD; Beth D. Darnall, PhD; Laurence C. Baker, PhD; Sean Mackey, MD, PhD

IMPORTANCE Chronic opioid use imposes a substantial burden in terms of morbidity and economic costs. Whether opioid-naive patients undergoing surgery are at increased risk for chronic opioid use is unknown, as are the potential risk factors for chronic opioid use following surgery.

OBJECTIVE To characterize the risk of chronic opioid use among opioid-naive patients following 1 of 11 surgical procedures compared with nonsurgical patients.

DESIGN, SETTING, AND PARTICIPANTS Retrospective analysis of administrative health claims to determine the association between chronic opioid use and surgery among privately insured patients between January 1, 2001, and December 31, 2013. The data included 11 surgical procedures (total knee arthroplasty [TKA], total hip arthroplasty, laparoscopic cholecystectomy, open cholecystectomy, laparoscopic appendectomy, open appendectomy, cesarean delivery, functional endoscopic sinus surgery [FESS], cataract surgery, transurethral prostate resection [TURP], and simple mastectomy). Multivariable logistic regression analysis was performed to control for possible confounders, including sex, age, preoperative history of depression, psychosis, drug or alcohol abuse, and preoperative use of benzodiazepines, antipsychotics, and antidepressants.

EXPOSURES One of the 11 study surgical procedures.

MAIN OUTCOMES AND MEASURES Chronic opioid use, defined as having filled 10 or more prescriptions or more than 120 days' supply of an opioid in the first year after surgery, excluding the first 90 postoperative days. For nonsurgical patients, chronic opioid use was defined as having filled 10 or more prescriptions or more than 120 days' supply following a randomly assigned "surgery date."

RESULTS The study included 641 941 opioid-naive surgical patients (169 666 men; mean [SD] age, 44.0 [12.8] years), and 18 011 137 opioid-naive nonsurgical patients (8 849 107 men; mean [SD] age, 42.4 [12.6] years). Among the surgical patients, the incidence of chronic opioid in the first preoperative year ranged from 0.119% for Cesarean delivery (95% CI, 0.104%-0.134%) to 1.41% for TKA (95% CI, 1.29%-1.53%). The baseline incidence of chronic opioid use among the nonsurgical patients was 0.136% (95% CI, 0.134%-0.137%). Except for cataract surgery, laparoscopic appendectomy, FESS, and TURP, all of the surgical procedures were associated with an increased risk of chronic opioid use, with odds ratios ranging from 1.28 (95% CI, 1.12-1.46) for cesarean delivery to 5.10 (95% CI, 4.67-5.58) for TKA. Male sex, age older than 50 years, and preoperative history of drug abuse, alcohol abuse, depression, benzodiazepine use, or antidepressant use were associated with chronic opioid use among surgical patients.

CONCLUSIONS AND RELEVANCE In opioid-naive patients, many surgical procedures are associated with an increased risk of chronic opioid use in the postoperative period. A certain subset of patients (eg, men, elderly patients) may be particularly vulnerable.

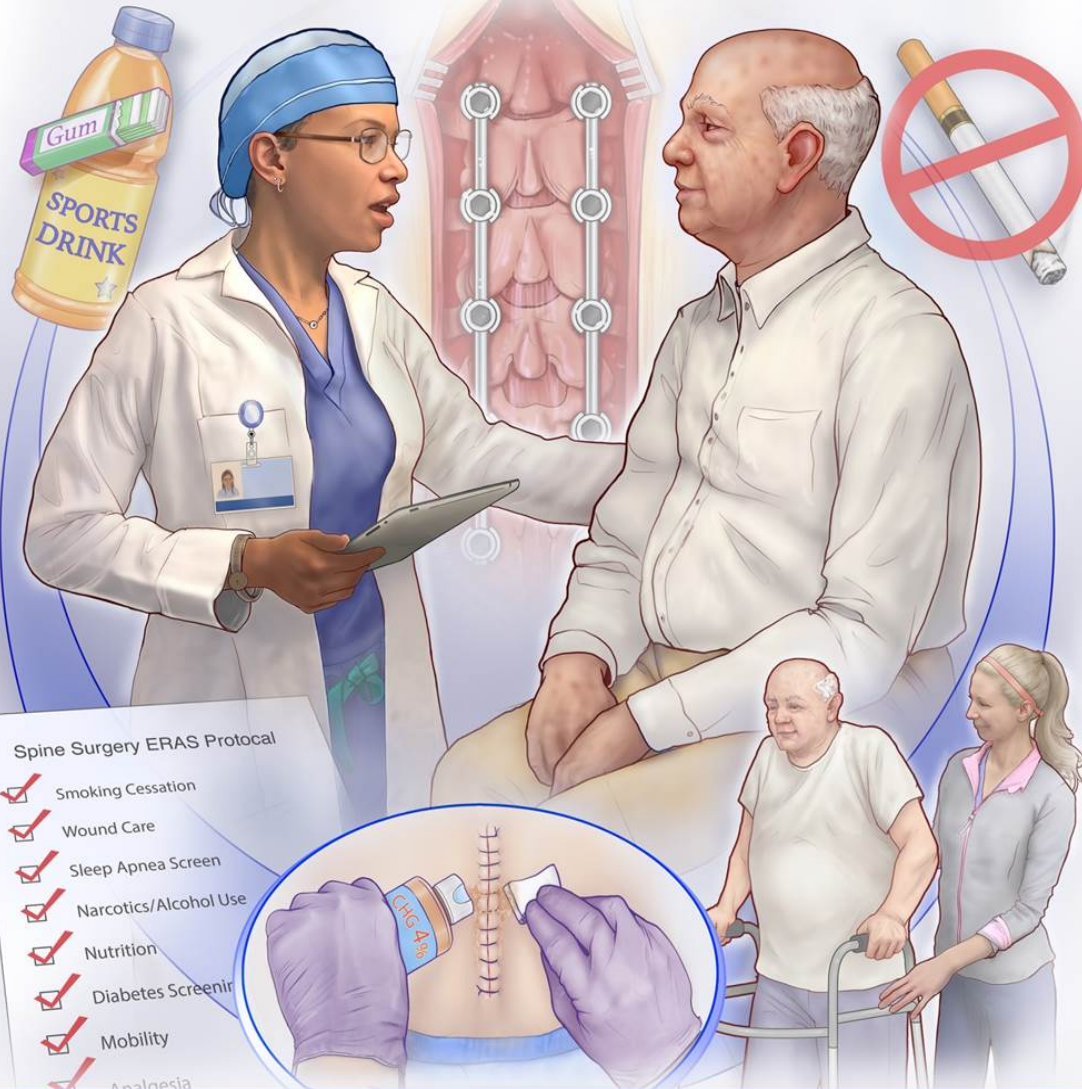
JAMA Intern Med. 2016;176(9):1286-1293. doi:10.1001/jamainternmed.2016.3298
Published online July 11, 2016. Corrected on August 8, 2016.

