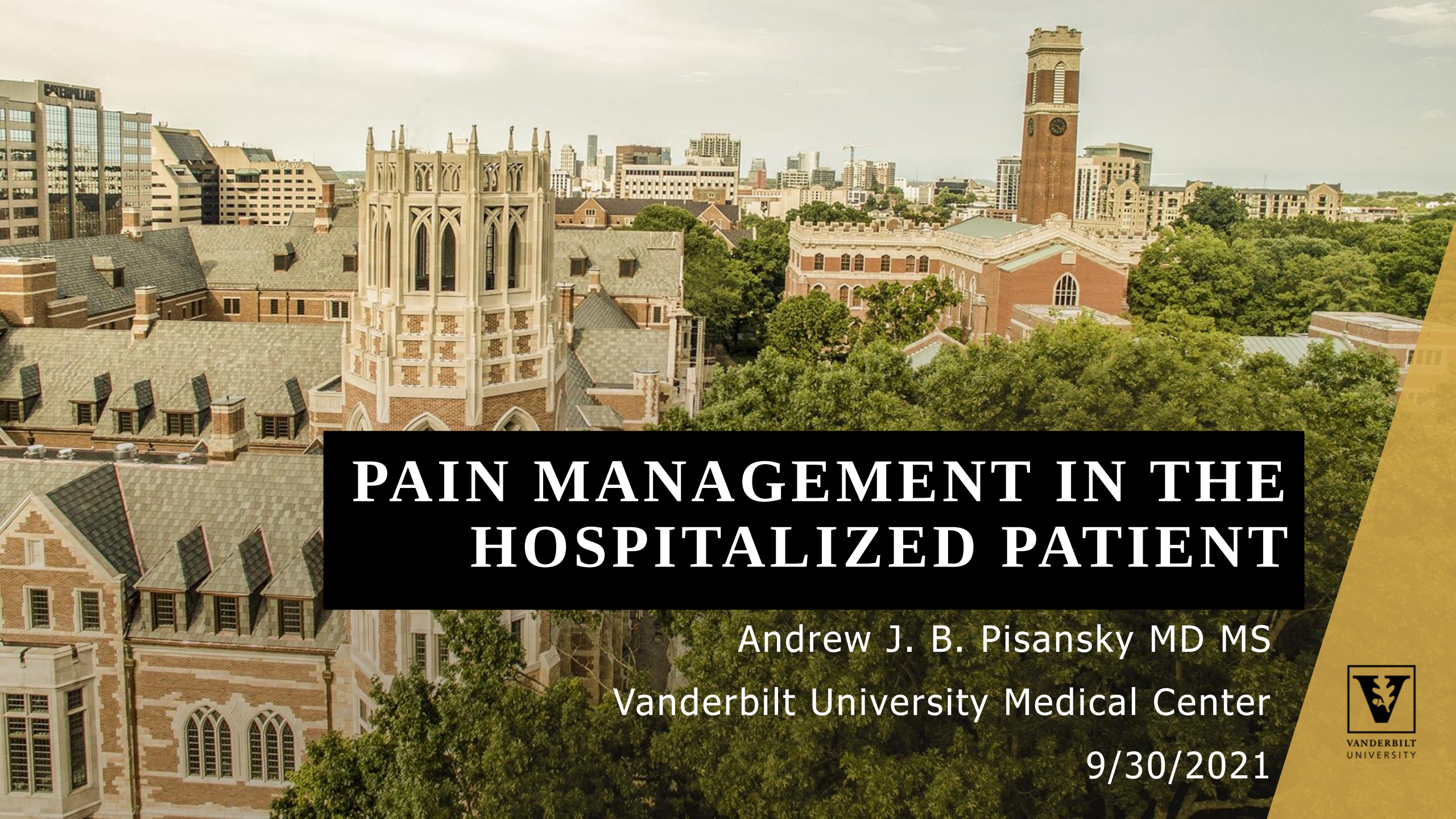

PAIN MANAGEMENT IN THE HOSPITALIZED PATIENT

Andrew J. B. Pisansky MD MS

Vanderbilt University Medical Center

9/30/2021

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DISCLAIMERS & CREDENTIALS

Disclosures

- No financial or commercial conflicts or disclosures

Credentials

- Anesthesiology Boarded
- Pain Medicine Subspecialty Boarded
- Director: VUMC Inpatient Comprehensive Pain Service
- Director: VUMC Transitional Pain Service

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LEARNING OBJECTIVES

- Describe the basic pathophysiology of pain
- Describe a mechanism-based approach to pain management
- Separate analgesic medications by mechanism of action & understand how this applies to mechanism-based approach to pain management
- Describe a multimodal analgesia plan
- Recognize the options for pain management in patient with special considerations in hospital
- Describe strategies for control of opioid escalation in the patient with chronic pain

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WHY DO WE CARE?

- 78% of patients visiting the Emergency Department list pain among their chief concerns
- 40% of all Emergency Department Patients presenting with pain have an underlying chronic pain condition
    - 50% of these patients report that worsening of a chronic painful condition was the sole reason for presentation

Cordell 2002
Johnston 1998
Tanabe 1999
Neighbor 2007

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WHY DO WE CARE?

Adverse Physiologic Effects of Uncontrolled Acute Pain	
Cardiac	HTN, tachycardia, dysrhythmias, MI
Pulmonary	Atelectasis, mismatch, pneumonia
Endocrine	Protein catabolism, hyperglycemia, fluid retention
Immune	Immune function impairment
Coagulation	Hypercoagulation, ↑ platelet adhesion
GI	Ileus
GU	Urinary retention

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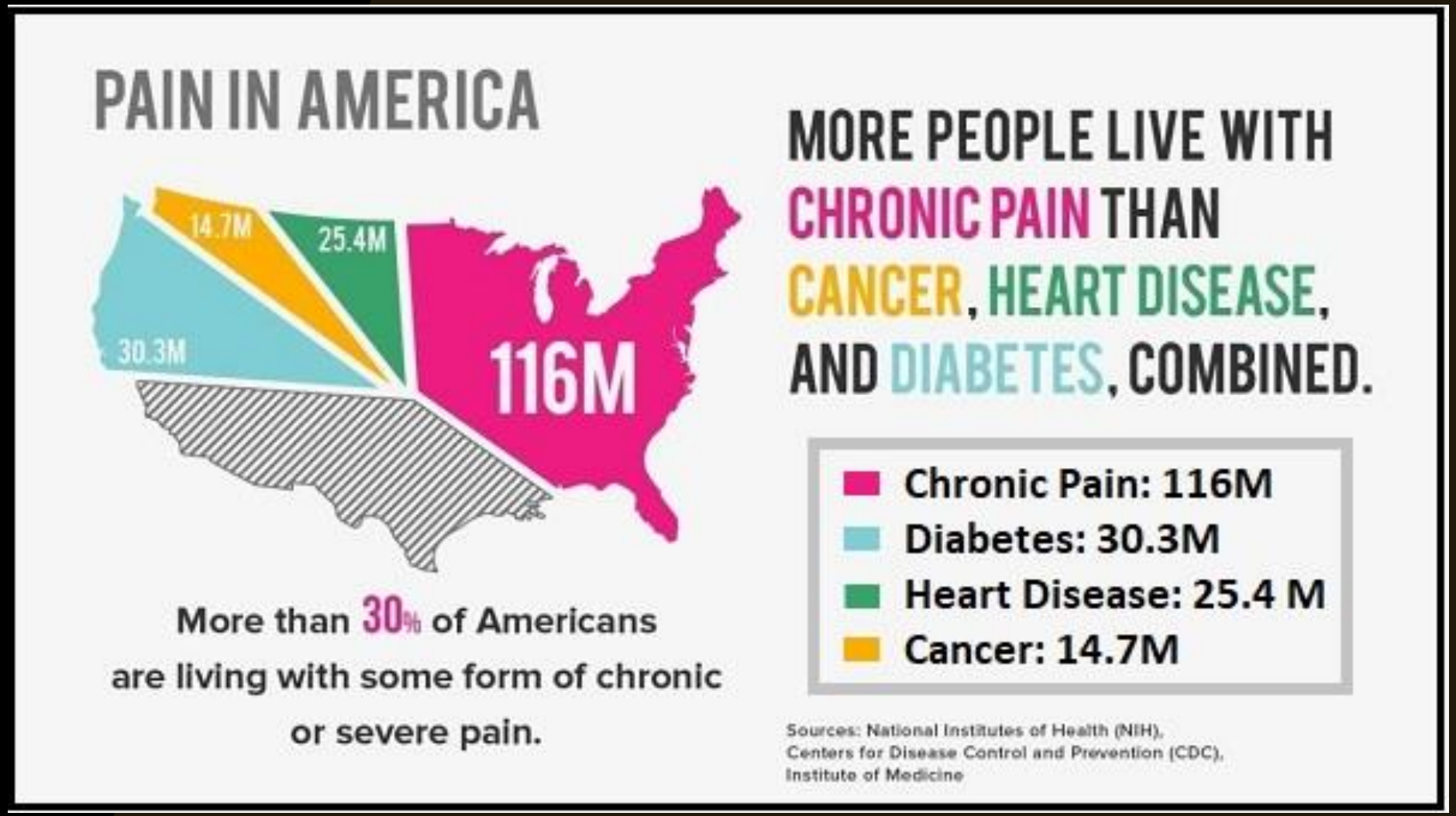
WHY DO WE CARE?

Chronic pain



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WHY DO WE CARE?

