Rib Fractures: Viewed Across the TPM Career Continuum

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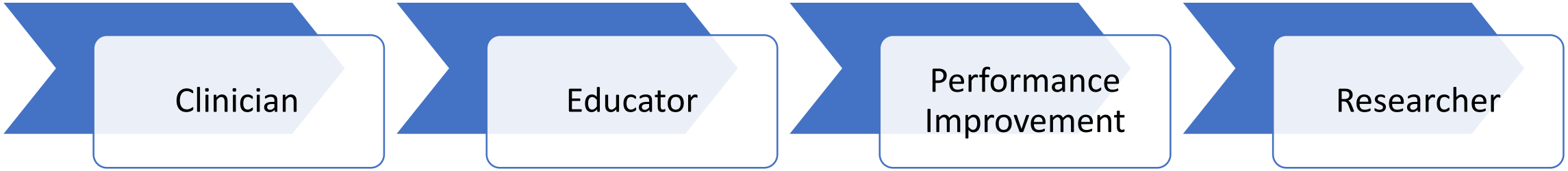
Editor in Chief, Journal of Trauma Nursing

TPM Career Trajectory: Quadruple Threat



Objectives

The learner will be able to:

1. List 3 best practices in management of the rib fracture patient
2. Identify 3 performance improvement measures for the rib fracture patient
3. Develop a rib fracture research abstract

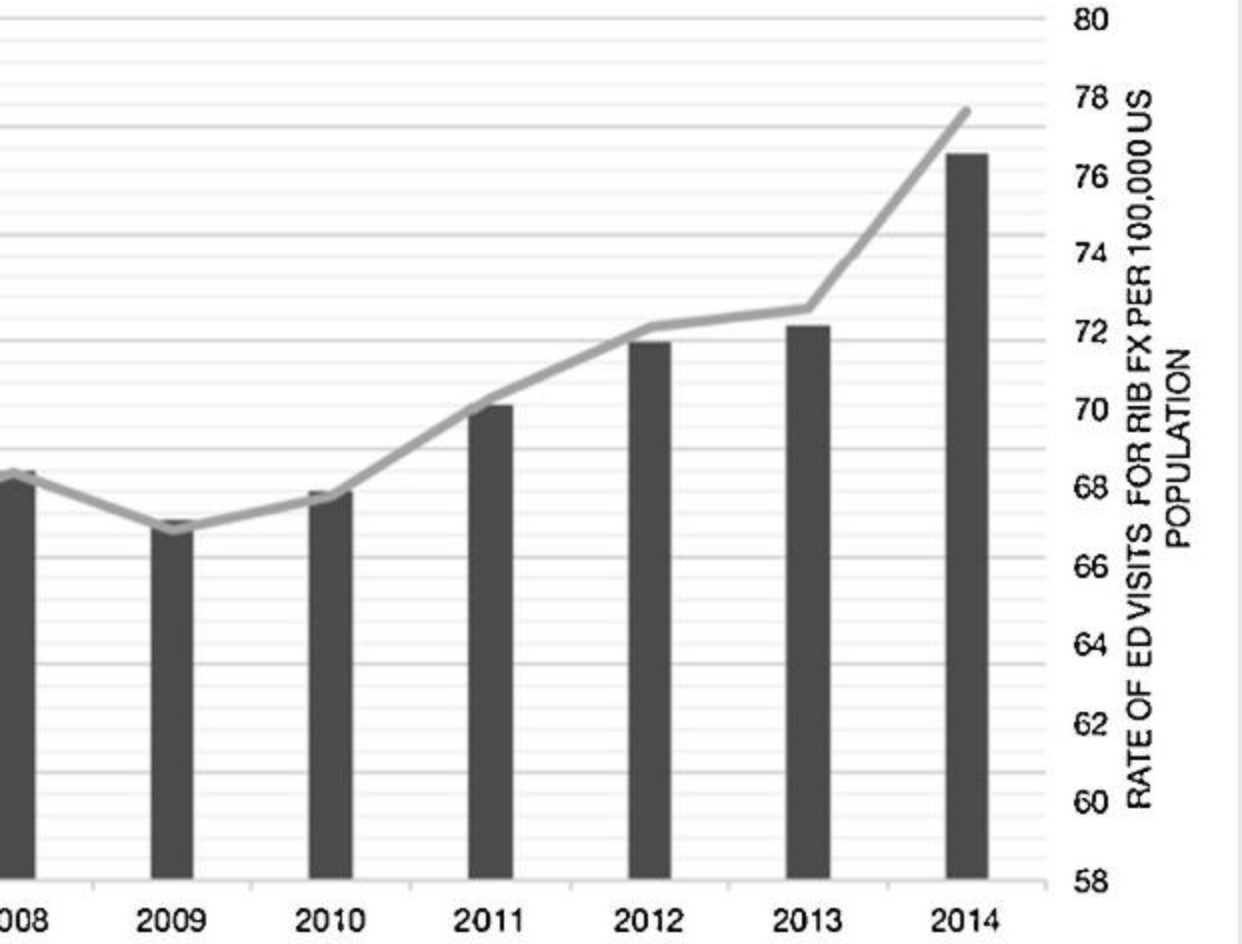
Epidemiology

- Estimated >300,000 rib fractures present annually to US ED's
- Roughly 180,000 admitted
- >1/3 over age 65

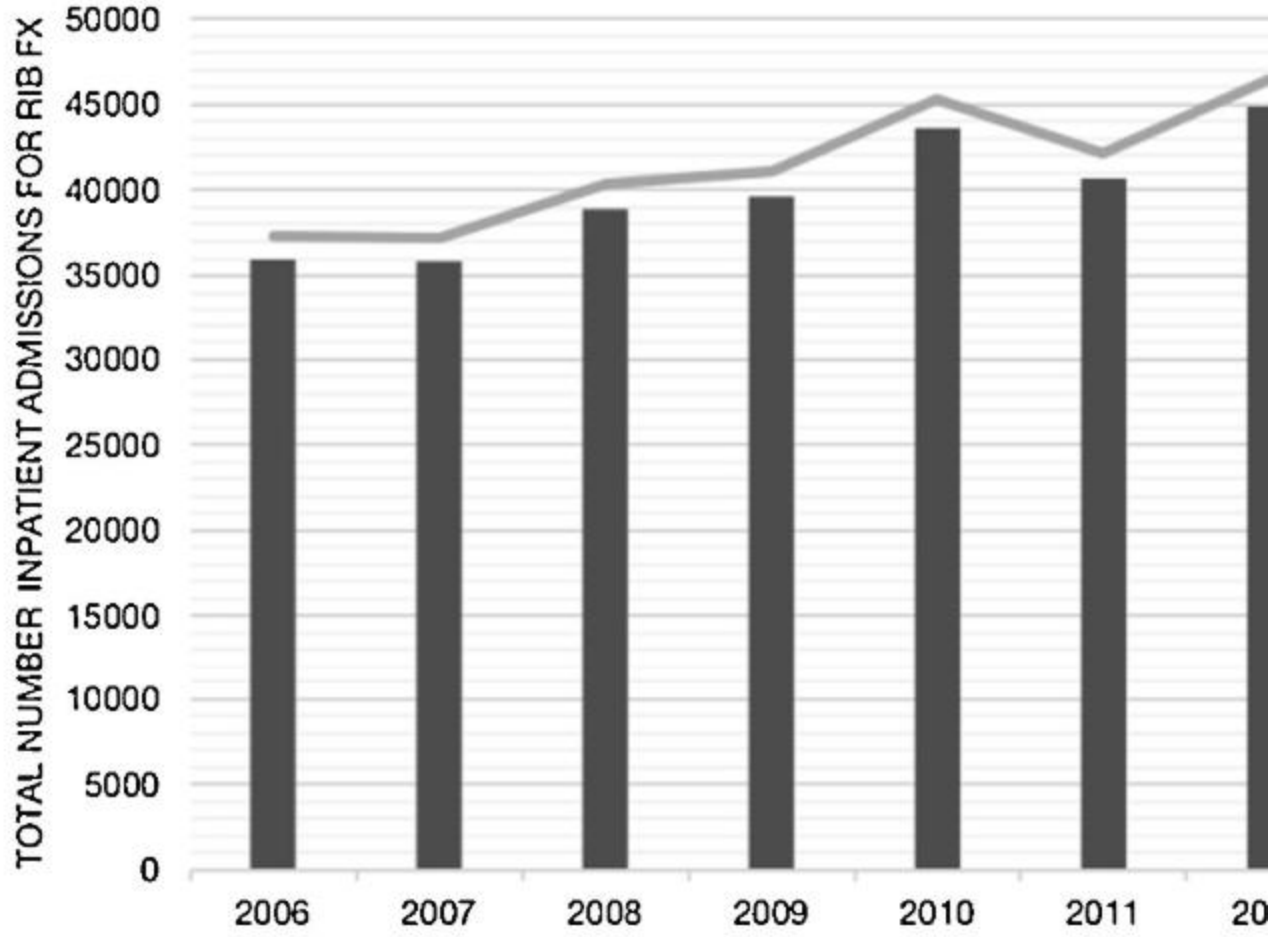
Mortality

- 10% Young adults due indirectly to associated injuries
- 20% Elderly directly related to resp failure/pneumonia