Enhanced Recovery After Surgery



- ◆ Pioneered by general surgeon Henrik Kehlet, MD, PhD in Denmark in late 1990s
- ◆ Identified factors that delay postoperative recovery
 - Pain
 - Gut dysfunction
 - Immobilization
- ◆ Combined a series of interventions to reduce perioperative stress and organ dysfunction
- ◆ Enhanced Recovery After Surgery (ERAS) Study Group 2001

Enhanced Recovery After NEUROsurgery: A Patient-Centered Spine Surgery Pathway



- Spine Surgery ERAS Protocol
- Smoking Cessation
 - Wound Care
 - Sleep Apnea Screen
 - Narcotics/Alcohol Use
 - Nutrition
 - Diabetes Screening
 - Mobility
 - Analgesia

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Penn Neurosurgery ERAS Protocol

Pre-op

Surgical Education & Expectation Management

Surgical Site Education

Nutrition Optimization

Diabetes Management

Smoking Cessation

Narcotic/ Alcohol Use

Obstructive Sleep Apnea

Discharge Planning

Peri-op

Metabolism Management

Multimodal Analgesia

Surgery Checklist

Early Mobilization

Wound Care Management

Post-op

Clinical Team Communication

Wound Care Management

Post Acute Care Resource Utilization

Penn Neurosurgery ERAS – Pre-op

Pre-op

Surgical Education & Expectation Management

Surgical Site Education

Nutrition Optimization

Diabetes Management

Smoking Cessation

Narcotic/ Alcohol Use

Obstructive Sleep Apnea

Discharge Planning

ERAS Consult Letter

Neurosurgery - Enhanced Recovery After Surgery (ERAS)
Department of Neurosurgery
235 S. 8th Street-Entrance on Locust
Philadelphia, PA 19106
Phone: 215-829-6700 Fax: 215-829-6645

We are requesting that you be referred for consultation and/or treatment for the following: **Pain Management**. It is important to evaluate your condition before admission to the hospital in effort to best prepare your body for your spine surgery and to help improve your recovery.

Please call the consulting department listed below to schedule an appointment at your convenience.

Consulting Department

Penn Pain Medicine Center
Tuttleman Center
1840 South St, 2nd Floor
Philadelphia, PA 19146
215-893-7246

If you have any questions for your neurosurgeon, please contact:

Department of Neurosurgery
235 S. 8th Street-Entrance on Locust
Philadelphia, PA 19106
Phone: 215-829-6700
Fax: 215-829-6645

Neurosurgery-Enhanced Recovery After Surgery (ERAS)
Department of Neurosurgery

Patient Checklist: Perioperative History & Physical Visit And Prior To Surgery (1/4)

I. Necessary Appointments Before Surgery

- Preanesthesia Testing
 - Baseline pre-operative labs
 - Chest X-ray if cardiopulmonary disease
 - Barium EsGI
 - Serum Albumin if Body Mass Index (BMI) is <18.5 or >35
 - Strenuous A/L if diabetic
- Appointment with Primary Care Physician or Cardiologist
- Additional Consultations: If request by your surgeon:
 - Nutrition Consultation
 - Pain Medicine Consultation
 - Sleep Medicine Consultation
 - Endocrine Consultation

