

Geriatric Trauma: Challenges & Opportunities

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Case

- 70 y/o M, falls from ladder while cleaning out the gutters
- On scene: Awake and alert, GCS 15, SBP 130/80, HR 72, RR 24, c/o left chest pain
- Denies syncope
- PMH: Atrial fibrillation on Coumadin, HTN on Atenolol, COPD on intermittent inhalers



Case

- Primary care at local community hospital 15 minutes away (Not a trauma center)
- Closest trauma center 40 minutes away
- What prehospital intervention does he need
 - ALS vs BLS?
 - Does he need to go to a trauma center?

On arrival

- En route patient becomes confused & somnolent
- Admission VS: SBP 110/80, HR 70, RR 30
Oxygen saturation 90%, GCS 12
- Should we intubate?
- How much fluid to give?

ED course

- Mental status continues to decline GCS 8
- Intubated in ED
- After intubation and 1 liter bolus
 - SBP 90/50, HR 75
- What now?
 - More fluid? Blood?
 - FAST vs CT?

Injuries

- Left rib fractures 5-9 with hemothorax
 - CT 400cc blood
- Splenic laceration
 - Active bleeding requiring splenectomy
 - Shock masked by beta blockers and baseline hypertension
- Traumatic Brain Injury
 - Acute subdural hematoma
- INR on admission 3.5
 - Needs rapid correction of coagulopathy

Outline

- Epidemiology of Geriatric trauma
- Acute resuscitation issues
- Triage (Hospital and Prehospital)
- High Risk Injury patterns
 - TBI with anticoagulation
 - Rib fractures
 - Solid organ injury
 - Pelvic fracture
 - C-spine fracture

Who is elderly?

- 50 is the new 40!
- Age > 55 years?
 - Solid organ injury
 - Pelvic fracture
- Age > 65 years?
 - Rib fractures
 - Traumatic Brain Injury
- Age > 70 years?
 - Trauma team activation studies