Department Visits for Rib Fracture



Inpatient Admissions for Rib



Rib Fractures in Blunt Thoracic Trauma

Most rib fractures by themselves do well and go home

Rib Fractures also serve as a marker for other things…

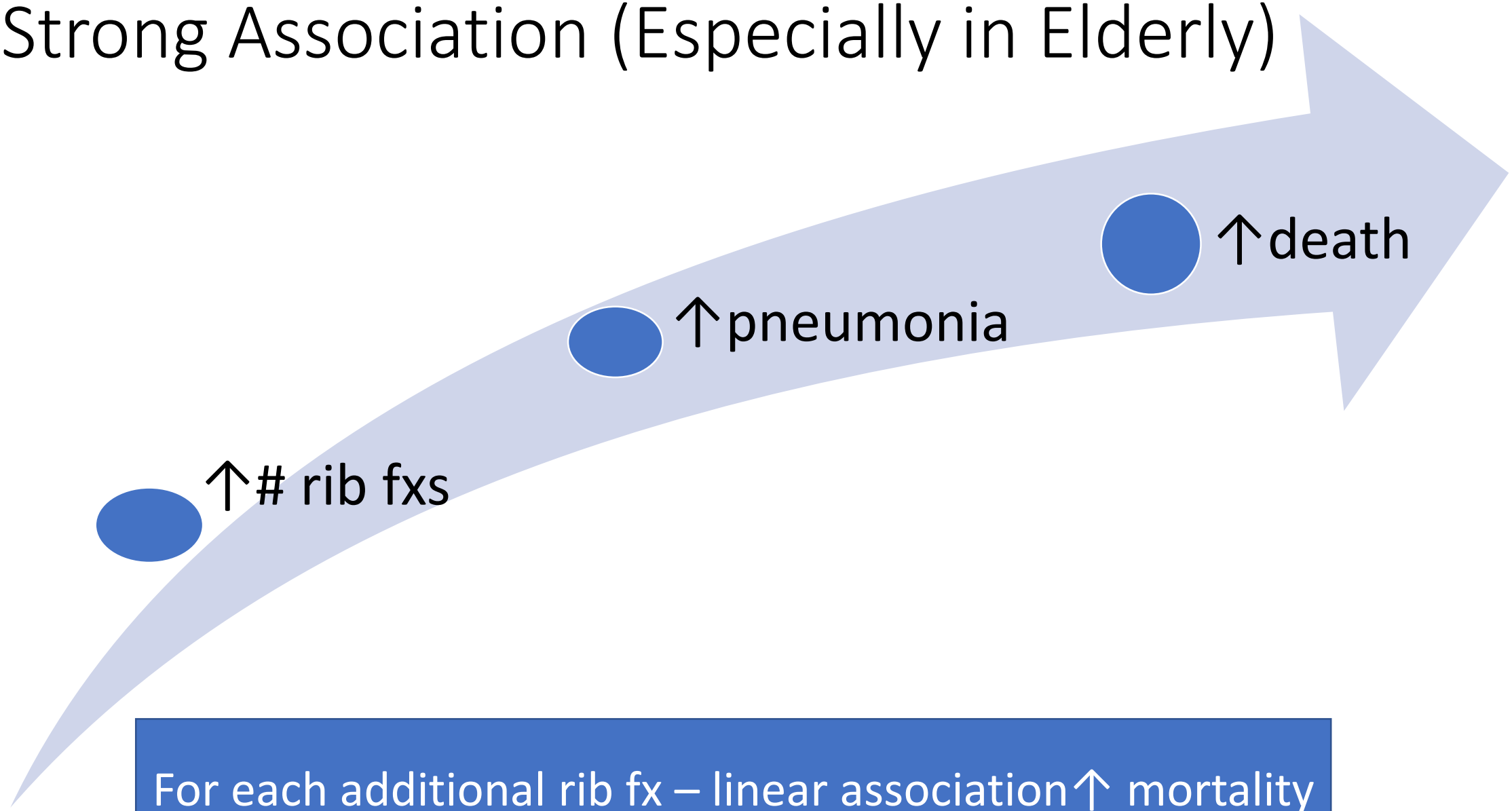
Associated Injuries

- Blunt cardiac injury
- Pulmonary contusion
- Great vessel injury

Associated Complications

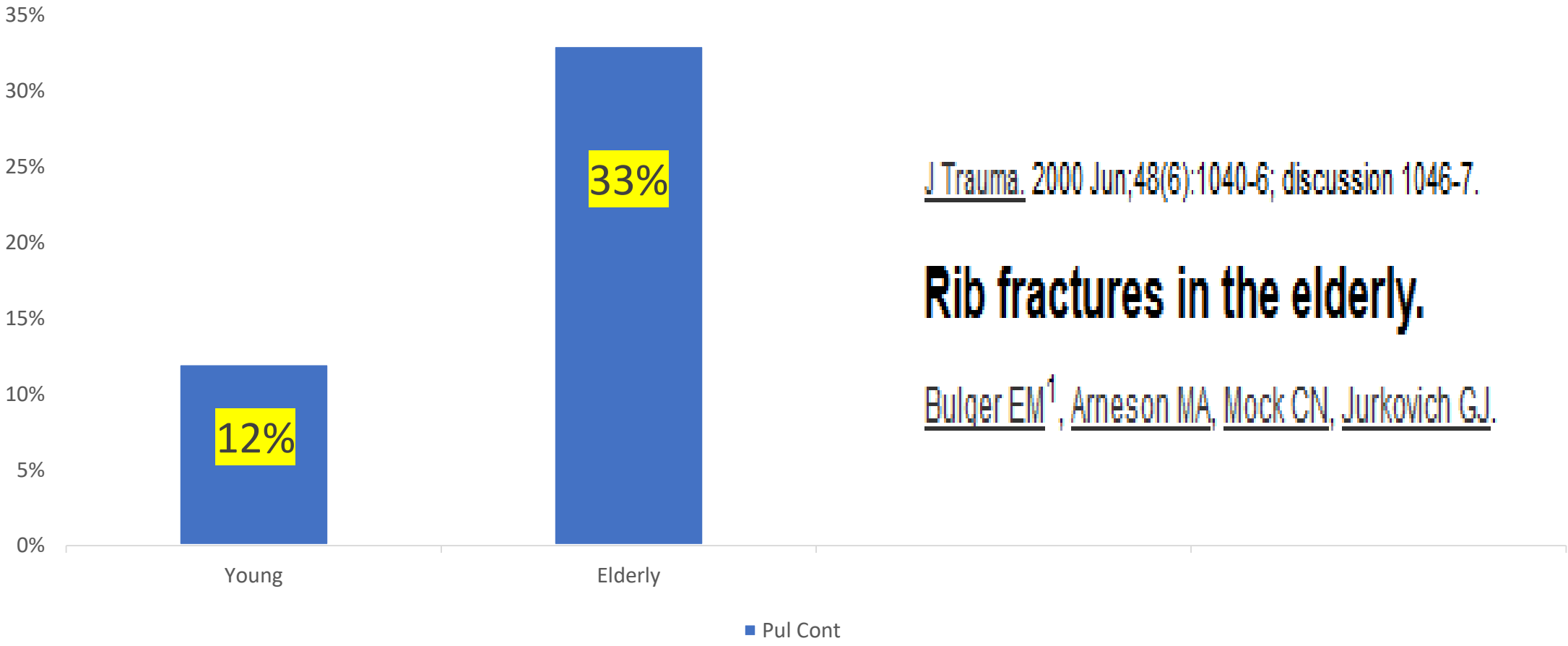
- Pneumonia
- Prolonged vent times
- Prolonged LOS
- Chronic pain

Strong Association (Especially in Elderly)



For each additional rib fx – linear association↑ mortality

Incidence of pulmonary contusion by age with similar fracture pattern



J Trauma. 2000 Jun;48(6):1040-6; discussion 1046-7.