II. Preoperative/Instructions Before Surgery

- Pick up 10 cc. of non-red Gatorade or Powerade for the day before AND day of surgery
- Discuss holding your NSAIDs (e.g. ibuprofen and naproxen), Aspirin, Plavix or other anti-platelet agents for 7 days with your surgeon
- Discuss with your cardiologist and surgeon about holding your Coumadin or other anticoagulation medications for 7 days before surgery
- Continue to take any other medications not listed above after discussing with your neurosurgical provider
- Continue regular diet unless instructed otherwise by your surgery team
- Refrain from smoking for a minimum of four weeks
- Continue your normal activity routine until day of surgery
- Sign up to participate in text messaging program
- Receive and respond to text messages that contains valuable information to help you through your surgical experience.

Patient Checklist: Day Prior To Surgery (2/4)

Day before Surgery

- You may eat a regular diet
- Drink 20 oz. of non-red Gatorade or Powerade
- After midnight, do not eat
- Generally, Powerade up until 2pm before your surgery
- Call OR for surgery time if not contacted by Signs
- Bring CPAP machine to hospital (if you use one)

Diabetes Education Center
Pennsylvania Hospital

Protein Intake Pre/Post Spinal Surgery

What is protein and why is it so important to consume?

- Protein is an important macronutrient used by the body as a building block, repair and essential tissue.
- Protein is part of every cell, tissue, and organ in our bodies.
- It is important to consume enough protein before surgery to ensure that our tissues are optimal before opening them up. After surgery, it will help heal back all of the tissues in our body (including organs, muscle, and skin).

How much protein should you consume post-surgery?

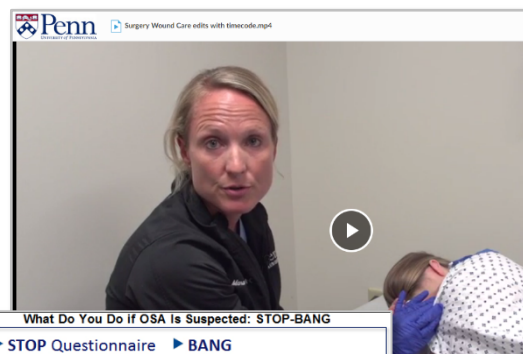
- It is common to consume about 60 grams of protein per day (including prior to surgery).
- After surgery, we need much more for healing, so we will depend on current body weight and height but may require over 100 grams of protein daily.

High Protein Foods

Food	Amount	Protein (grams)
Chicken, skinless	3 oz	24
Turkey, skinless	3 oz	20
Lean, fat-free ground beef	3 oz	20
Lean, fat-free ground turkey	3 oz	18.4
Chicken breast, boneless/skinless	3 oz	19.4
Cottage cheese, lowfat	1/2 cup	13.4
Low-fat milk	1 cup (8 oz)	11
Soybeans	1/2 cup	16
Vegetable soy patties	1 patty	11
Pumpkin seeds	1 oz	8.7
Milk (low-fat, low-lactose, whole)	1 cup (8 oz)	8
Protein bars, sweet or salty	2 bars (approx.)	8
Yogurt	6 oz	8
Egg whites	1/2 cup	7.8
Chickpeas	1/2 cup	7
Beans, canned	1/2 cup	7
Non-fat, protein powder, unflavored	1 oz	6
Fish (halibut, flounder, perch, haddock)	1 oz	6.7
Egg, whole or hard-boiled	1 egg	6
Cashew nuts	1 oz	5.7

Created by Mikael Fahl, MD, LBN
1918-029-6700
Diabetes Education Center
Source: Nutrition Care Manual – Sample Images

Patient Education



What Do You Do if OSA is Suspected: STOP-BANG

- STOP Questionnaire**
 - Snoring
 - Tiredness
 - Observed you stop breathing
 - Blood Pressure
- BANG**
 - BMI >35
 - Age >50
 - Neck circumference >40 cm (>15.7")
 - Gender male

High risk: Yes to ≥3 items → Refer for sleep testing

Quit Smoking Before Your Operation

Do you know that before surgery is the best time to quit smoking?

- You will decrease your risk of complications.
- Smoking increases the number of red blood cells, which can increase the risk of bleeding and other medical problems. Stopping before surgery can help reduce these risks.
- You quit soon enough when you quit before your operation.

Do your part and quit now! Your surgical team is here to help.

Smoking Increases Your Risk of Heart and Breathing Problems!

Smoking increases the number of red blood cells and decreases the ability to fight infection. It also increases the risk of bleeding and other medical problems. Stopping before surgery can help reduce these risks.

The number of cigarettes you smoke per day increases the number of red blood cells and the risk of bleeding and other medical problems. The number of cigarettes you smoke per day at least 1 day before your operation can reduce your risk of bleeding and other medical problems.

Smoking has an increased risk of blood clots and decreases the ability to fight infection.

A person who smokes 20 cigarettes a day has a 12 percent risk of getting a blood clot. A person who smokes 10 cigarettes a day has a 6 percent risk.