When patients with chronic pain are admitted to the hospital, they:

1. suffer[1,4,5,6]
2. are dissatisfied[1]
3. are at risk of being undertreated[1,2]
4. have increased length of stay[3]
5. are readmitted earlier and more frequently[3]
6. rate hospitals poorly (HCAHPS)[3]

1. Brennan, Carr, Cousins: Pain Management: A Fundamental Human Right. Anesthesia & Analgesia 2007; 105: 205-21
2. Albrecht, Taffe, Yersin, Schoettker, Decosterd, Hugli: Undertreatment of acute pain (oligoanalgesia) and medical practice variation in prehospital analgesia of adult trauma patients: a 10 yr retrospective study. British Journal of Anaesthesia 2012; 110: 96-106
3. Koury K, Chaudhary S, Williams L, Jaff M, Gulur P: Opioid tolerance--a predictor of increased length of stay and higher readmission rates. Pain physician 2014; 17: E503-7
4. PAIN C. Pain Management: Classifying, understanding, and treating pain. Hospital Physician. 2002.
5. Herzig SJ, Rothberg MB, Cheung M, Ngo LH, Marcantonio ER. Opioid utilization and opioid-related adverse events in nonsurgical patients in US hospitals. J Hosp Med. 2014 Feb;9(2):73–81
6. Apfelbaum JL, Chen C, Mehta SS, Gan TJ. Postoperative pain experience: results from a national survey suggest postoperative pain continues to be undermanaged. Anesth Analg. 2003 Aug 1;97(2):534–contents.

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WHAT SHOULD BE OUR GOALS FOR TREATING PAIN?

1. Reduce suffering
2. Treat acute pain
3. Minimize the long-term impact of pain
4. Maximize our resources
5. Create a plan

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HOW DO WE GET THERE?

- Patient-Centered and Patient-Specific Care Plans
- Mechanism Based Pain Treatment
- Risk Management and Opioid Escalation Control
- Appropriate referral and disposition planning

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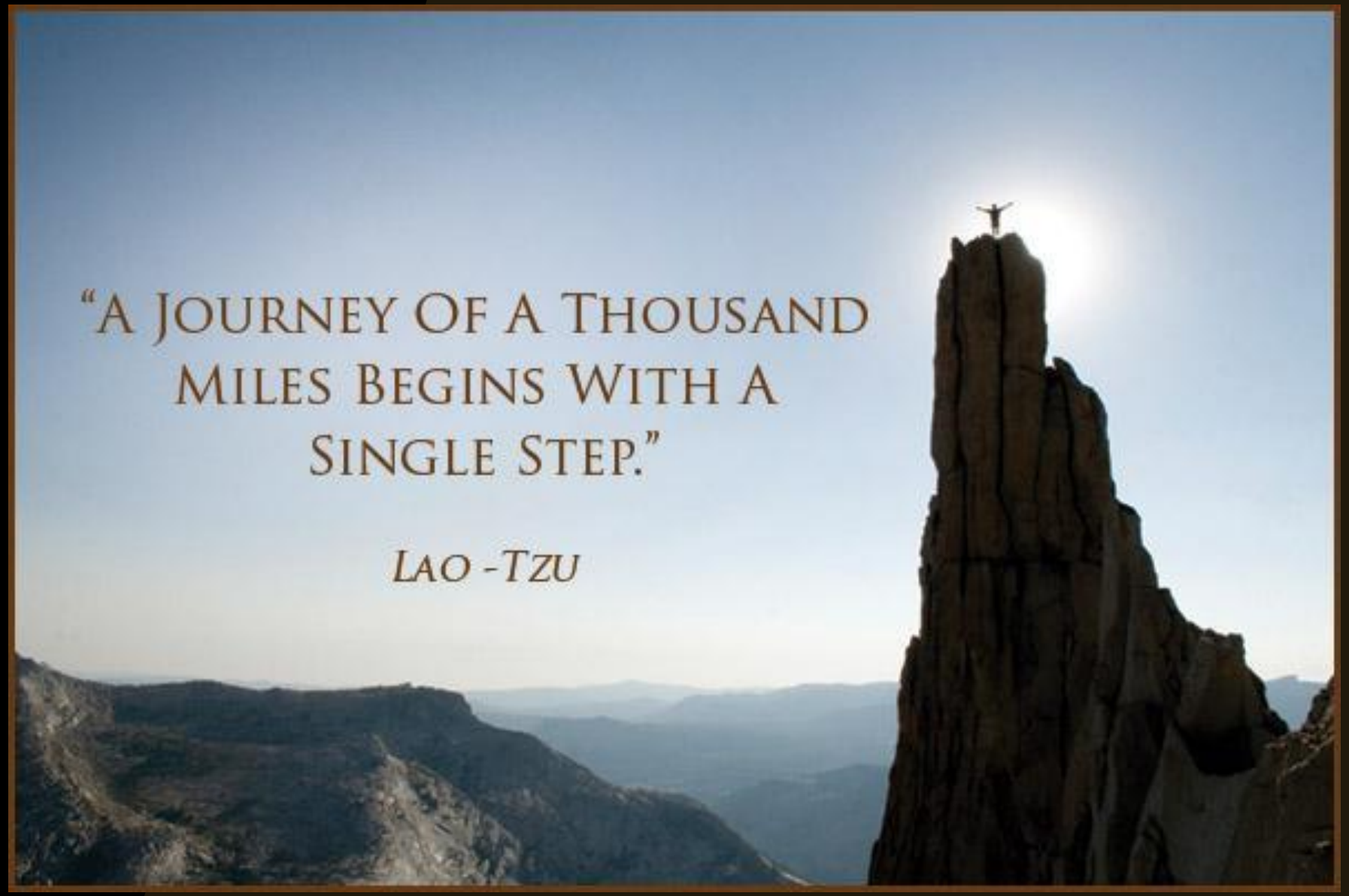

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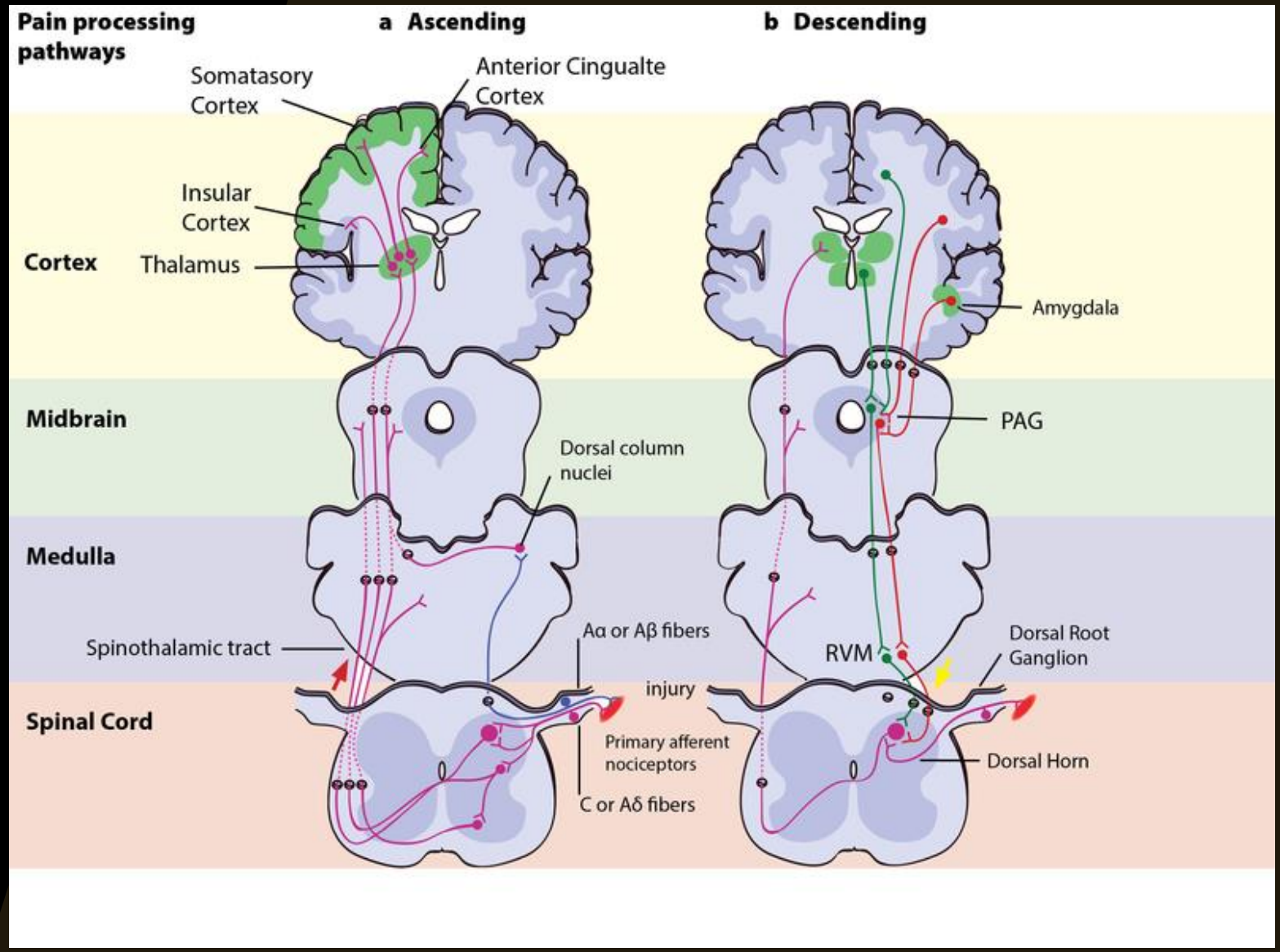
PAIN PATHOPHYSIOLOGY