Rib fractures in the elderly.

Bulger EM[1], Arneson MA, Mock CN, Jurkovich GJ.

Association of Pneumonia & # Rib Fractures

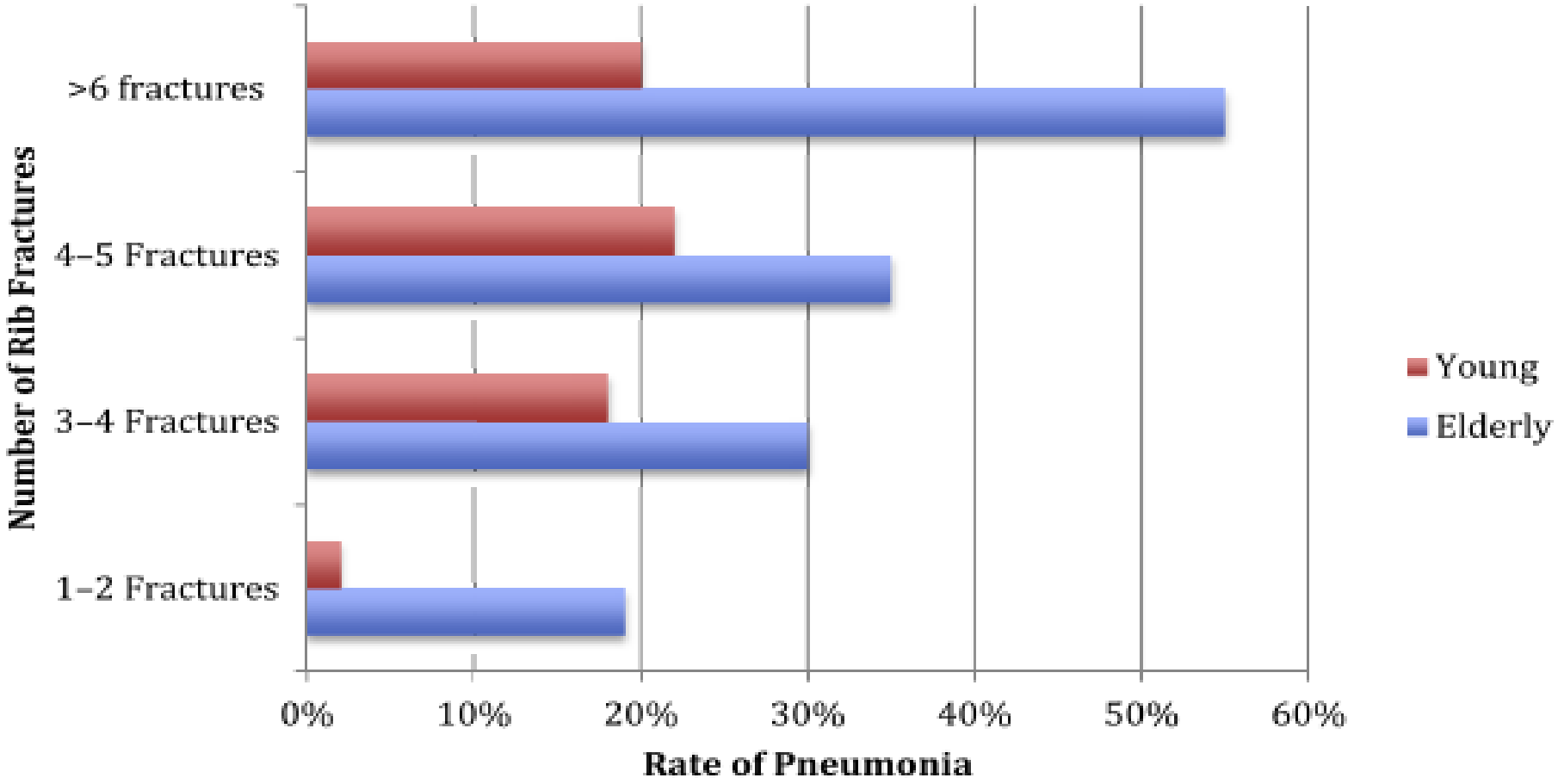


Fig. 1. Relationship between pneumonia and number of rib fractures. The pneumonia rate increases as the number of rib fractures increases, most notably for the elderly group. (*From* Bulger EM, Arneson MA, Mock CN, et al. Rib fractures in the elderly. J Trauma 2000;48(6):1040–6. [discussion: 1046–7].)

Magic Number?

≥ 5 rib fractures

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Surgery

Volume 161, Issue 4, April 2017, Pages 1083-1089

Outcomes

Presented at the Academic Surgical Congress 2016

Number of rib fractures thresholds independently predict worse outcomes in older patients with blunt trauma

Presented at the 11th Annual Academic Surgical Congress in Jacksonville, FL, February 2–4, 2016 as a podium presentation entitled "Thresholds independently predict worse outcomes in older adults."

Nikita O. Shulzhenko BA, Tiffany J. Zens MD, Megan V. Beems MD, Hee Soo Jung MD, Ann P. O'Rourke MD, MPH, Amy E. Liepert MD, John E. Scarborough MD, Suresh K. Agarwal MD

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Surgery

Volume 162, Issue 6, December 2017, Page 1343

Letter to the Editor

Threshold of number of rib fractures in elderly blunt trauma: A simple or complex matter of numbers?

Yalim Dikmen MD [a], Pablo Bayoumy Delis MD [b], Antonio M. Esquinas MD, PhD, FCCP [b]

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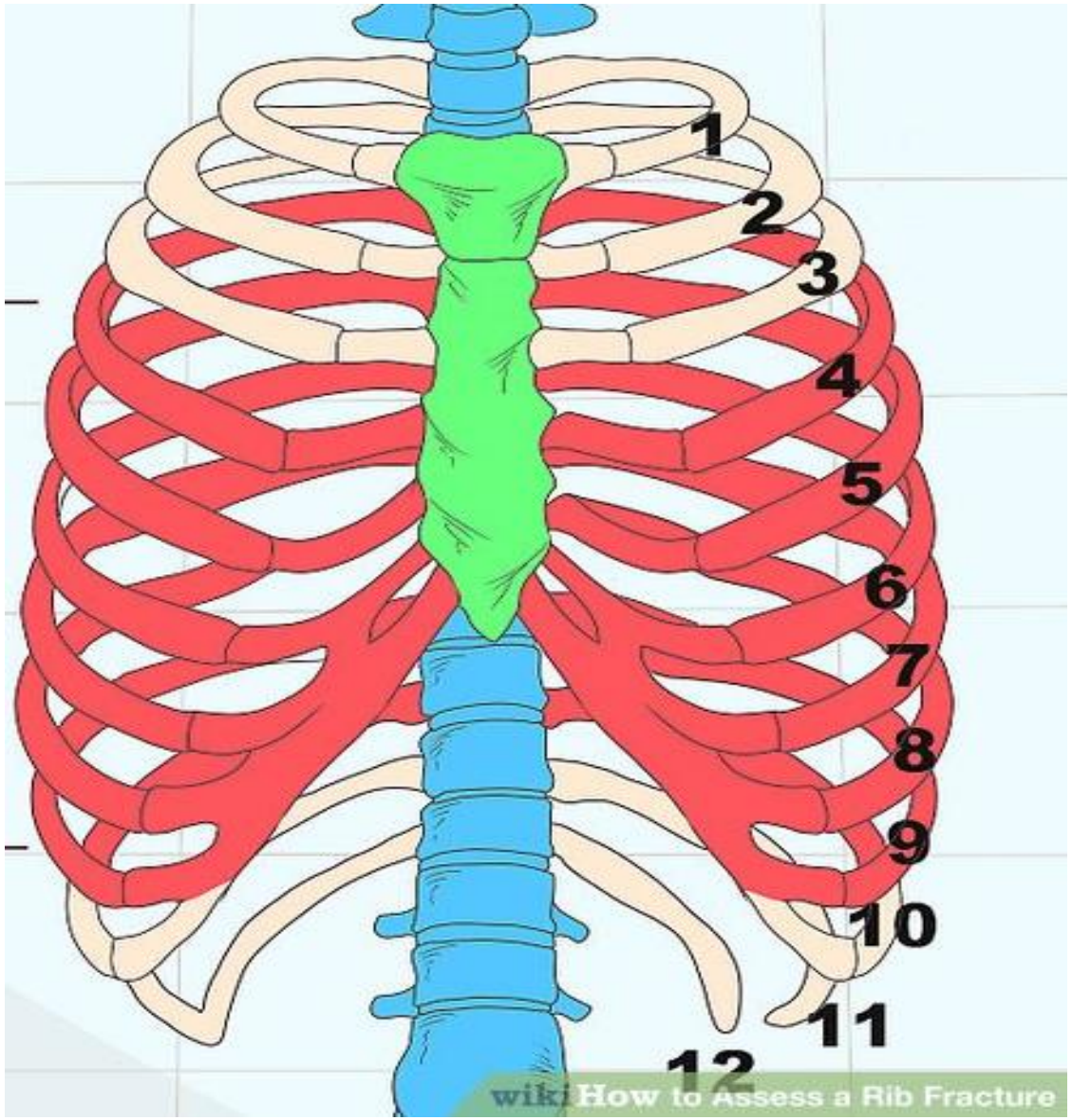
https://doi.org/10.1016/j.surg.2017.03.007