AMERICAN COLLEGE OF SURGEONS | DIVISION OF EDUCATION
Special Surgical Education and Training for US

“Game Plan Bag”

Patients receive text reminders about the critical ERAS behaviors

Messages ERAS Details

Text Message
Fri, Feb 17, 9:05 AM

Hi Zarina. Welcome to ERAP, Engaged Recovery at Penn. ERAP will send tips and reminders to coach you through your preparation for surgery.

Fri, Feb 17, 10:06 AM

Did you know you can contact your doctor's office online? Sign up for myPennMedicine! <http://mypennmedicine.org>

Be sure you have a stock of food for when you come home from the hospital; prepare some meals now that are easy to reheat.

Fri, Feb 17, 12:05 PM

To help prevent infection have plenty of clean sheets, towels, and comfortable clothing so friends and family can concentrate on YOU and not chores.

Fri, Feb 17, 1:05 PM

Text Message Send

Penn Neurosurgery ERAS – Peri-op

Peri-op

- Metabolism Management
- Multimodal Analgesia
- Surgery Checklist
- Early Mobilization
- Wound Care Management

PRACTICE PARAMETERS

Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures

*An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration**

PRACTICE guidelines are systematically developed recommendations that assist the practitioner and patient in making decisions about health care. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints, and are not intended to replace local institutional policies. In addition, practice guidelines developed by the American Society of Anesthesiologists (ASA) are not intended as standards or absolute requirements, and their use cannot guarantee any specific outcome. Practice guidelines are subject to revision as warranted by the evolution of medical knowledge, technology, and practice. They provide basic recommendations that are supported by a synthesis and analysis of the current literature, expert and practitioner opinion, open forum commentary, and clinical feasibility data.

This document updates the "Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: An Updated Report" adopted by the ASA in 2010 and published in 2011.¹

Methodology

Definition of Preoperative Fasting and Pulmonary Aspiration

For these guidelines, *preoperative fasting* is defined as a prescribed period of time during which oral and gastric intake is not allowed. *Pulmonary aspiration* is defined as the entry of gastric contents into the lungs, resulting in pulmonary aspiration pneumonia, respiratory compromise, and related morbidities.

these guidelines, the term "preoperative" should be considered synonymous with "preprocedural," as the latter term is often used to describe procedures that are not considered to be operations. Anesthesia care during procedures refers to general anesthesia, regional anesthesia, or procedural sedation and analgesia.

Purposes of the Guidelines

The purposes of these guidelines are to provide direction for clinical practice related to preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration and to reduce the severity of complications related to perioperative pulmonary aspiration. Clinical practice includes, but is not limited to, withholding of liquids and solids for specified time periods before surgery and prescribing pharmacologic agents to reduce gastric volume and acidity. Enhancements in the quality and efficiency of anesthesia care include, but are not limited to, the utilization of perioperative preventive medication, increased patient satisfaction, avoidance of delays and cancellations, decreased risk of dehydration or hypoglycemia from prolonged fasting, and the minimization of perioperative morbidity. Complications of aspiration include, but are not limited to, aspiration pneumonia, respiratory compromise, and related morbidities.

Enhanced Recovery After Surgery (ERAS)
Department of Neurosurgery

DATE _____ PATIENT STICKER:

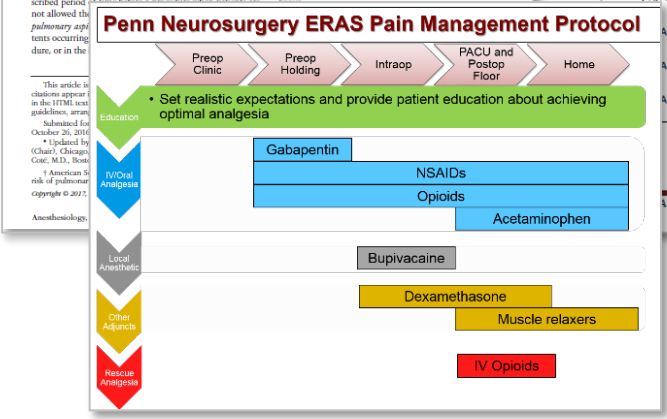
FOLEY

- No foley during or after procedure
- Foley placed for procedure and removed
- Foley placed and kept in place due to
 - CSF leak
 - >3 levels of thoracic or lumbar fusion
 - medical/urologic necessary

Spine Surgery Checklist

- N/A 1. Decompression/Stabilization/Reconstruction & Realignment
- N/A 2. Neuromonitoring assessment
- N/A 3. Final imaging
- N/A 4. Final screw tightening
- N/A 5. Antibiotic irrigation
- N/A 6. Decortication & Application of bone graft
- N/A 7. Hemostasis and placement of drain
- N/A 8. Vancomycin powder application
- N/A 9. Final neuromonitoring assessment
- 10. Local anesthetic
- 11. Closure
- 12. Check drain