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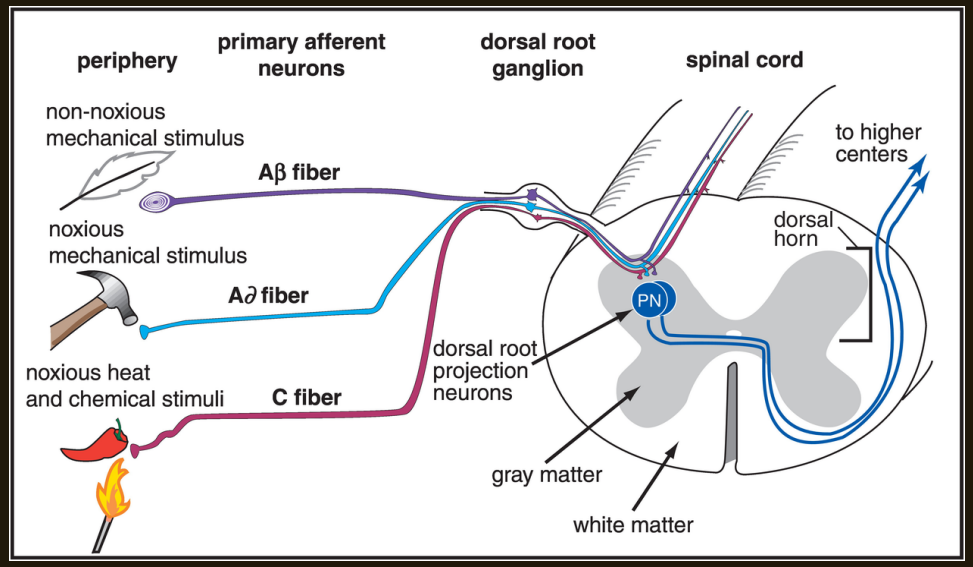
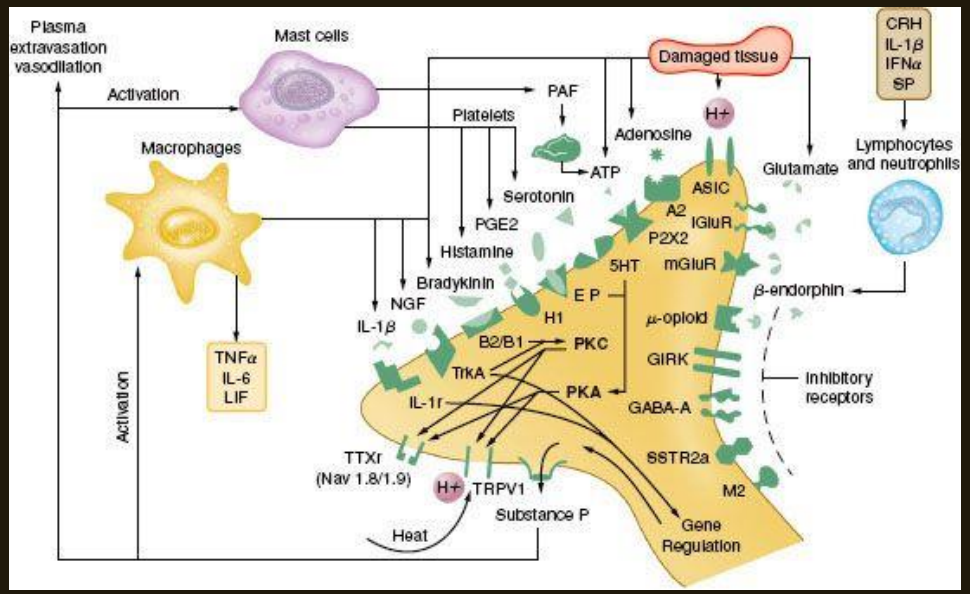
PAIN PATHOPHYSIOLOGY

Ascending Pathways

- Peripheral nociceptors:
  - Aβ - mechanical stimuli
  - Aδ - low or high intensity thermal or mechanical stimuli
  - C - high intensity thermal or mechanical stimuli
- Local inflammatory release:
  - Sensitization
    - Hyperalgesia
  - Abnormal signaling
    - Allodynia





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PAIN PATHOPHYSIOLOGY

Ascending Pathways

- Peripheral nociceptors:
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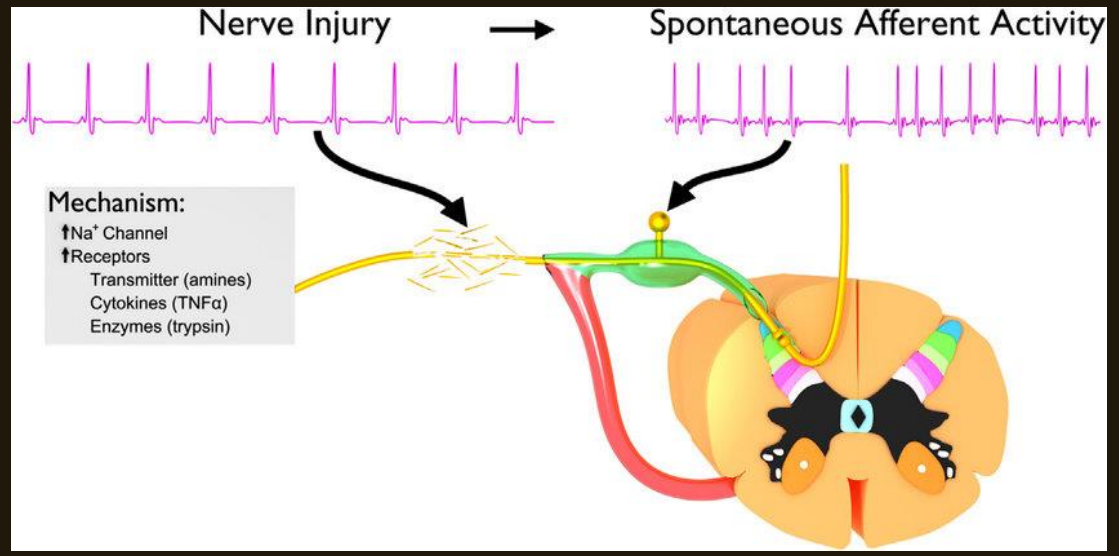
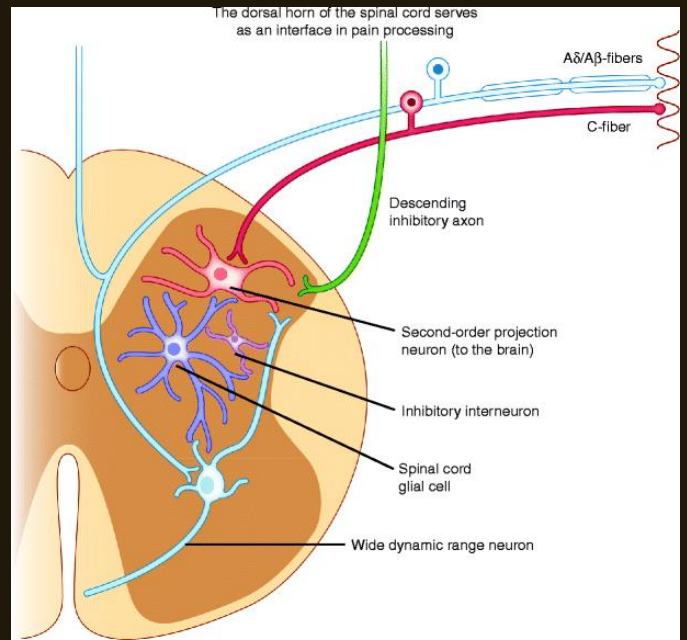
  - C - high intensity thermal or mechanical stimuli
- Local inflammatory release:
  - Sensitization
    - Hyperalgesia
  - Abnormal signaling
    - Allodynia

- Nerve injury:
  - Ion channel up/down regulation
  - Na^+, K^+, Ca^{2+}
- Central changes:
  - Wind-up (Dorsal Horn)
  - Spontaneous activity (DRG)





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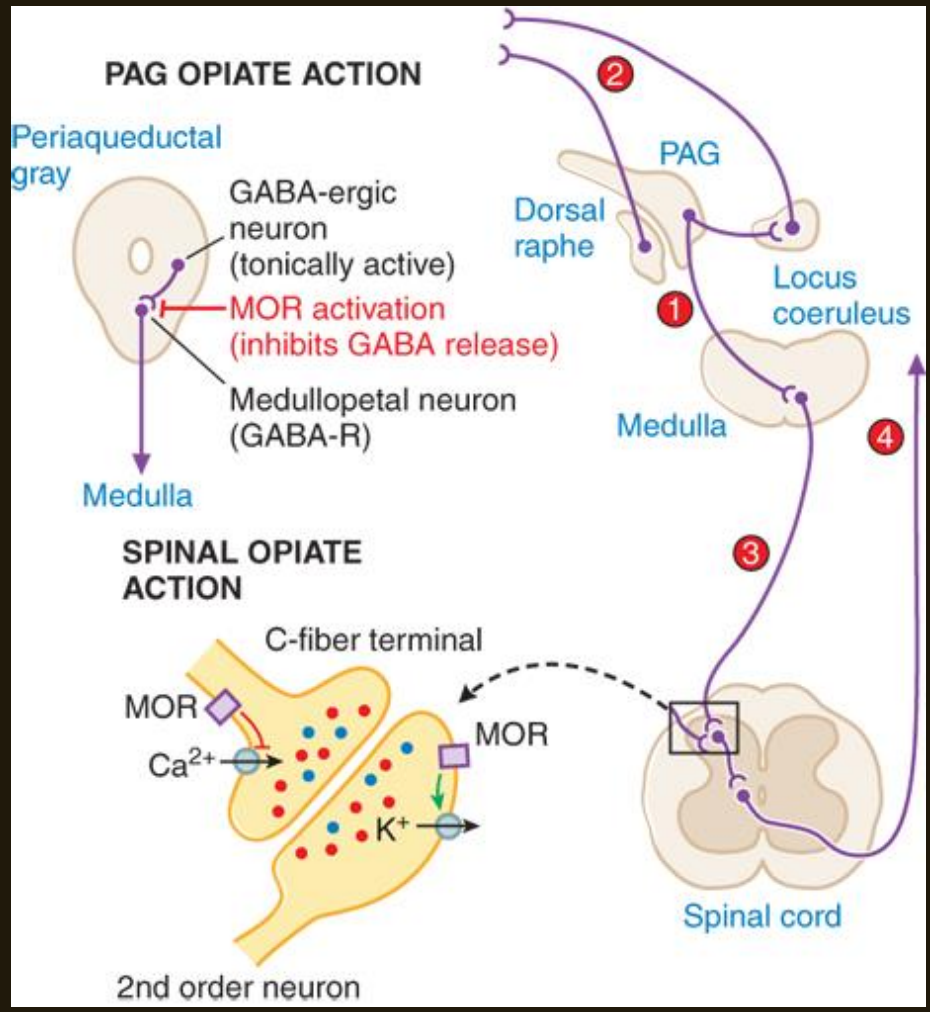
PAIN PATHOPHYSIOLOGY