Refers to Nikita O. Shulzhenko, Tiffany J. Zens, Megan V. Beems, Hee Soo Jung, Ann P. O'Rourke, Amy E. Liepert,

Previously > 6

Associated Injuries



- Ribs 1-3 (nerve/vas injury)
- Ribs 4-10 (most common)
- Ribs 10-12 (spleen,liver, retrop)
- Esophageal/Gastric Injury Always R/O Associated Chest Injury

Rib Fx Incidence

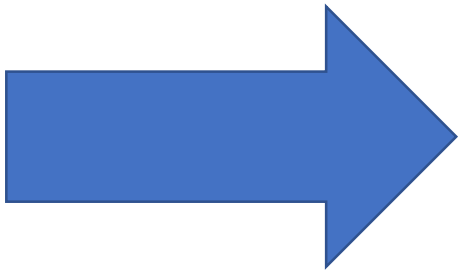
Question

- Which population sustains more rib fractures?
- Which population sustains less rib fractures?

Flail Chest Diagnosis

Traditional Criteria

- ≥3 fx's broken with free floating segment
- Paradoxical movement



Comprehensive Rib Fx Scoring

- # Fractures
- Bilateral
- Location
- Distribution
- Degree of displacement
- Pulmonary contusion

Question

How long before paradoxical movement is typically seen in flail chest?

Best matches for rib fracture scoring:

RibScore: A novel radiographic score based on **fracture** pattern that predicts pneumonia, respiratory failure, and tracheostomy.

Chapman BC et al. J Trauma Acute Care Surg. (2016)

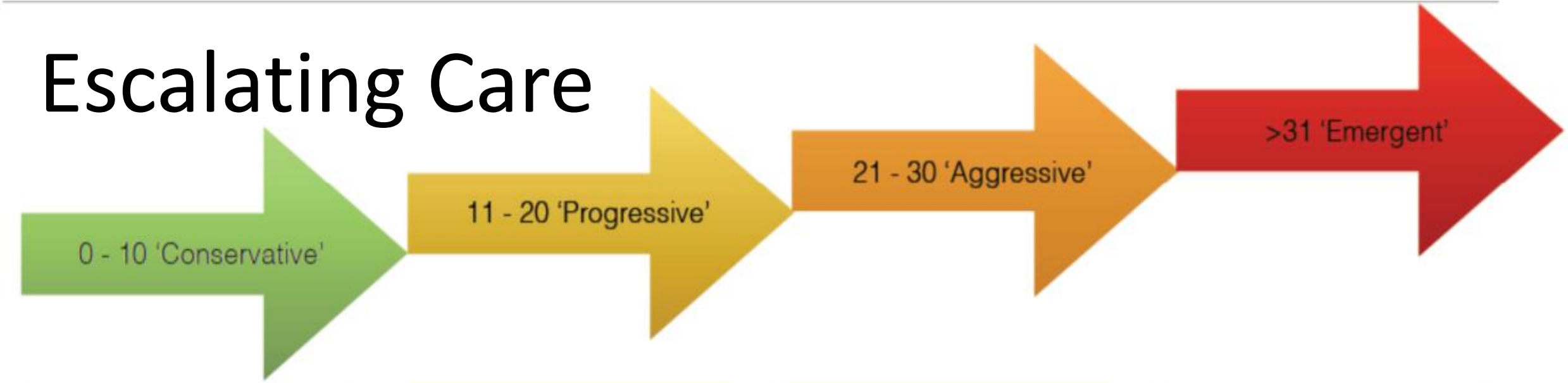
Quantification of **rib fractures** by different **scoring** systems.

Fokin A et al. J Surg Res. (2018)

A pilot single-institution predictive model to guide **rib fracture** management in elderly patients.

Gonzalez KW et al. J Trauma Acute Care Surg. (2015)

Escalating Care



Simple oral analgesics.Safe for discharge home? Review in knowledge of age and co-morbidities. If pain persists or increases add PCA

PCA +/- adjuvants. If PCA inadequate add ketamine infusion as per guidelines. If unable to cough or deep breathe, consider epidural or para-vertebral catheter. Chest drains to be managed in level 1 beds as a minimum level of care.

Epidural or para-vertebral block. Also consider inter-pleural and intercostal blocks. CPAP required for respiratory support? Level 2 bed indicated. Epidurals should only be sited in clean environments.

Epidural or para-vertebral blocks. Do not site catheters in ventilated patients until they are suitable for extubation. Level 2/3 beds.

Flail chest, respiratory compromise is caused by?

1. Paradoxical movement
2. Underlying contusion and pain

Imaging

CXR	Ultrasound	CT Scan
Missed Injuries: • >50% rib fx • 10-50% pneumo's	Better accuracy than CXR	Highest accuracy of fx dx
	But: • Time consuming • Costly • Painful	Find underlying injuries
	Not advocated- trauma	3 D Reconstruction if repair planned

2016

Operative fixation of rib fractures after blunt trauma: A practice management guideline from the Eastern Association for the Surgery of Trauma

George Kasotakis, MD, MPH, Erik A. Hasenboehler, MD, Erik W. Streib, MD, Nimitt Patel, MD, Mayur B. Patel, MD, MPH, Louis Alarcon, MD, Patrick L. Bosarge, MD, Joseph Love, MD, Elliott R. Haut, MD, PhD, *and* John J. Como, MD, MPH, *Boston, Massachusetts*

BACKGROUND: Rib fractures are identified in 10% of all injury victims and are associated with significant morbidity (33%) and mortality (12%). Significant progress has been made in the management of rib fractures over the past few decades, including operative reduction and internal fixation (rib ORIF); however, the subset of patients that would benefit most from this procedure remains ill-defined. The aim of

METHODS: Popula … flail chest. Outco … CU) length of stay … ysis of currently … Evaluation metho…

RESULTS: Twenty … t rib ORIF. Rib O… d need for trache… for pain in patient…

CONCLUSION: In adult patients with flail chest, we conditionally recommend rib ORIF to decrease mortality; shorten DMV, hospital LOS, and ICU LOS; and decrease incidence of pneumonia and need for tracheostomy. We cannot offer a recommendation for pain control, … h currently available data. (*J Trauma Acute Care Surg.* 2017;82: 618–626.

… n and internal fixation; systematic review and meta-analysis.