12.1.2017



Penn Neurosurgery ERAS – Post-op

Post-op

Clinical Team
Communication

Wound Care Management

Post Acute Care
Resource Utilization



PAH Postop Spine Triage Protocol

Department of Neurosurgery
235 S. 8th Street-Entrance on Locust
Philadelphia, PA 19106
Phone: 215-829-6700 Fax: 215-829-6645

Routine Care	Routine Contact
<ul style="list-style-type: none"> Medication management or refill Physical or Occupational Therapy Orders Schedule Routine Post-Op Visits Requesting Office Notes or Discharge Summaries to be faxed Non-urgent patient-related questions 	<p>Neurosurgery Main Number: 215-829-6700</p>
Urgent Care	Urgent Care Contact
<p>Patients showing worsening symptoms related to:</p> <ul style="list-style-type: none"> Wound drainage or dehiscence Warm, Red, Swollen site Fever (≥ 101.5) Uncontrollable pain 	<ul style="list-style-type: none"> Call 215-829-6700 to speak to a nurse right away to address serious patient concerns related to surgery Hours: 24/7 You may be asked to send the patient to the Emergency Room for evaluation <p>*Use for clinical staff only</p>
Emergent Care	Emergency: Call 911
<ul style="list-style-type: none"> Abnormal / difficulty breathing Confusion Unrelieved chest pain Loss of consciousness 	<p>Call 911 right away</p>

Penn Medicine

ERAP Home

Colorectal Surgery

Gynecologic Surgery

Neurosurgery

Neurosurgery

In an effort to provide the best care before, during, and after spine surgery, the Department of Neurosurgery has introduced an evidence-based approach to delivering spine care, called Enhanced Recovery After Surgery (ERAS). Through our protocol and Engaged Recovery at Penn (ERAP), we will address your pain, nutrition, movement, surgical site care and educational needs. Our goal is to deliver the highest quality of care across all phases of your surgical journey.



Reducing
Pneumonia
Risk: Breathing
and Oral Care

Staying Active
After Surgery

Strengthening
Exercises

Checklists & Instructions

- Preoperative Skin Wash Instructions (PDF)
- Quit Smoking Before Your Operation (PDF)
- Protein Intake Pre/Post Spinal Surgery (PDF)
- ERAS Patient Checklist (PDF)
- Video on Surgical Site Care
- Eating and Drinking Before Surgery (PDF)
- Opioid Fact Sheet (PDF)
- Safe Pain Management (PDF)
- Home Safety Tips (PDF)
- Preventing Blood Clots (PDF)

Other Resources

- Free mindfulness meditation app to reduce stress

Pilot Neurosurgery ERAS Study: Elective Spine and Peripheral Nerve Surgery

- ◆ **Novel ERAS protocol developed and implemented at Pennsylvania Hospital (PAH)**
- ◆ **Prospective enrollment of n= 201 ERAS patients (April – June 2017)**
- ◆ **PAH Historical Control n=74 (Sept-Dec 2016)**
 - Traditional surgical care at the discretion of the attending neurosurgeon in a non-standardized fashion

Pilot Neurosurgery ERAS Study: Elective Spine and Peripheral Nerve Surgery

Inclusion Criteria:

- ◆ Clinical history and diagnostic imaging supporting the need for elective spine or peripheral nerve surgery
- ◆ Age > 18 years
- ◆ Ability to understand and actively participate in the program as deemed by the attending neurosurgeon

Exclusion Criteria:

- ◆ Contraindications to elective spine or peripheral nerve surgery
- ◆ Diagnosis of liver disease
- ◆ Pregnancy

Primary Outcomes:

- ◆ Opioid and non-opioid consumption on POD 1
- ◆ Need for opioid use at one month post-operatively
- ◆ Patient-reported pain scores

Secondary Outcomes:

- ◆ Length of stay (days)
- ◆ Need for ICU admission
- ◆ Discharge status
- ◆ Re-admission within 30 days
- ◆ Re-admission within 90 days

Statistics:

- ◆ All data for the study were collected and analyzed by independent observers in collaboration with a biostatistician
- ◆ Independent two-sample t-tests for continuous variables and Fisher's exact test for categorical variables

Penn Neurosurgery ERAS: one-year outcomes

- ◆ **Prospective enrollment of 636 ERAS patients (April 2017 – April 2018)**
- ◆ **PAH Historical Control n=74 (September - December 2016)**
 - Traditional surgical care at the discretion of the attending neurosurgeon in a non-standardized fashion, including routine post-operative pain management with patient-controlled analgesia (PCA) from POD 0-1
- ◆ **Hospital of the Univ. of Pennsylvania (HUP) Historical Control n=59 (September – December 2016)**
 - Traditional surgical care at the discretion of the attending neurosurgeon in a non-standardized fashion, including routine post-operative pain management with patient-controlled analgesia (PCA) from POD 0-1