Descending Pathways

- Norepinephrine
  - Brain: Emotional response
  - Spinal cord: Primary afferents
- Serotonin
  - Brain and spinal cord
  - Mixed effect on pain processing
- Periaquaductal Gray – Opiates
  - Inhibitory pathway activation
  - Limbic system modulation
  - Medulla modulation



Benzon, Practical Management of Pain

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MECHANISM-BASED PAIN MANAGEMENT

- Pain management requires diagnosis before treatment
- Diagnosis requires looking for symptoms and signs
- Symptoms and signs point to a mechanism
- Medicines are selected based on the mechanism

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MECHANISM-BASED PAIN MANAGEMENT

Pain Signs

- Nociceptive
  - Somatic – point tender
  - Visceral – diffuse tender
- Inflammatory
  - Rubor, Calor, Dolor…
- Neuropathic
  - Allodynia
- Central
  - Diffuse/generalized

Pain Symptoms

- Nociceptive
  - Somatic – localized, sharp
  - Visceral – diffuse, dull
- Inflammatory
  - Throbbing, aching
- Neuropathic
  - Burning, electric, paresthesia
- Central
  - Diffuse/generalized

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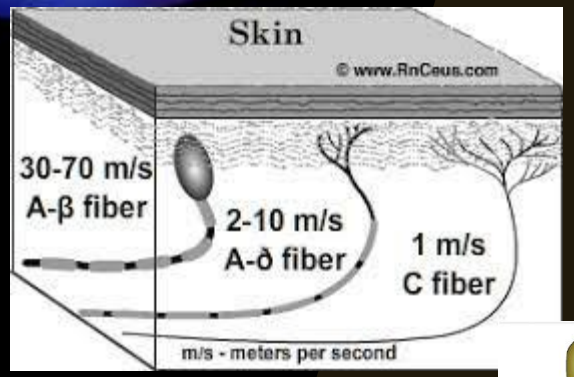
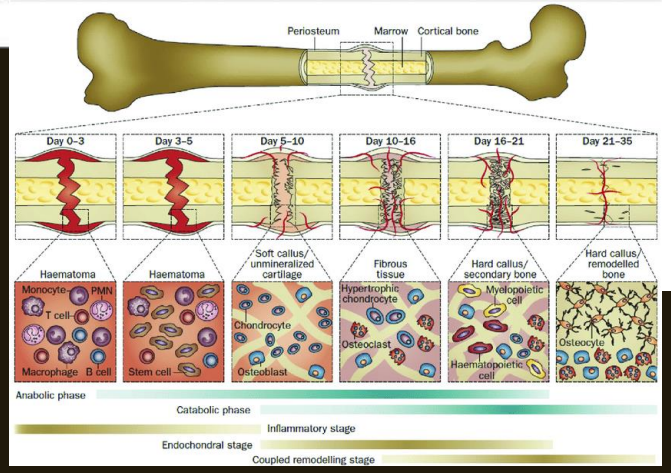
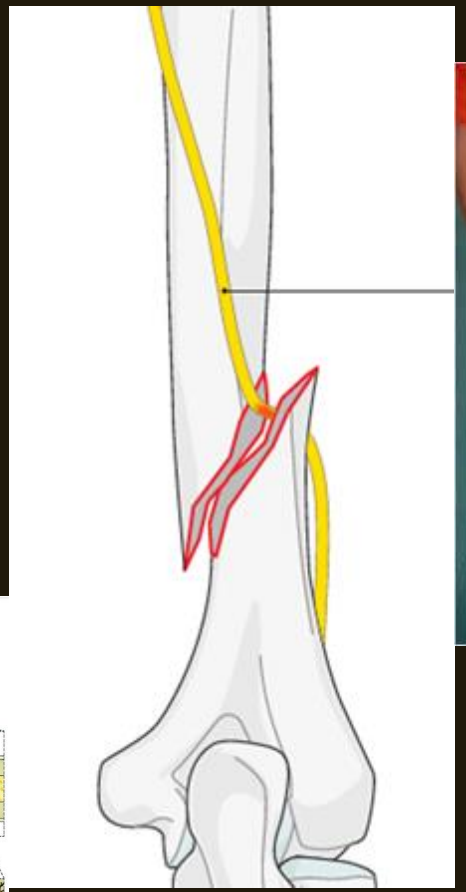
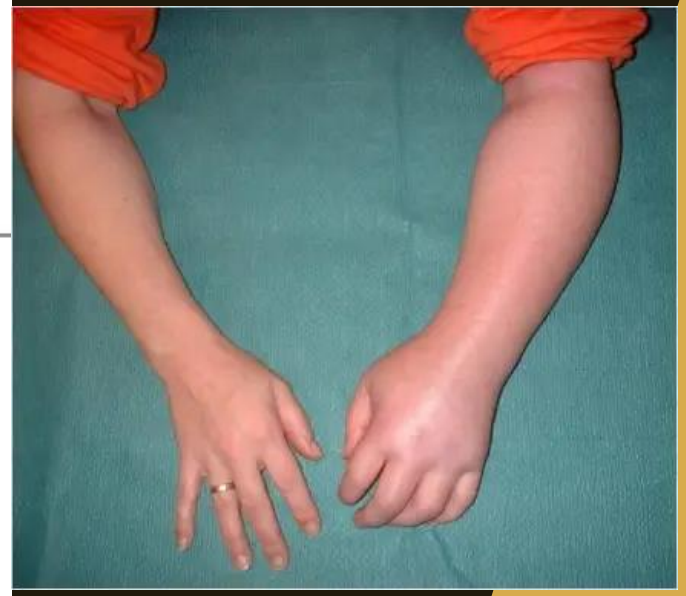
MECHANISM-BASED PAIN MANAGEMENT









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MECHANISM-BASED PAIN MANAGEMENT

Pain Medications (non-opioids)**	
Inflammatory Pain	NSAIDs (non-steroidal anti-inflammatory drugs) • ibuprofen (PO) • naproxen (PO) • ketorolac (PO, IM, IV) • diclofenac (PO, topical gel) • etodolac (PO) • meloxicam (PO) • methyl salicylate/menthol (topical) Steroids (oral, intra-articular, peri-neural, epidural, IM, IV)
Neuropathic Pain & Central Pathologic Pain	Anticonvulsants • gabapentin, pregabalin SNRIs (serotonin norepinephrine reuptake inhibitors) • duloxetine, milnacipran Tricyclic anti-depressants • amitriptyline, nortriptyline, desipramine Na^+ channel blockers • lidocaine (topical cream/patch, IM, IV), mexilitine, topiramate TRPV1 ion channel blocker • capsaicin (topical cream/ointment/patch) NMDA receptor antagonists • ketamine (IV), memantine (PO), dextromethorphan, Mg^{2+}

Pain Medications (non-opioids)**	
Nociceptive Pain	Antispasmotics (muscle spasm related pain) • cyclobenzaprine, tizanidine, baclofen, diazepam/lorazepam Acetaminophen and NSAIDs also effective, especially if inflammatory pain is also present
Non-specific Pain	Acetaminophen Alpha agonists • clonidine (PO, patch), dexmedetomidine (IV), guanfacine (PO)

Image Credit: David A Edwards MD PhD
Vardeh 2015

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ANALGESIC CLASSES

What's in the toolbox?

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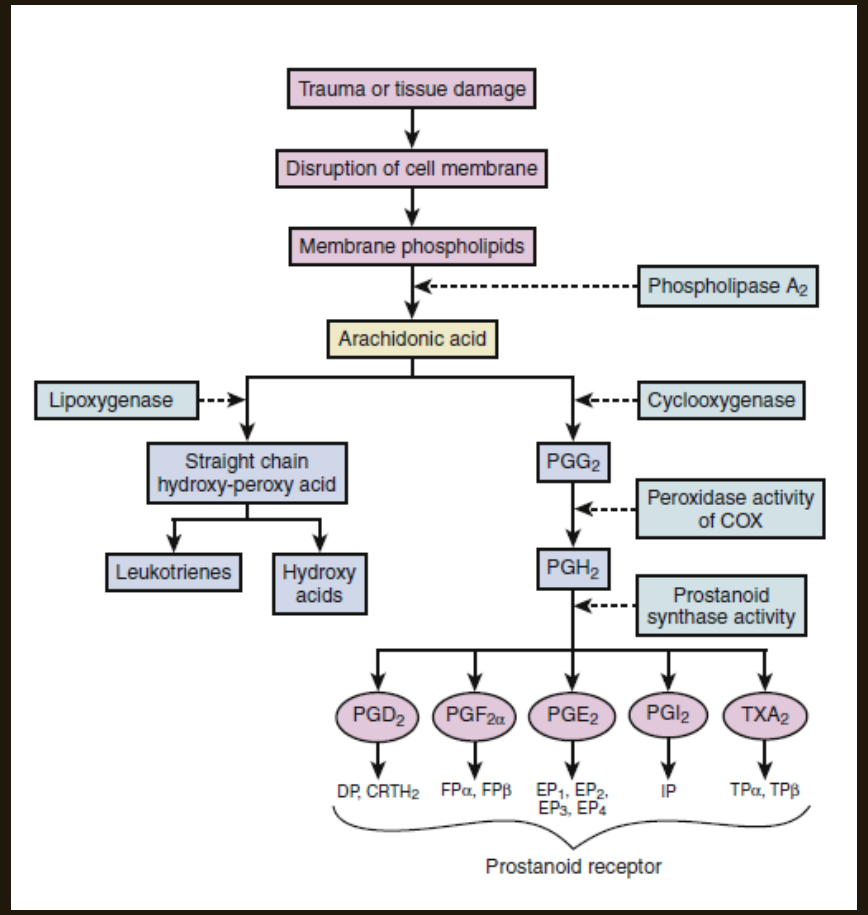
ANALGESIC CLASSES