Conditionally recommend Rib ORIF for Flail Chest
Decreased: mort, pneum, trach, LOS

No difference in Pain, Long Term Outcomes

Reality Check

The Journal of TRAUMA® Injury, Infection, and Critical Care

Surveyed Opinion of American Trauma, Orthopedic, and Thoracic Surgeons On Rib and Sternal Fracture Repair

John C. Mayberry, MD, L. Bruce Ham, MD, Paul H. Schipper, MD, Thomas J. Ellis, MD, and Richard J. Mullins, MD

Introduction: Rib and sternal fracture repair are controversial. The opinion of surgeons regarding those patients who would

cated in selected patients. A greater proportion of surgeons thought that sternal fracture repair was indicated in selected

would be necessary to change their negative opinion.

Conclusions: A majority of surveyed

Lack of familiarity reduces implementation

Survey of 230 Surgeons

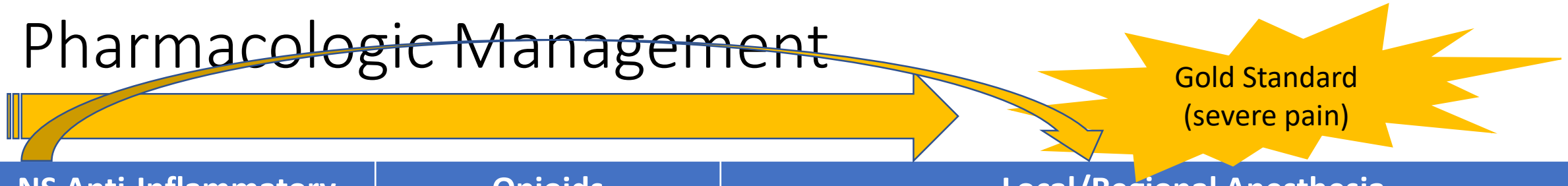
Only 26% had performed or assisted in Chest Wall Fracture Repair

The Future…
Video Assisted Thoracic Surgery (VATS)

Minimally invasive thoracic surgery is also known by the name *VATS* (short for video-assisted thoracic surgery). Utilizing specially-adapted, videoendoscopic instruments, VATS is used for a variety of diagnostic and therapeutic procedures and involves smaller incisions in the chest wall

Smaller incisions, No need to spread the ribs
Faster Improved Recovery than ORIF?

Pharmacologic Management



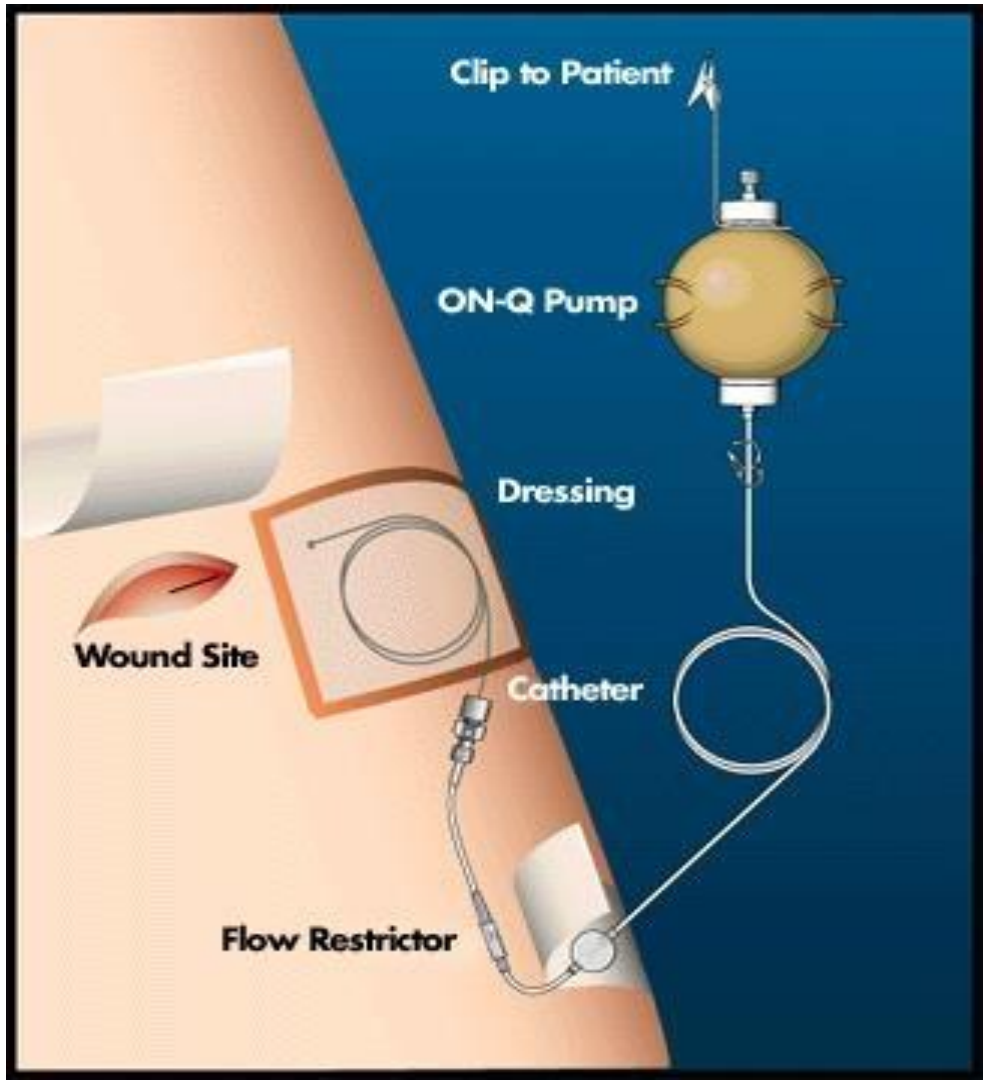
NS Anti-Inflammatory	Opioids	Local/Regional Anesthesia
Ease of use, accessible	Effective Oral/IV/PCA	Intercostal nerve blocks: • No CNS depress • No risk of dependence • Time consuming • Temporary (8-12 hrs)
↔ respiratory drive Avoid in peptic ulcer Avoid in PLT dysfunct Risk of renal damage	Caution: • CNS depression • Nausea • Constipation • Increasing tolerance	Epidural (Lumbar or Thoracic) • Provides bilateral pain relief • Lower dosage requirement • ↑ FRC & VC • Technically demanding • Time sensitive • Side effects: hypotension, urinary retention, delayed resp depression
		Contraindicated in elevated intracranial pressure

Research Building Favoring Local Regional Anesthesia

On Q Pump

- **How does ON-Q* work?**
- Post op pain relief system designed to deliver local anesthetic to surgical site.
- Provides days of targeted pain relief after surgery

•Better pain relief
•Less need for narcotics
•Faster return to normal activities
•Greater mobility
•Potential for earlier hospital release