Baseline Patient Demographics

PAH Controls vs. PAH ERAS

Preoperative Characteristics	PAH Controls (n=74)	PAH ERAS (n=636)	p-value
Age (years)	$\mu=63.5$ ($\sigma=11.2$)	$\mu=61.6$ ($\sigma=13.5$)	0.182
BMI	$\mu=30.2$ ($\sigma=5.6$)	$\mu=29.8$ ($\sigma=5.7$)	0.781
Males	42 (56.7%)	352 (55.3%)	0.9
Prior spinal/peripheral nerve surgery	28 (37.8%)	239 (37.6%)	1
Preop use of narcotics	19 (25.7%)	183 (28.8%)	0.68
Sleep apnea	13 (17.6%)	104 (16.4%)	0.74
Smoking status			
Current	11 (14.9%)	78 (12.3%)	0.6
Former	30 (40.5%)	238 (37.4%)	
Never	33 (44.6%)	320 (50.3%)	
Diabetes	16 (21.6%)	112 (17.6%)	0.42
Hypertension	51 (68.9%)	357 (56.1%)	0.036
COPD	4 (5.4%)	22 (3.5%)	0.34

Baseline Patient Demographics

HUP Controls vs. PAH ERAS

Preoperative Characteristics	HUP Controls (n=59)	PAH ERAS (n=636)	p-value
Age (years)	$\mu=62.4$ ($\sigma=13.6$)	$\mu=61.6$ ($\sigma=13.5$)	0.641
BMI	$\mu=27.8$ ($\sigma=5.5$)	$\mu=29.8$ ($\sigma=5.7$)	0.0131
Males	31 (52.5%)	352 (55.3%)	0.68
Prior spinal/peripheral nerve surgery	20 (33.9%)	239 (37.6%)	0.67
Preop use of narcotics	16 (27.1%)	183 (28.8%)	0.88
Sleep apnea	12 (20.3%)	104 (16.4%)	0.46
Smoking status			
Current	12 (20.3%)	78 (12.3%)	0.12
Former	24 (40.7%)	238 (37.4%)	
Never	23 (39.0%)	320 (50.3%)	
Diabetes	13 (22.0%)	112 (17.6%)	0.38
Hypertension	31 (52.5%)	357 (56.1%)	0.68
COPD	4 (6.8%)	22 (3.5%)	0.27

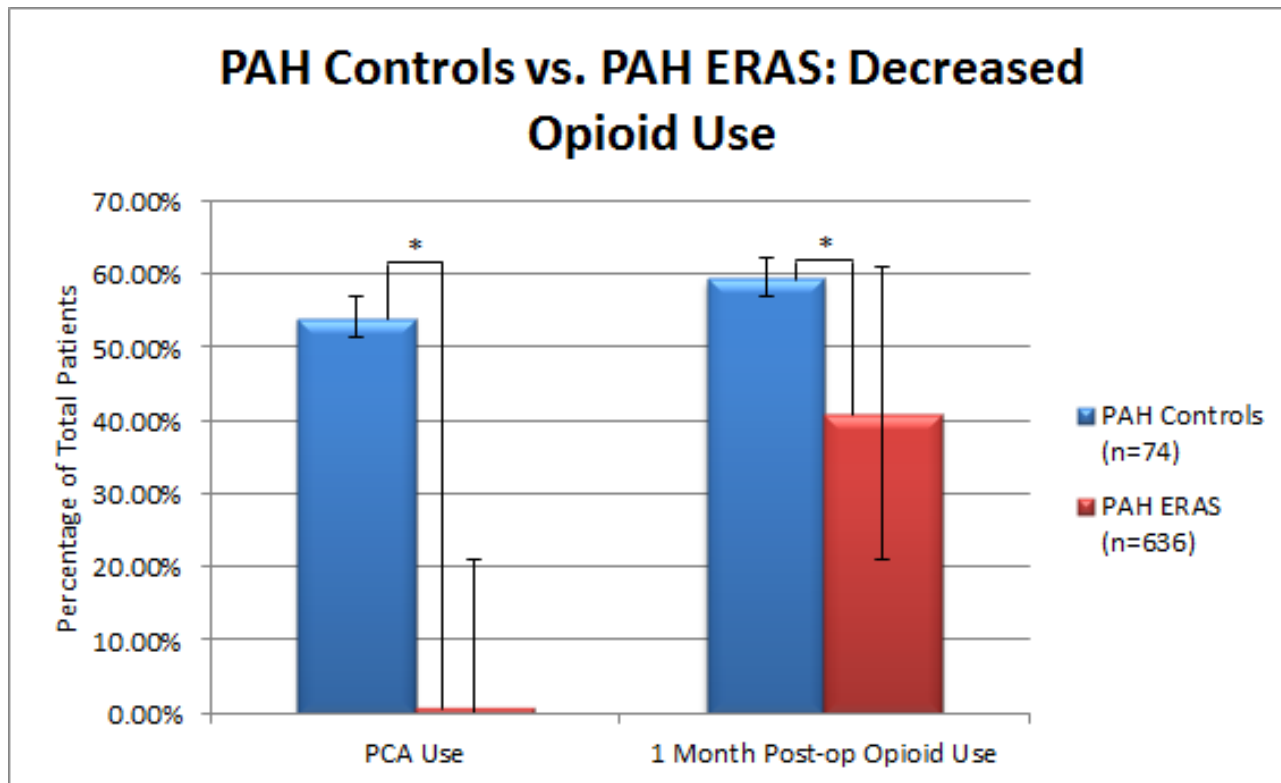
Procedures

Procedures	PAH Controls (n=74)	PAH ERAS (n=636)	p-value
Laminectomy/ discectomy/foraminotomy	41.90%	43.10%	0.77
Thoracolumbosacral fusion (0-3 levels)	16.24%	16.67%	
Thoracolumbosacral fusion (4+ levels)	4.06%	6.13%	
Cervico-thoracic laminectomy +/- fusion (0-3 levels)	6.76%	11.02%	
Cervico-thoracic laminectomy +/- fusion (4+ levels)	14.86%	5.68%	
ACDF	6.80%	6.60%	
Other	9.50%	10.70%	