Non-steroidal Anti-inflammatory Drugs (NSAID)

Mechanism of action

- Prostaglandins are synthesized and released in response to local tissue injury
- Cyclooxygenase converts arachidonic acid into multiple forms of prostaglandin
  - This is done predominantly by the COX-2 isoform
- Prostaglandin E2 (PGE2) is the most associated with inflammatory responses and nociceptor sensitization



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ANALGESIC CLASSES

Non-steroidal Anti-inflammatory Drugs (NSAID)

Pathophysiologic Conditions & NSAIDS

- Kidney Disease
  - Significantly reduced clearance
  - Worsening of acute kidney injury
- Hepatic Disease
  - Limited affect on clearance unless bound to albumin (indomethacin)
  - Beware of concomitant renal disease

NSAID Classes

- Acetic Acid Derivatives
  - Pyrrole acetic acids
    - Ketorolac
  - Phenylacetic acids
    - Diclofenac
- Propionic Acid Derivatives
  - Non-selective
    - Ibuprofen
    - Naproxen
  - COX-2 selective
    - Celecoxib

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ANALGESIC CLASSES

Non-steroidal Anti-inflammatory Drugs (NSAID)

Table 40.2 IC_{50} Ratios for Inhibition of COX-1 and COX-2 in Human Whole Blood*

Drug	IC_{50} Ratio
Lumiracoxib	700
Etoricoxib	344
Rofecoxib	272
Valdecoxib	61
Celecoxib	30
Meloxicam	18
Naproxen	0.7
Ibuprofen	1.5
Indomethacin	0.02
Aspirin	0.007

IC_{50}, concentration needed to inhibit 50% of COX-1 and COX-2.
*A higher ratio indicates greater COX-2 selectivity.

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NSAID Considerations

- Cardiovascular Risk
- Bone Healing
- Hypersensitivity Reactions
- Gastrointestinal Effects
- Renal toxicity

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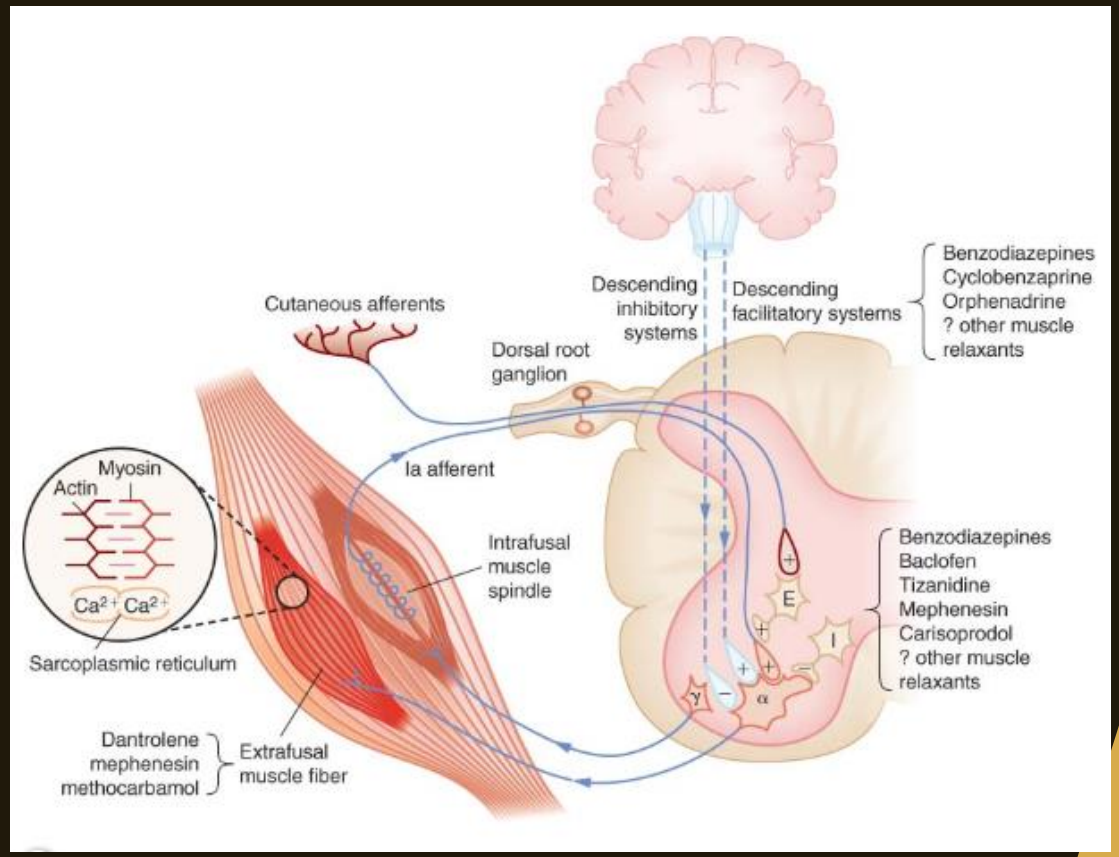
ANALGESIC CLASSES

Muscle Relaxants

- Classes
  - Sedatives
  - TCA-like
  - Antihistamine
  - GABA
  - Central
- Primary Indications
  - Spasticity, Muscle Spasm, Myofascial Pain
- Contraindications (relative)
  - Hypersensitivity
  - Primarily related to interaction with MAOI, TCA, and opioids



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ANALGESIC CLASSES

Muscle Relaxants

Anti-Spasmodics

- Methocarbamol
  - Extrafusal muscle fiber
  - General CNS depression
- Cyclobenzaprine
  - Descending facilitatory systems
  - TCA analog
  - Caution with serotonergics

Anti-Spasticity

- Alpha 2 Agonist
  - Tizanidine
  - Caution with renal impairment
  - Hypotension
- GABA-B Agonist
  - Baclofen
  - Caution with renal impairment
  - Interaction with SSRI (short term memory loss)