US Guided
Serratus Nerve Blocks

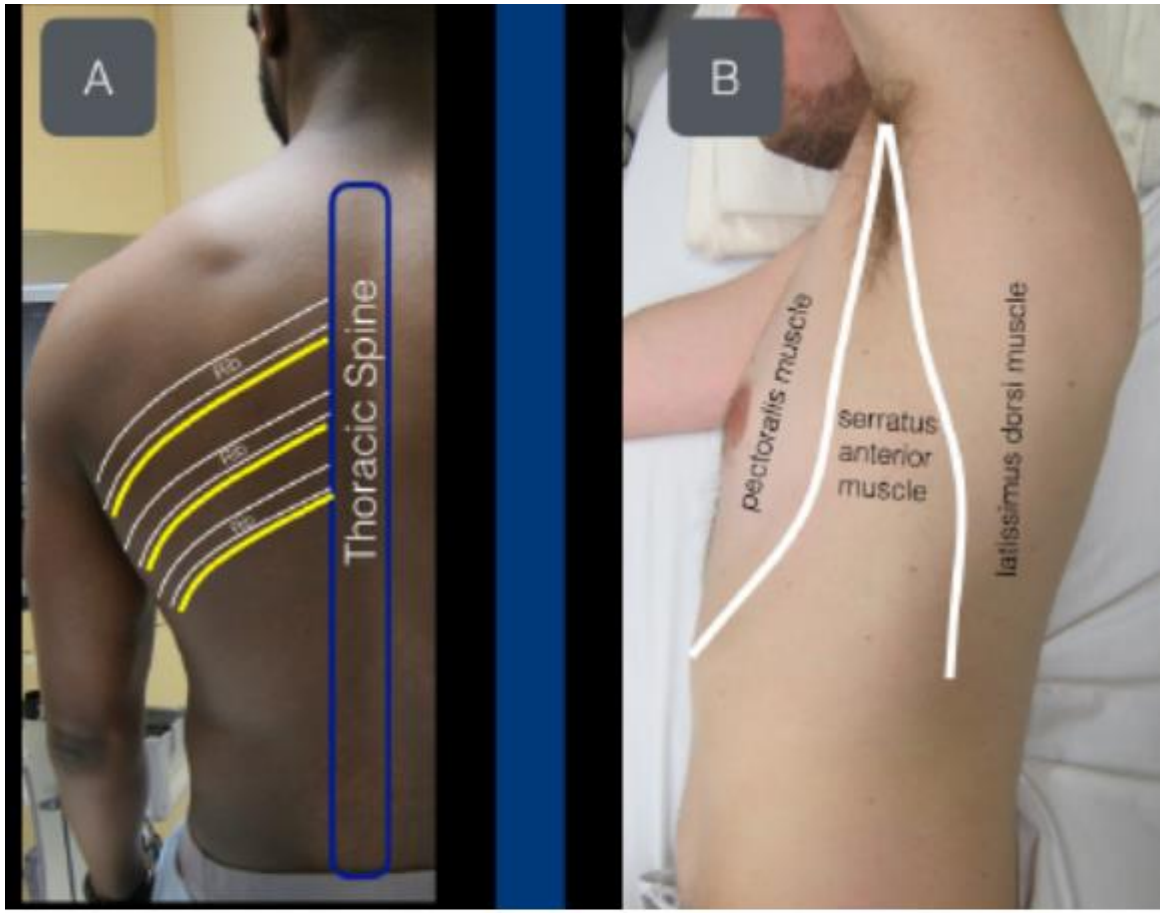


Figure 1A: View of the thoracic intercostal nerves as they exit the spine inferior to the ribs.

igure 1B: The serratus anterior muscle sits between the pectoralis muscle (anterior) a latissimus dorsi muscle (posterior).

Conundrum

Need for VTE Prophylaxis in the Presence of Regional Anesth

- ✓When placing an epidural catheter
  - ✓Wait at least 10-12 hrs after last LMWH prophylaxis dose

- ✓When removing an epidural catheter
  - ✓Wait until 2 hours after removal before resuming prophylaxis

American Society of Regional
Anesthesia and Pain Medicine Guideline

Lung Recruitment Strategies

Acapella Device

- Vibratory therapy
- Loosens mucous

Non Invasive Ventilation

- (BiPap)
- Bilevel pos airway pressure

Pulmonary Toilet Nursing Myth?

- Cough & Deep Breath
- Get out of bed

- Long held beliefs
- Anecdotal experience
- Few supporting data

Incentive Spirometry Mechanics

Physiology:

- Long, slow breaths exercise the inspiratory muscles, decreases pleural pressure, improves gas exchange, and promotes lung expansion

Procedure:

- Inspiration should be performed over a period of five seconds followed by a breath-hold and normal exhalation.

American Association of Respiratory Care

Incentive Spirometry 2012

Go Madonna!

J Trauma Nurs. 2012 Apr-Jun;19(2):89-91; quiz 92-3. doi: 10.1097/JTN.0b013e31825629ee.

Patients with rib fractures: use of incentive spirometry volumes to guide care.

Brown SD[1], Walters MR.

Author information

Predictor of Respiratory Decline

Abstract

Rib fractures pose significant risk to trauma patients. Effective pain control and the ability to take deep breaths are crucial for optimal recovery, and these are key elements in current clinical guidelines. These guidelines use incentive spirometry volumes along with other assessment values to guide patient care. However, despite current guidelines, nurses do not routinely document inspired respiratory volumes. This article provides trauma nurses with the rationale for documenting and tracking incentive spirometry volumes to improve outcomes for patients with rib fractures. This promotes early detection of respiratory decline and early interventions to improve pain control and pulmonary function.

CJEM. 2019 Feb 12:1-4. doi: 10.1017/cem.2018.492. [Epub ahead of print] 2019

Potential benefits of incentive spirometry following a rib fracture: a propensity score analysis.

Batomen Kuimi BL[1], Lague A[1], Boucher V[1], Guimont C[2], Chauny JM[3], Shields JF[2], Vanier L[4], Plourde M[2], Émond M[1].

Author information

Update of
Madonna's Article

Abstract

CLINICIAN'S CAPSULEWhat is known about the topic?Literature regarding the impact of incentive spirometry on patients with rib fractures is unclear; there are no recommendations for its use in the emergency department (ED).What did this study ask?The objective of this study was to assess the impact of incentive spirometry on delayed complications in patients with rib fractures in the ED.What did this study find? Unsupervised incentive spirometry use does not have a protective effect against delayed pulmonary complications after a rib fracture.Why does this study matter to clinicians?Clear guidelines for incentive spirometry use for patients with rib fractures and further research to assess its usefulness in other ED populations are needed.

KEYWORDS: Emergency department; incentive spirom

Prognostic Value > Therapeutic Value?

Incentive Spirometry

- In theory should work
- Limited high level evidence
- Lack of consensus on use

Why? →Inconsistent Application
  - Patient compliance
  - Nursing standardization

Research Gap

Currently:

➢Routine post op use not advised

- Developed by:
- Wellspan York Hospital, PA
- 2014 TQIP Mtg
- Harborview, WA
- Serial Scoring by nurses
- White board in pt rm
- Instant pt feedback
- Engages pt & family

Human Factors

➢Pt perception of benefit

➢Device location

PIC Score

1 2 3 4 5 6 7 8 9 10

Pain Patient-reported, 0-10 scale	Inspiration Inspiratory spirometer; goal and alert levels set by respiratory therapist	Cough Assessed by bedside nurse
3 - Controlled (Pain intensity scale 0-4)	4 – Above goal volume	3 - Strong
	3 – Goal to alert volume	
2 - Moderate (Pain intensity scale 5-7)		2 - Weak
	2 – Below alert volume	
1 - Severe (Pain intensity scale 8-10)	1 – Unable to perform incentive spirometry	1 - Absent

Patient name: *Date:* *IS Goal:*

Research Gap

In practice, wide variation among clinicians:

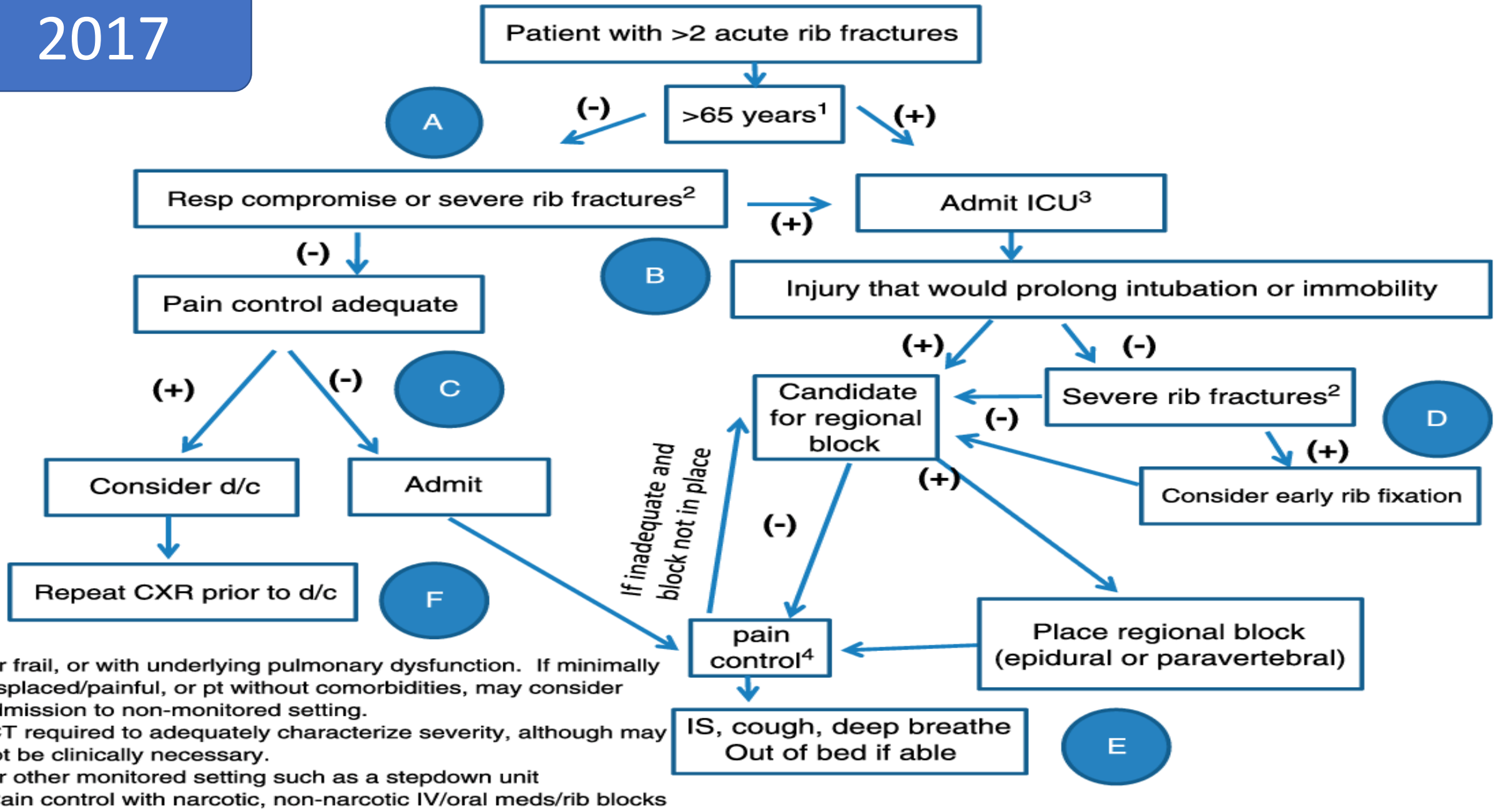
- Duration of inhalation
- Duration of breath hold
- Numbers of breaths per session
- Frequency of sessions
- Target inspiratory volumes