Procedures	HUP Controls (n=59)	PAH ERAS (n=636)	p-value
Laminectomy/ discectomy/foraminotomy	30.50%	43.10%	0.1
Thoracolumbosacral fusion (0-3 levels)	30.49%	16.67%	
Thoracolumbosacral fusion (4+ levels)	1.71%	6.13%	
Cervico-thoracic laminectomy +/- fusion (0-3 levels)	11.90%	11.02%	
Cervico-thoracic laminectomy +/- fusion (4+ levels)	3.40%	5.68%	
ACDF	13.60%	6.60%	
Other	8.50%	10.70%	

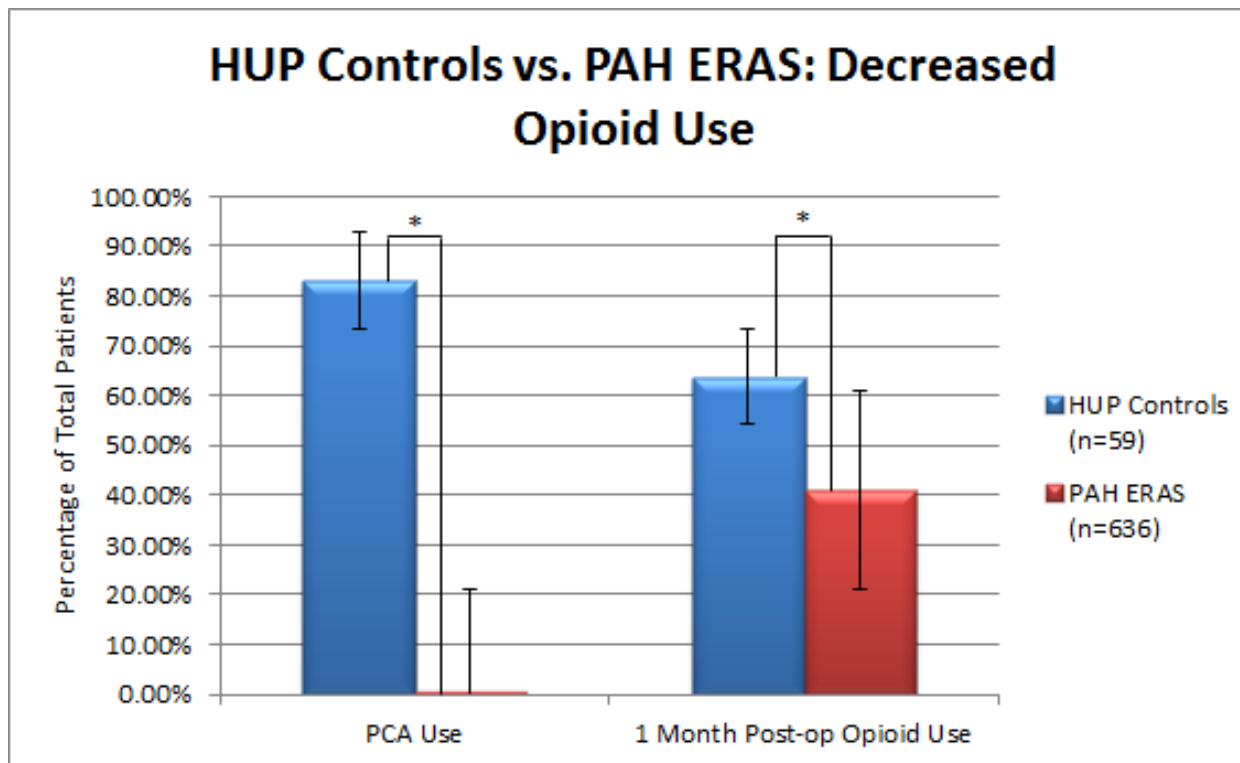
Decreased Opioid Use: PAH Controls vs. PAH ERAS

Pain medications	PAH Controls (n=74)	PAH ERAS (n=636)	p-value
PCA Use	54.10%	0.90%	<0.0010
1 Month Post-op Opioid Use	59.50%	40.90%	0.004



Decreased Opioid Use: HUP Controls vs. PAH ERAS

Pain medications	HUP Controls (n=59)	PAH ERAS (n=636)	p-value
PCA Use	83.10%	0.90%	<0.0010
1 Month Post-op Opioid Use	63.80%	40.90%	0.003