*NOT Soma

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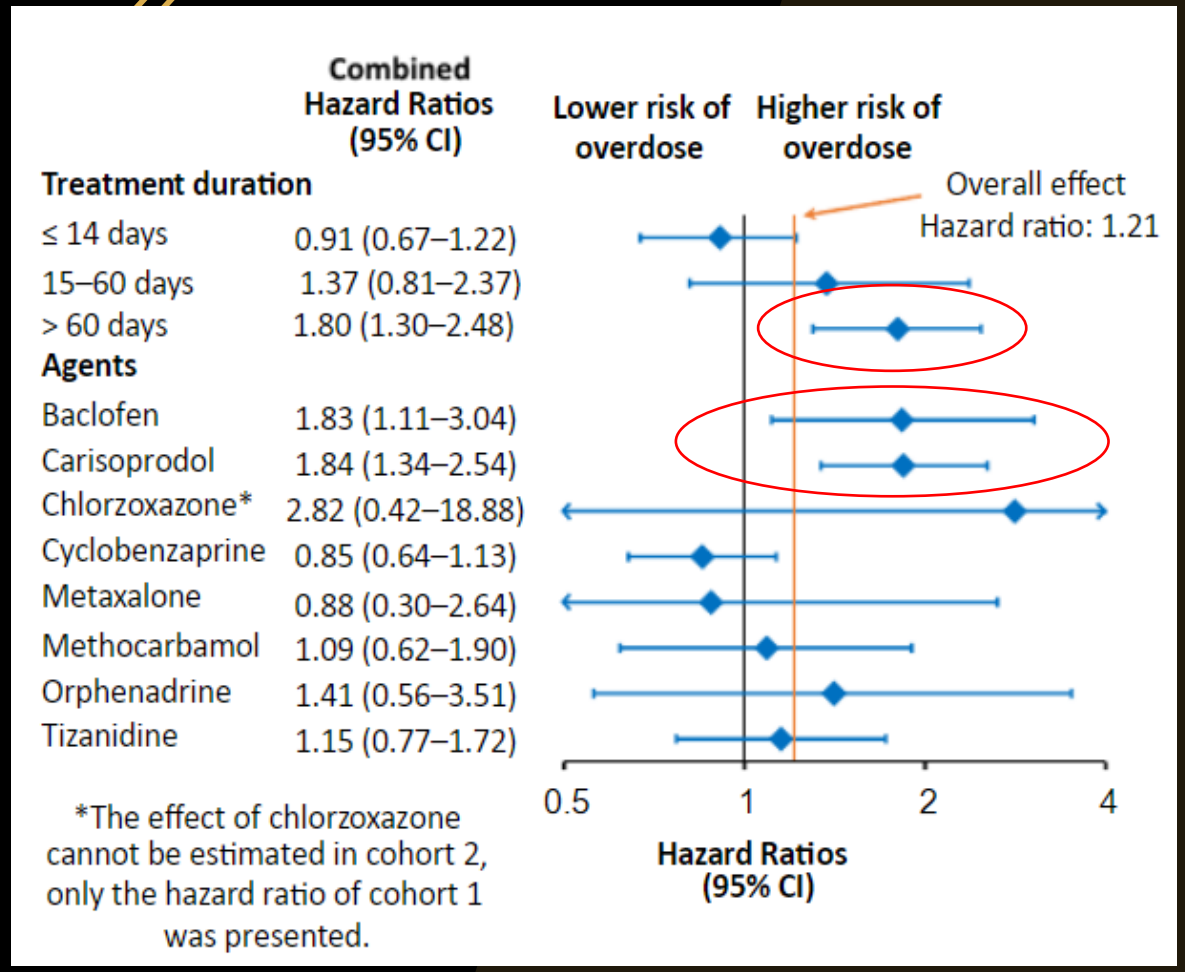
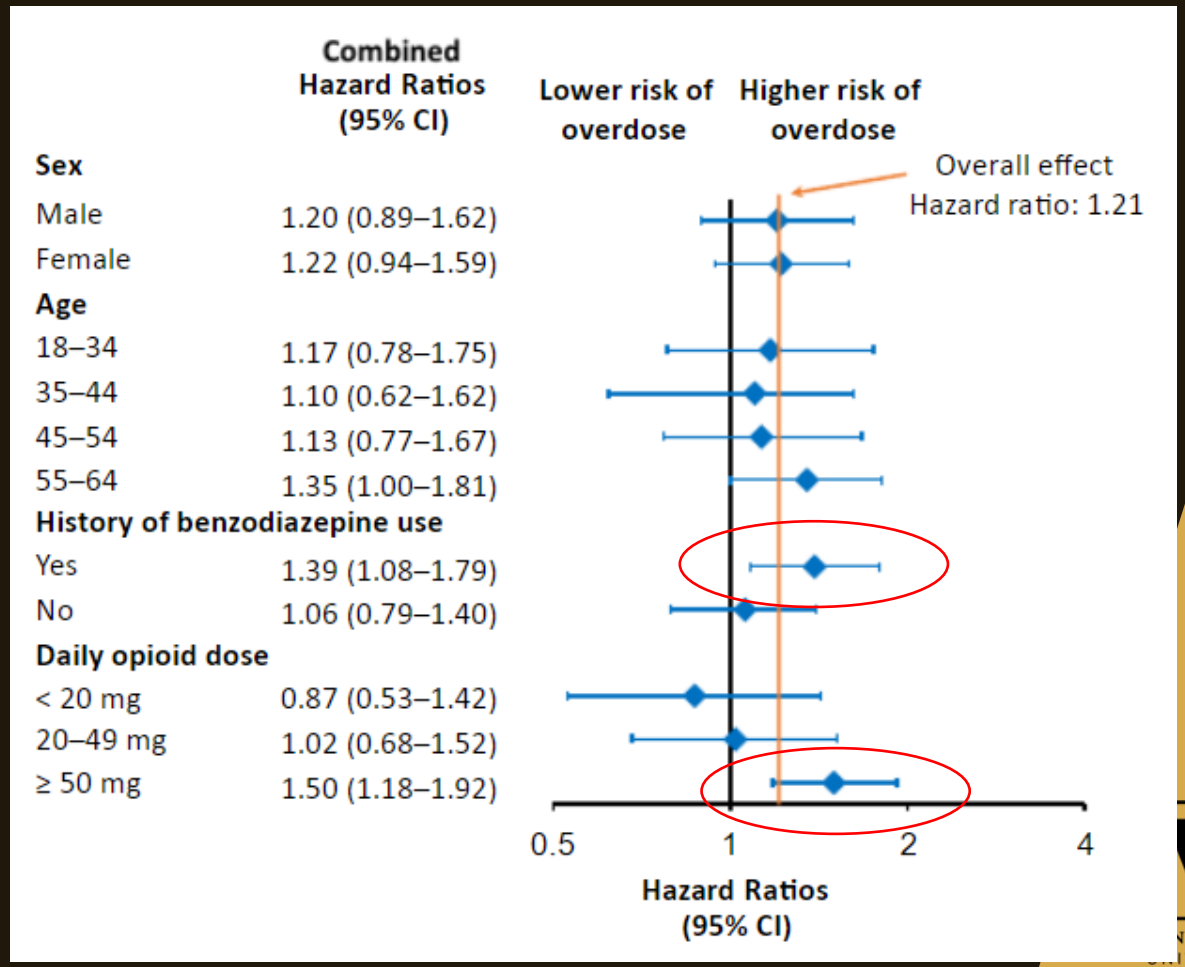
ANALGESIC CLASSES

Muscle Relaxants





Li et al 2020

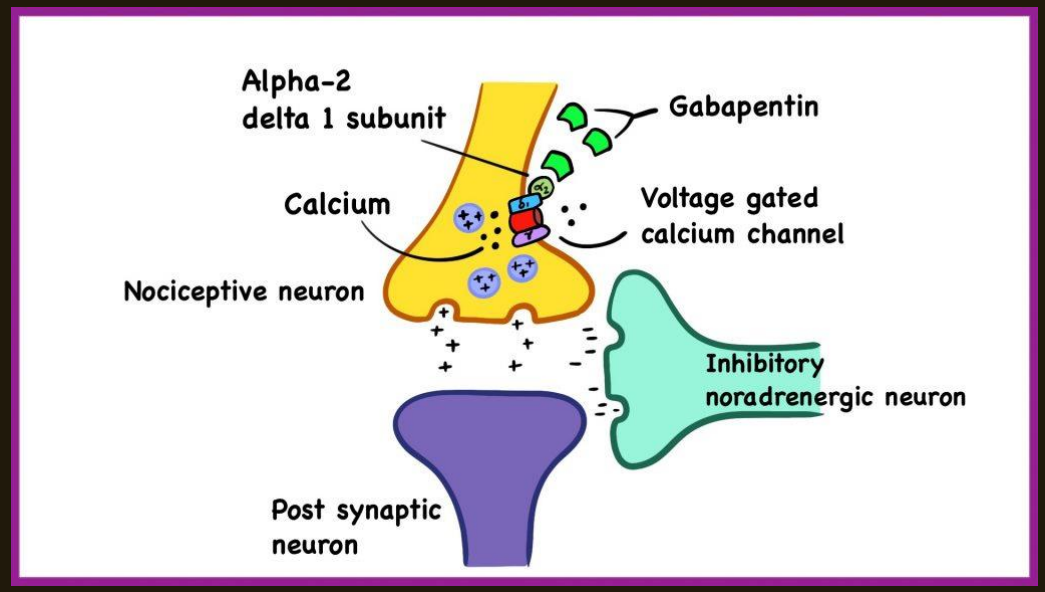
ANALGESIC CLASSES

Neuropathic Pain Medications

Anticonvulsants (Gabapentinoids)

Mechanism of action:

- Alpha 2 Delta Binding
  - Decrease in glutamate, norepinephrine, and substance P at the L-type calcium channel
- L type calcium channel
  - Neuronal tissue, smooth muscle, skeletal muscle
- Structurally derived from GABA
  - NO action at the GABA receptor



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ANALGESIC CLASSES

Neuropathic Pain Medications

Anticonvulsants (Gabapentinoids)

Gabapentin

- FDA indications
  - Post herpetic neuralgia
- Additional indications
  - Painful diabetic neuropathy
  - CRPS
  - Postsurgical pain
- Considerations
  - Renal impairment
  - Slow titration
- Side effects
  - Fatigue, somnolence

Pregabalin

- FDA indications
  - Post herpetic neuralgia
  - Painful diabetic neuropathy
  - Fibromyalgia
  - Spinal cord injury pain
- Additional indications
  - CRPS
  - Postsurgical pain
- Considerations and side effects
  - Same as gabapentin
  - Generally faster onset of action

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ANALGESIC CLASSES

Neuropathic/Central Pain Medications

Sodium Channel and NMDA Antagonists

Lidocaine Infusion

- Mechanism of action
  - Sodium channel antagonist
- Indications
  - Post surgical abdominal pain
  - Chronic abdominal pain
- Considerations
  - Liver disease
  - Cardiac conduction issues
  - Seizure disorder

Ketamine Infusion

- Mechanism of action
  - NMDA Antagonist
- Indications
  - Acute severe pain
  - Opioid induced hyperalgesia
- Considerations
  - PTSD
  - Schizophrenia
  - History of hallucinations