Optimal Protocol Unknown
Limits generalizability of available evidence on efficacy

Risk Prediction

Patient Selection	Respiratory Compromise
Arbitrary age cut off? > 60 >65	Hypoxemia O2 Sat <92% rm air
Frailty score?	Incentive spirometry < 1000 cc or <15cc/kg
	Vital Capacity < 1.4 or < 30% predicted VC

2017



[1]or frail, or with underlying pulmonary dysfunction. If minimally displaced/painful, or pt without comorbidities, may consider admission to non-monitored setting.
[2]CT required to adequately characterize severity, although may not be clinically necessary.
[3]or other monitored setting such as a stepdown unit
[4]Pain control with narcotic, non-narcotic IV/oral meds/rib blocks

Western Trauma Association rib fracture algorithm. *Circled letters* refer to corresponding areas within the text.

Admission Best Practice

Western Trauma Association Recommendation
(> 2 rib fx's) + (Age > 65) → admit to ICU If OK after 24 hrs → to floor

2018

Original Article

Bundle of care for blunt chest trauma patients improves analgesia but increases rates of intensive care unit admission: A retrospective case-control study

Cédric Carrie [a,*], [illegible] [b], Philippe Revel [b],

[a] Anaesthesiology and Critica
[b] Emergency Department, CH
[c] Anaesthesiology and Critical
[d] Université de Bordeaux Seg

Blunt Chest Trauma > 3 Rib Fx (No Vent)
Before and After Analysis
Bundle Implementation
N=69 pairs
Matched: Age,Severity indicies
Results: Improved pain control
More ICU admissions
No reduction respiratory complications

ARTICLE INFO

Article history:
Available online 21 Septemb

Keywords:
Blunt chest trauma
Clinical pathways
Epidural analgesia
Non-invasive ventilation
Outcome

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ergency department

rib fractures and no
over two 24-month
algesia was the main
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uction of the rate of
primary ICU transfer
duction of secondary
non-steroidal anti-
econdary respiratory

complications (OR = 0.3 [0.1–0.9], $P = 0.03$).
Conclusion: Implementation of a multidisciplinary clinical pathway significantly improves pain control after ED management, but increases the rate of primary ICU admission without significant reduction of secondary respiratory complications.

Early Use of a Chest Trauma Protocol in Elderly Patients with Rib Fractures Improves Pulmonary Outcomes

2019

KATHERINE M. KELLEY, M.D.,* JESSICA BURGESS, M.D.,* LEONARD WEIRETER, M.D.,* TIMOTHY J. NOVOSEL, M.D.,* KRISTA PARKS, R.R.T.,† MICHELLE ASEUGA, R.R.T.,† JAY COLLINS, M.D.*

*From the *Eastern Virginia Medical School, Norfolk, Virginia; and †Sentara Norfolk General Hospital, Norfolk, Virginia*

Rib fractures are among the most common injuries identified in blunt trauma patients. Morbidity increases with increasing age and increasing number of rib fractures. The use of noninvasive ventilation has been shown to be helpful as a rescue technique avoiding intubation in patients who have become hypoxemic but little data with regard to its use to prophylactically prevent worsening respiratory status are available. We developed a chest trauma protocol for our "elderly" (>45 ary outc RL) and ted of in sive venti nts meet 11 unpl nts diag ned ICU pa- tient sed adverse pulmonary events in our older blunt chest trauma population with multiple rib fractures. This protocol has become our standard procedure for patients older than 45 years admitted with rib fractures.