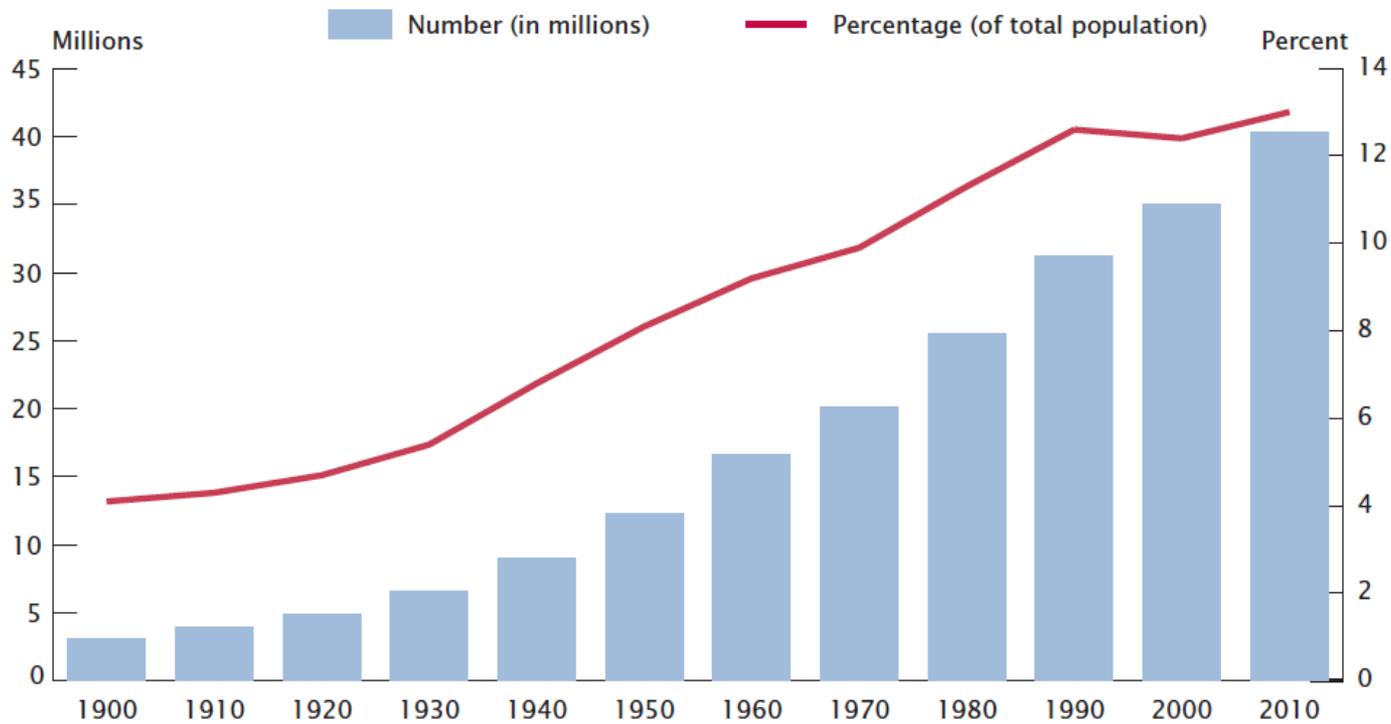


2010 Census

Figure 2.

Population 65 Years and Older by Size and Percent of Total Population: 1900 to 2010

(For more information on confidentiality protection, nonsampling error, and definitions, see www.census.gov/prod/cen2010/doc/sf1.pdf)



Sources: U.S. Census Bureau, decennial census of population, 1900 to 2000; 2010 Census Summary File 1.

The Scope of the Problem

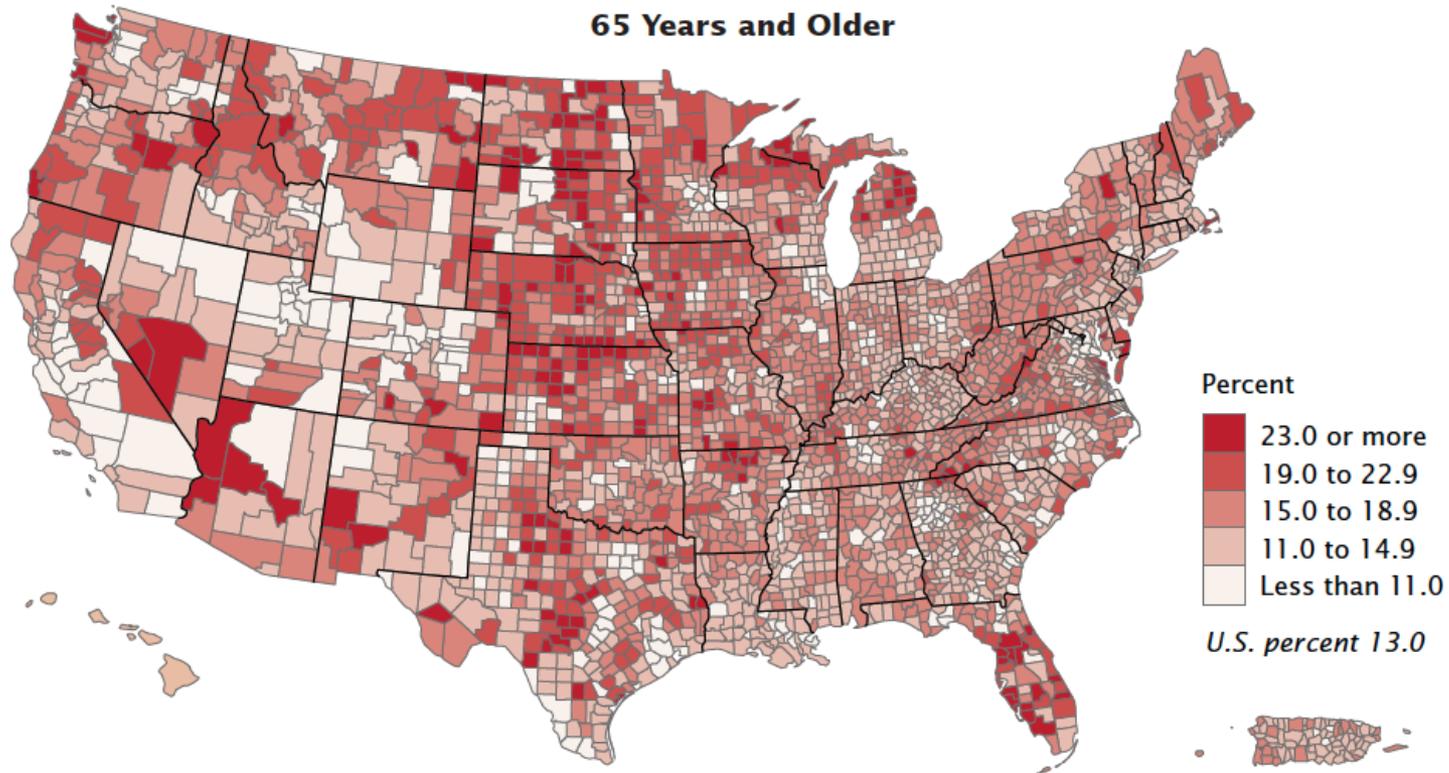
- 2010: Age > 65 yrs= 13% of the population
 - 27.9% of the deaths due to accidental causes
 - 33% of health care resources spent on trauma
- Trauma is the 7th leading cause of death over age 65
- 10,000 people a day turn 65, life expectancy 76.5 years, by 2050 1 in 5 Americans will be 65 or older