*Call the Pain Specialist

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OPIOIDS

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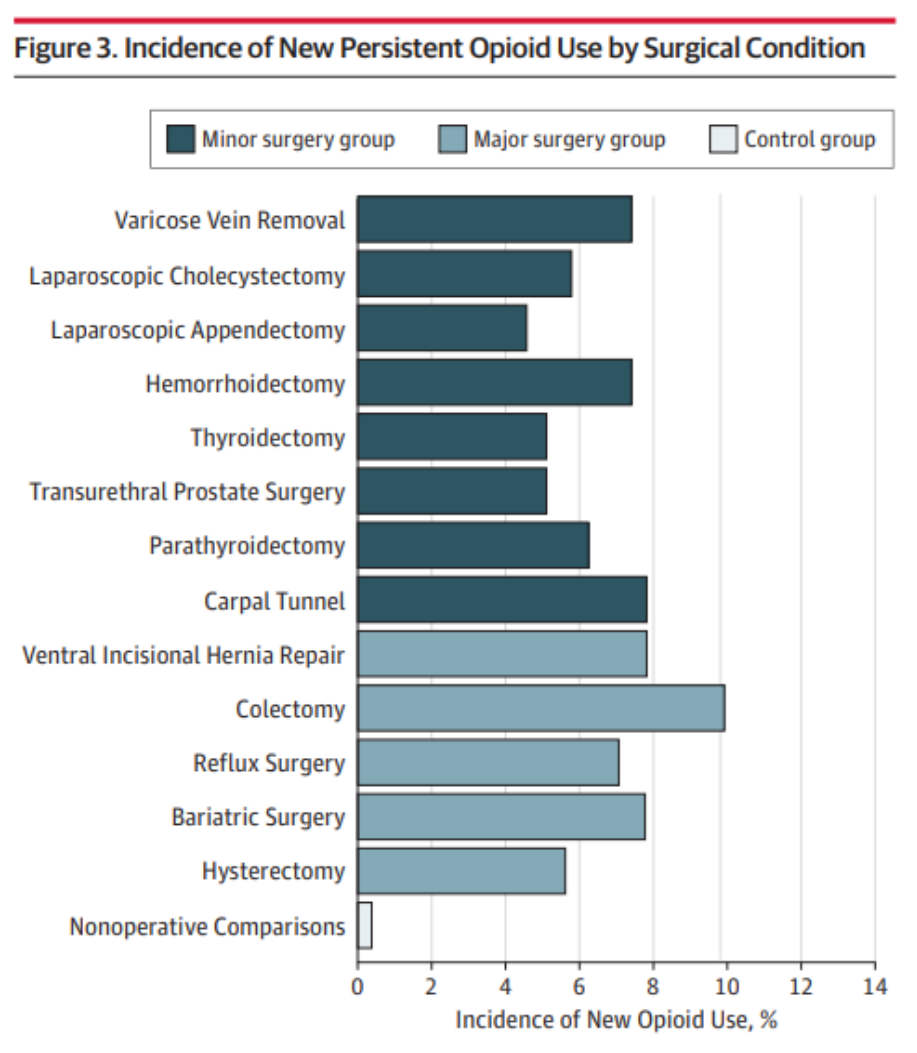
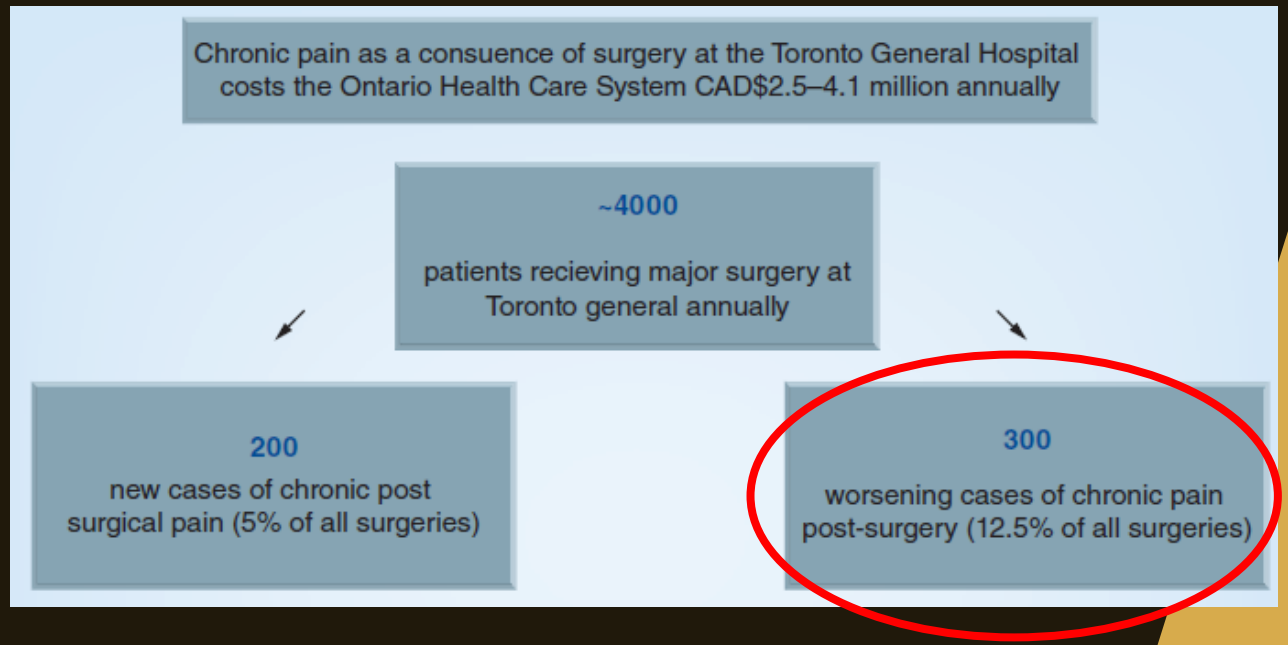
WHY DO WE CARE?

Opioid Dosing Often Changes During Hospitalization





Patients with worsening chronic pain after surgery <u>discharged on 100-300% more opioid than when admitted</u>

Brummett 2017
Huang 2016

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WHY DO WE CARE?

HIGHER OPIOID DOSES → HIGHER RISK OF ADVERSE EVENTS

Hazard Ratio for Fatal Overdose

1-20 MME vs 100 MME

Acute pain: HR = 6.64

Chronic pain: HR = 7.18

Cancer related pain:

HR = 11.99

Substance use history:

HR = 4.54

Bohnert 2011

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Association Between Opioid Prescribing Patterns and Opioid Overdose-Related Deaths

Amy S. B. Bohnert, PhD
Marcia Valenstein, MD
Matthew J. Bair, MD
Dara Ganoczy, MPH
John F. McCarthy, PhD
Mark A. Ilgen, PhD
Frederic C. Blow, PhD

Context The rate of prescription opioid–related overdose death increased substantially in the United States over the past decade. Patterns of opioid prescribing may be related to risk of overdose mortality.

Objective To examine the association of maximum prescribed daily opioid dose and dosing schedule ("as needed," regularly scheduled, or both) with risk of opioid overdose death among patients with cancer, chronic pain, acute pain, and substance use disorders.

Design Case-cohort study.

Setting Veterans Health Administration (VHA), 2004 through 2008.

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OPIOIDS & ACUTE PAIN

Opioid Equianalgesic Doses		
Drug	**PO/PR (mg)**	**Subcut/IV (mg)**
Morphine	30	10
OxyCODONE	20	n/a
HYDROcodone	20	n/a
HYDROmorphone	7.5	1.5

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OPIOIDS & CHRONIC PAIN

- Non-opioids on first and off last
- Opioid use for Acute on Chronic Pain
  - Manage with 25% escalation
  - < 7 day escalation
  - Have a taper plan
  - We do not use opioids in isolation

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OPIOIDS & ANY PAIN

MEDICATION	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
TYLENOL	1000 mg Q8h	1000 mg x 1	1000 mg Q8h	1000 mg Q8h	1000 mg Q8h	1000 mg Q8h
NSAID	Choice	Celecoxib 400 mg	Naproxen 200 mg Q12h	Naproxen 200 mg Q12h	Naproxen 200 mg Q12h	Naproxen 200 mg Q12h
GABAPENTIN		100 – 600 mg x 1	100 – 600 mg Q8h	100 – 600 mg Q8h	100 – 600 mg Q8h	Taper
MEMANTINE		+/-	10 mg BID	10 mg BID	10 mg BID	Taper
OPIOID	Taper	+/-	50 MME/d	40 MME/d	Taper -> OFF	OFF v. Referral

- Focus on function
- Multimodal analgesia → Cascade on, cascade off

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OPIOIDS

60 MME

50 MME

40 MME

A healthcare practitioner may prescribe:

TN TOGETHER
ENDING THE OPIOID CRISIS

- Up to 3-day opioid prescription
- 180 MME total dosage

No requirements before prescribing

- Up to 10-day opioid prescription
- 500 MME total dosage

ICD-10 Code

For a more than minimally invasive procedure:

- Up to 30-day opioid prescription
- 1200 MME total dosage

ICD-10 Code

For medical necessity (after trial and failure or contraindication of a non-opioid treatment):

- Up to 30-day opioid prescription
- 1200 MME total dosage

ICD-10 Code
Medical Necessity

Requirements before prescribing:

- Check the CSMD
- Thorough patient evaluation
- Document consideration of alternative treatments and why an opioid was used
- Obtain informed consent
- Include the ICD-10 code on chart and Rx

The following are individuals exempted if the prescription includes the ICD-10 Code and the word "exempt":