Before and After evaluation Chest Bundle

Bundle: IS, NIV, Analgesia

Results: ↓ Pneumonia, ↓Unplanned ETT, ↓ Return to ICU

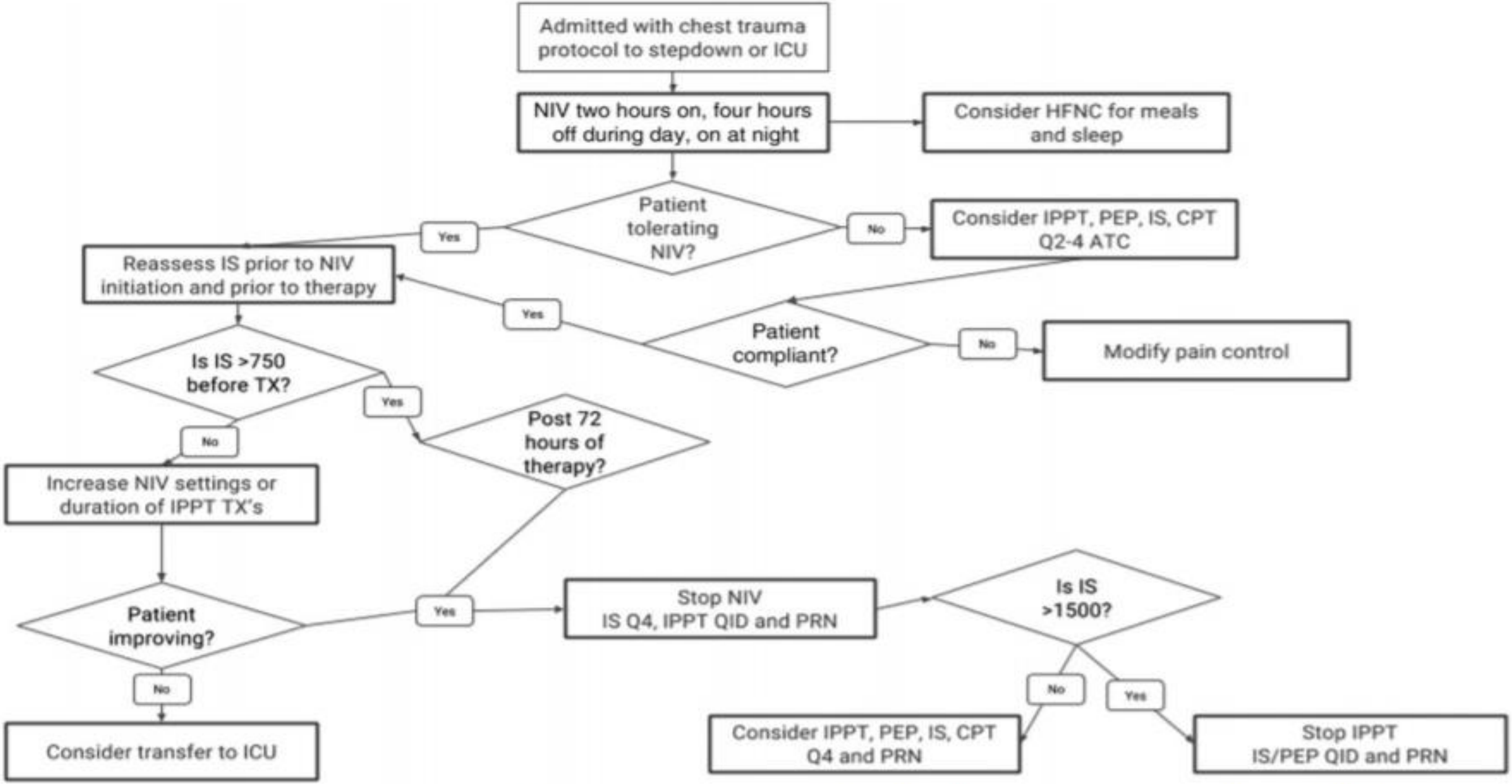


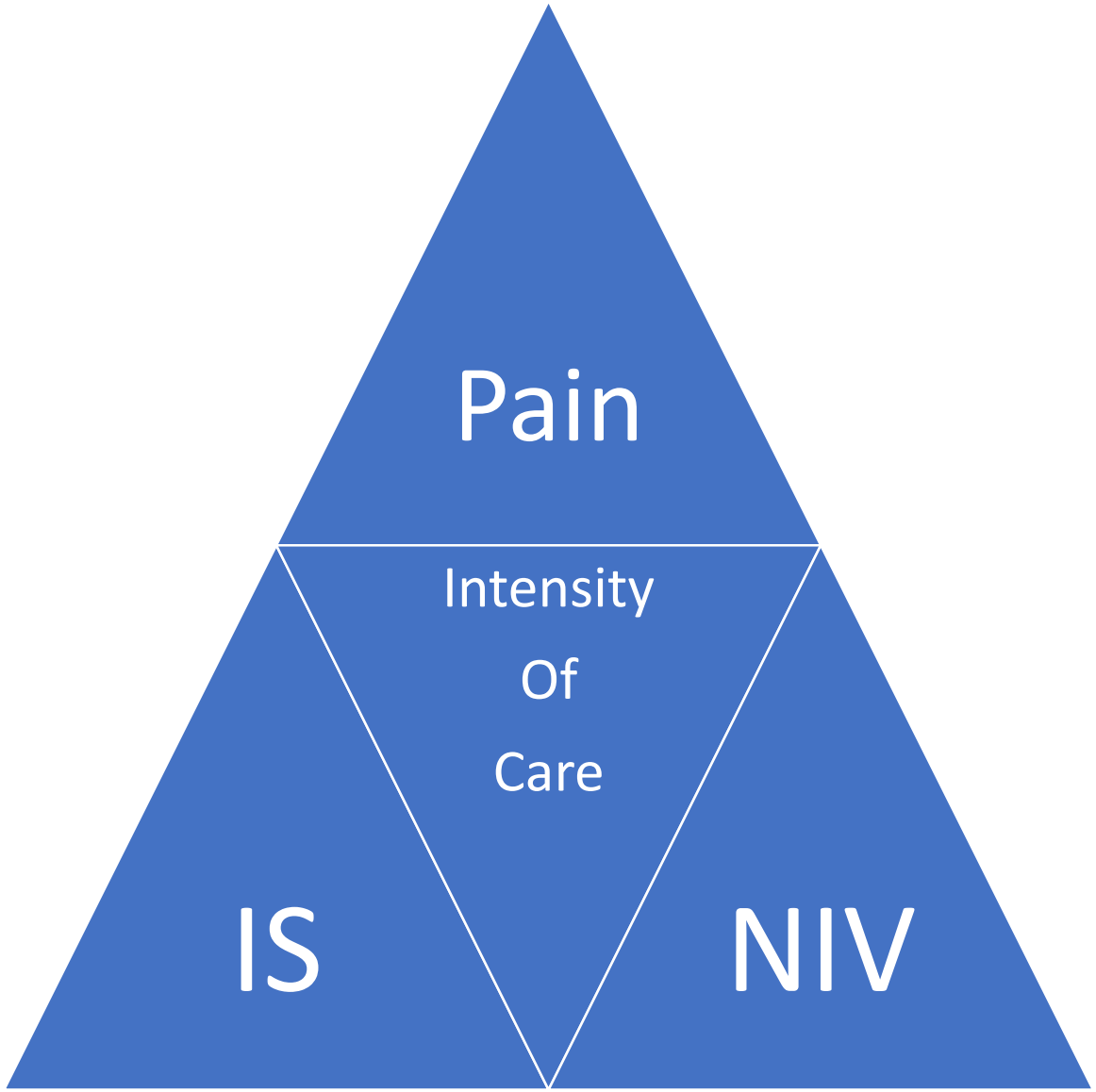
FIG. 1. Chest trauma respiratory protocol. IS, incentive spirometry; IPPT, intermittent positive pressure therapy; PEP, positive expiratory pressure therapy; TX, treatment; CPT, chest physiotherapy; ATC, around the clock.

Bundles

Mix People & Places:

- Physicians
- Nursing
- Respiratory Therapy

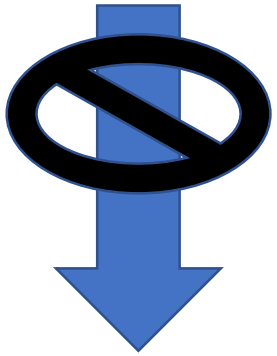
Bed Placement



Performance Improvement

Over arching goal with rib fractures:

- Prevent/Minimize Associated Complications



- Failure to Rescue

Rib Fx Performance Improvement Laundry List

- Risk prediction assessment
- Floor placement-nursing intensity
- Nursing care protocols (pain management, pulmonary toilet)
- Incentive Spirometry --PICC --White board
- Nursing Escalation of care
- Unplanned intubation
- Unplanned ICU admission
- Rapid response team activations
- Pneumonia
- Failure to rescue

Research Ideas

	QUALITATIVE	QUANTITATIVE
Type of Data	Verbal, conceptual	Numerical
Purpose	Exploration: Researchers are not sure what they are looking for	Confirmation: Researchers know what they are looking for
Question Types	Open ended "what," "how," and "why" questions	Closed ended "how many," "how often," "how much" questions
Number of Participants	Few, but in-depth conversations	Many, to produce reliable results
Typical Methods	Focus groups, in-depth interviews, ethnographies	Surveys

Qualitative Research Ideas

1. Patient and/or Family Interviews:
   - knowledge, motivation, adherence to incentive spirometry

2. Nurse Interviews:
   - knowledge, attitudes toward incentive spirometry

3. Nurse Interviews:
   - knowledge, attitudes, regarding escalation of care

- Open ended questions
- Vignette based

Mixed Methods Study Idea

- Qualitative Nursing Interviews AND
- Quantitative Nursing Questionnaires/Stats
  - Education
  - Experience
  - Extra training
  - Staffing ratios
  - Unit case mix

Quantitative Study Ideas

- Use of incentive spirometry to activate rapid response team?
- Is incentive spirometry therapeutic for rib fracture patients?
- What is the effect of incentive spirometry on rib fracture outcomes?
- What is the effect of education and implementation of a standardized incentive spirometry protocol on nursing adherence to IS?

- Before: Does a standardized incentive spirometry protocol decrease pneumonia and LOS in rib fractures?
- After: A standardized incentive spirometry protocol decreases pneumonia and LOS in rib fracture patients.

In Summary
The Trauma Population Is Challenging to Study

- Randomized Control Trial (RCT) on Incentive Spirometry
- Control for:
  - Patient : Age, Race, Gender, SES, Education level, Insurance status
  - Mechanism of injury
  - Physiologic status: BP, HR, RR, SI, GCS, GOS
  - Anatomic status: AIS, ISS, NISS
  - Number, degree of displacement of rib fractures
  - Analgesia
  - Nursing unit intensity and training

  - Randomized Control Study on Incentive Spirometry in Rib Fx?
  - Blinding not possible
  - Consider sham device (placebo)?
  - Every other patient given the real IS, patient and nurse blinded