Pain Scores

Average Pain Score [n=PAH control/PAH ERAS]	PAH Controls	PAH ERAS	p-value
POD0 [n=73/628]	3.7	4.1	0.291
POD1 [n=65/546]	5.3	5.5	0.271
POD2 [n=52/396]	5.5	5.5	0.921
POD3 [n=34/232]	4.9	5.2	0.341

Average Pain Score [n=HUP control/PAH ERAS]	HUP Controls	PAH ERAS	p-value
POD0 [n=58/628]	4.9	4.1	0.0271
POD1 [n=51/546]	5.5	5.5	0.791
POD2 [n=44/396]	5	5.5	0.201
POD3 [n=32/232]	4.9	5.2	0.381

Conclusions

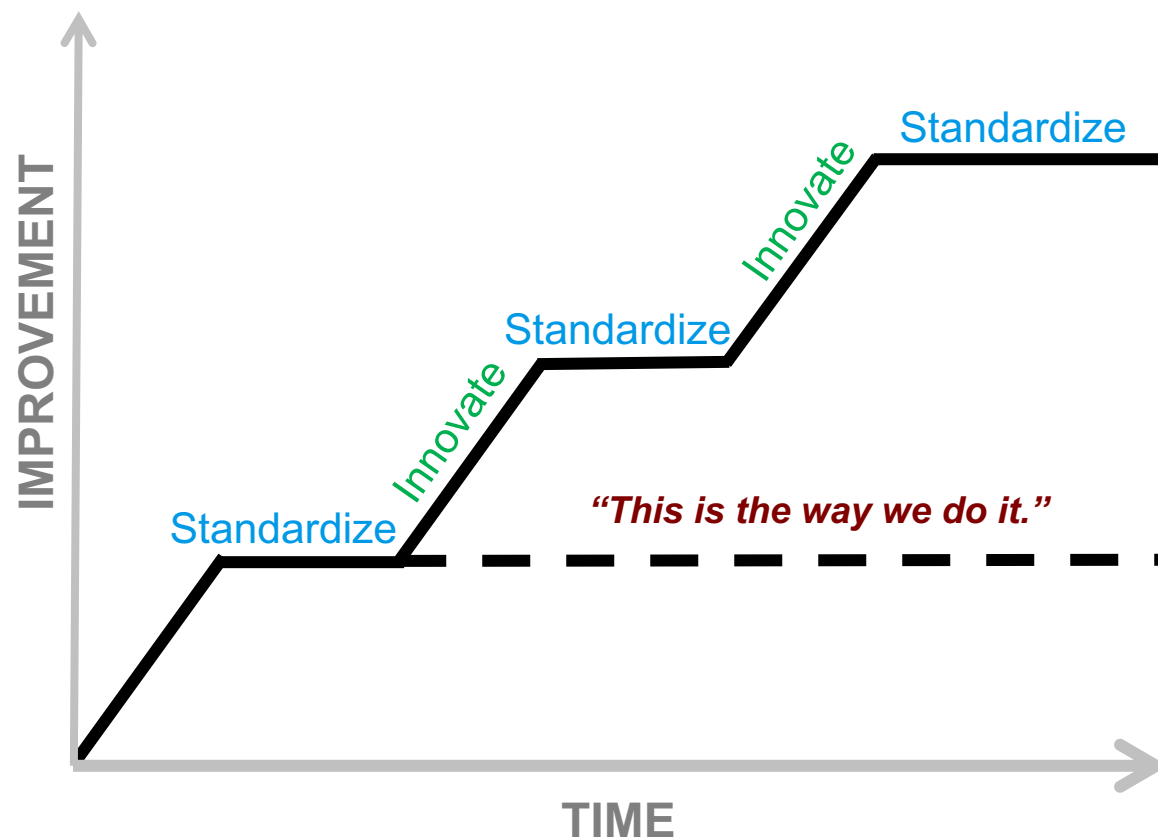
- ◆ ERAS engages each aspect of the patient's surgical journey in order to improve outcomes in a multi-disciplinary, multi-modal approach
- ◆ The present study has shown that our ERAS protocol, and, in particular, our ERAS pain management protocol has the potential to safely reduce opioid use both in the peri-operative period as well as at one month after surgery
- ◆ **Further long term data with randomization is required to address whether this reduction in opioid use is durable**

Limitations

- ◆ Historical control groups
- ◆ Retrospective data analysis, randomization and blinding not performed
- ◆ Data collection is limited to the information provided in medical records
- ◆ Minor protocol deviation not well documented and difficult to assess

ERAS:

An Iterative Process of Quality Improvement, From Bench to Bedside and BEYOND



Clifford Ko, MD; ACS Director of NSIQP

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- ◆ Neurosurgery Residents
- ◆ Neurosurgery Clinical and Operating Room Staff
- ◆ Neurosciences Service Line
- ◆ Penn Innovation Center
- ◆ Penn Leonard Davis Institute of Health Economics
- ◆ Center for Clinical Epidemiology and Biostatistics
 - Michael Kallan, MS



Ali.ozturk@uphs.upenn.edu

Questions