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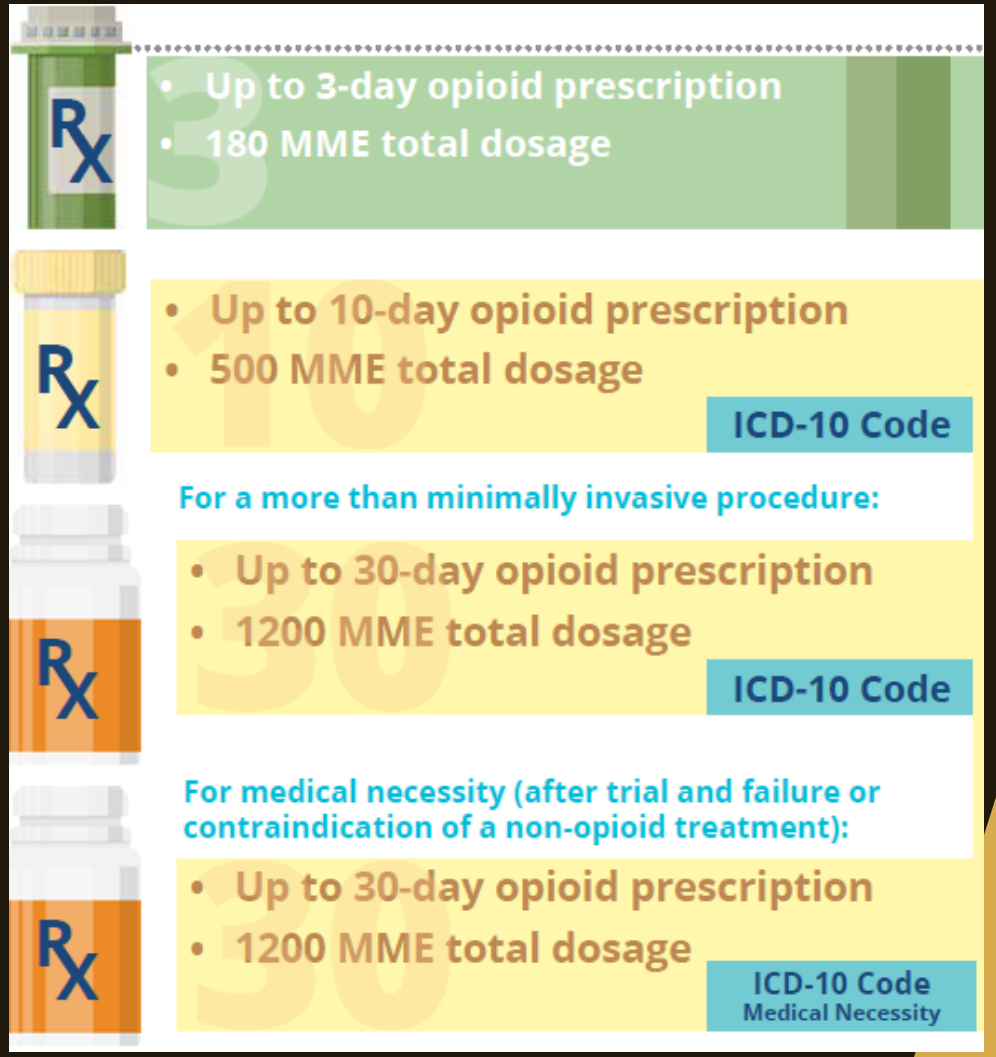
OPIOIDS

Opioid Management Recommendations

- Avoid opioid dose escalation to the extent possible
- Add opioids only after adjuncts are maximized
- Limit discharge opioids to expected duration of moderate to severe postoperative pain
- Coordinate opioid prescription with outpatient provider
- **Continue multimodals beyond the completion of opioid tapering**
- Monitor closely for opioid related adverse events (ORAE)



Hah 2018
TN Together

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CASES

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CASE 1

A 67 year old man with past medical history of essential hypertension (HCTZ), type 2 diabetes (metformin, A1c = 7.6) presents for elective total hip arthroplasty and plan for 23 hour observation overnight in the hospital.

Question 1: What medications and interventions can be given in the preoperative area prior to surgery (assuming no contraindications)?

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CASE 1

Preoperative medications:

- Acetaminophen, 1000 mg
- Gabapentin, 300 mg (may consider 100 mg)
- Famotidine, 20 mg
- Oxycodone extended release, 10 mg
- Celebrex, 200 mg
- Expectation setting

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CASE 1

A 67 year old man with past medical history of essential hypertension (HCTZ), type 2 diabetes (metformin, A1c = 7.6) presents for elective total hip arthroplasty and plan for 23 hour observation overnight in the hospital.

Question 2: What would be a reasonable multimodal analgesic plan for the postoperative period?

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CASE 1

MEDICATION	Days 1-3	Days 4-7	Days 7-14	Beyond
TYLENOL	1000 mg Q8h	1000 mg Q8h	1000 mg Q8h	1000 mg Q8h
NSAID	Celebrex 200 mg BID	Celebrex 200 mg BID	Celebrex 200 mg BID	OFF
GABAPENTIN	100 – 300 mg Q8h	100 – 300 mg Q8h	100 mg BID	OFF v. Referral
Oxycodone	5mg Q6H PRN	5mg daily PRN	OFF	OFF v. Referral

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CASE 2

A 32 year old African American man with a history of sickle cell disease presents to the emergency department with a 2 day history of severe flank pain, vomiting and hematuria. Diagnosis of sickle cell vasooclusive crisis is made.

Baseline pain regimen consists of Tylenol 500 mg QID, ibuprofen 400 mg TID, MS contin 30 mg BID, and oxycodone 10mg q8h as needed. Renal and liver function are normal. He is not tolerating oral medications and in severe pain, writhing in bed.

Question 1: What multimodal analgesic plan can be employed?

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CASE 2

Multimodal analgesia in the patient not tolerating oral intake

- Warm compresses and/or heat packs to the flank
- IV acetaminophen
- Hydromorphone patient controlled analgesia (PCA)
- IV Ketorolac 30 mg every 6 hours (may reduce to 30 mg every 8 hours)
- IV methocarbamol 750 mg every 8 hours x 3 days

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CASE 2

Baseline pain regimen consists of Tylenol 500 mg QID, ibuprofen 400 mg TID, MS contin 30 mg BID, and oxycodone 10mg q8h as needed. Renal and liver function are normal. He is not tolerating oral medications and in severe pain, writhing in bed.

Question 2: What dosing for patient controlled analgesia (PCA) should be used?

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OPIOIDS & ACUTE PAIN

Opioid Equianalgesic Doses		
Drug	**PO/PR (mg)**	**Subcut/IV (mg)**
Morphine	30	10
OxyCODONE	20	n/a
HYDROcodone	20	n/a
HYDROmorphone	7.5	1.5

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CASE 2

Patient controlled analgesia (PCA) dose conversion

- Baseline opioid use
  - MS contin 30 mg BID → 60 MME
  - Oxycodone 10 mg q8h → 30 mg oxycodone * 1.5 → 45 MME
  - Total = 105 MME
- Conversion to intravenous hydromorphone
  - 105 MME * (1.5 mg HM / 30 mg oral morphine) → 5.25 mg IV HM / 24 hours at baseline → 0.2 mg/hr baseline
- Initial PCA settings
  - 0.2 mg every 15 minutes, no continuous rate, max dose 0.8 mg/hr
- *Continuous pulse oximetry

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CASE 2

The above regimen is started but his pain remains uncontrolled. PCA is titrated upward and is now at 0.5 mg every 10 minutes without continuous rate.

Question 3: Can anything else be done aside from continuing to increase the PCA dose?

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WHY DO WE CARE?

Adverse Physiologic Effects of Uncontrolled Acute Pain	
Cardiac	HTN, tachycardia, dysrhythmias, MI
Pulmonary	Atelectasis, mismatch, pneumonia
Endocrine	Protein catabolism, hyperglycemia, fluid retention
Immune	Immune function impairment
Coagulation	Hypercoagulation, ↑ platelet adhesion
GI	Ileus
GU	Urinary retention

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CASE 2

Adjunctive medications for the patient with opioid tolerance and significant acute on chronic pain

- Consultation to the chronic pain service is made
- The patient is screened for a history of PTSD, schizophrenia, psychosis, or hallucinations (negative for these)
- Ketamine infusion is initiated at a dose of 2.5 mcg/kg/min
  - *Requires specialist involvement

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TAKE HOME POINTS

- Pain is a physiologic or pathophysiologic process that is amenable to diagnosis and treatment
- Analgesic medications can and should be selected based on the diagnosis of the type of pain
- Opioids are last on and first off! Pain management should be a cascade on and off medications if more than one agent is used
- Opioids are rarely (almost never) an appropriate single agent treatment for pain
- If things aren't going well, consult a pain specialist; we are happy to help

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REFERENCES

- Bohnert AS, Valenstein M, Bair MJ, Ganoczy D, McCarthy JF, Ilgen MA, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. Jama. 2011;305(13):1315-21.
- Cordell WH, Keene KK, Giles BK, et al. The high prevalence of pain in emergency medical care. *Am J Emerg Med*. 2002;20:165–9.
- Johnston CC, Gagnon AJ, Fullerton L, et al. One-week survey of pain intensity on admission to and discharge from the emergency department: A pilot study. *J Emerg Med*. 1998;16:377–82.
- Tanabe P, Buschmann M. A prospective study of ED pain management practices and the patient's perspective. *J Emerg Nurs*. 1999;25:171–7.
- Neighbor ML, Puntillo KA, Homel P, et al. Chronic pain in the emergency department. *Acad Emerg Med*. 2007;14(Suppl):S112.
- Benzon, H., Rathmell, J. P., Wu, C. L., Turk, D., Argoff, C. E., & Hurley, R. W. (2013). *Practical Management of Pain E-Book*. Elsevier Health Sciences.
- Li Y, Delcher C, Wei YJ, Reisfield GM, Brown JD, Tighe P, Winterstein AG. Risk of Opioid Overdose Associated With Concomitant Use of Opioids and Skeletal Muscle Relaxants: A Population-Based Cohort Study. Clin Pharmacol Ther. 2020 Jul;108(1):81-89. doi: 10.1002/cpt.1807. Epub 2020 Mar 17. PMID: 32022906.
- Vardeh D, Mannion RJ, Woolf CJ. Toward a Mechanism-Based Approach to Pain Diagnosis. J Pain. 2016;17(9 Suppl):T50-69.
- Hah J, Mackey SC, Schmidt P, McCue R, Humphreys K, Trafton J, et al. Effect of Perioperative Gabapentin on Postoperative Pain Resolution and Opioid Cessation in a Mixed Surgical Cohort: A Randomized Clinical Trial. JAMA Surg. 2018;153(4):303-11.
- Katz J, Weinrib A, Fashler SR, Katznelzon R, Shah BR, Ladak SS, et al. The Toronto General Hospital Transitional Pain Service: development and implementation of a multidisciplinary program to prevent chronic postsurgical pain. J Pain Res. 2015;8:695-702.
- Brummett, C. M., et al. (2017). "New Persistent Opioid Use After Minor and Major Surgical Procedures in US Adults." JAMA Surg 152(6): e170504.
- Huang, A., et al. (2016). "Chronic postsurgical pain and persistent opioid use following surgery: the need for a transitional pain service." Pain Manag 6(5): 435-443.

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Q & A

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