US Population Age > 65 years

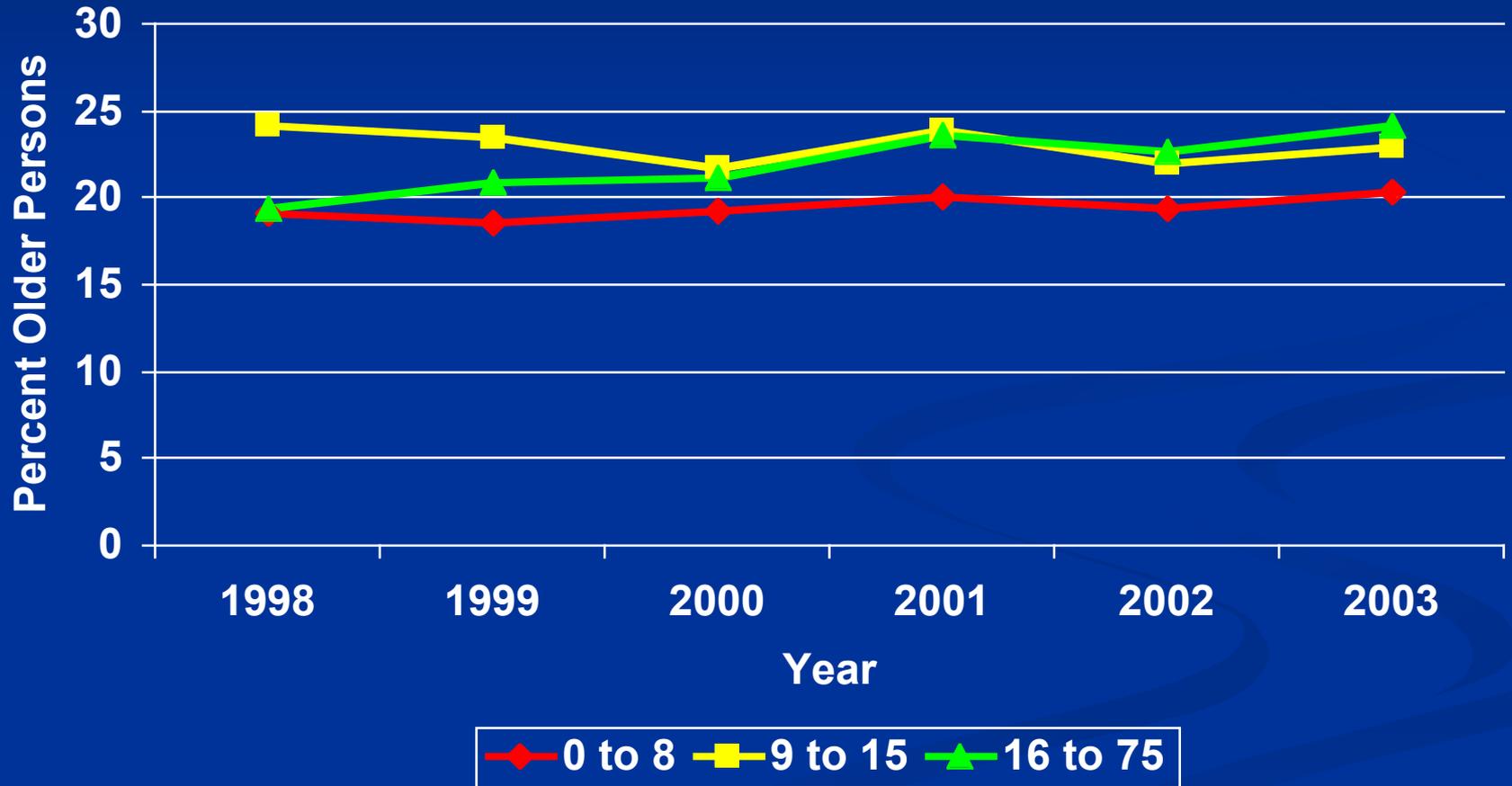


Figure 6.
**Percent 65 Years and Older and 85 Years and Older
by County: 2010**

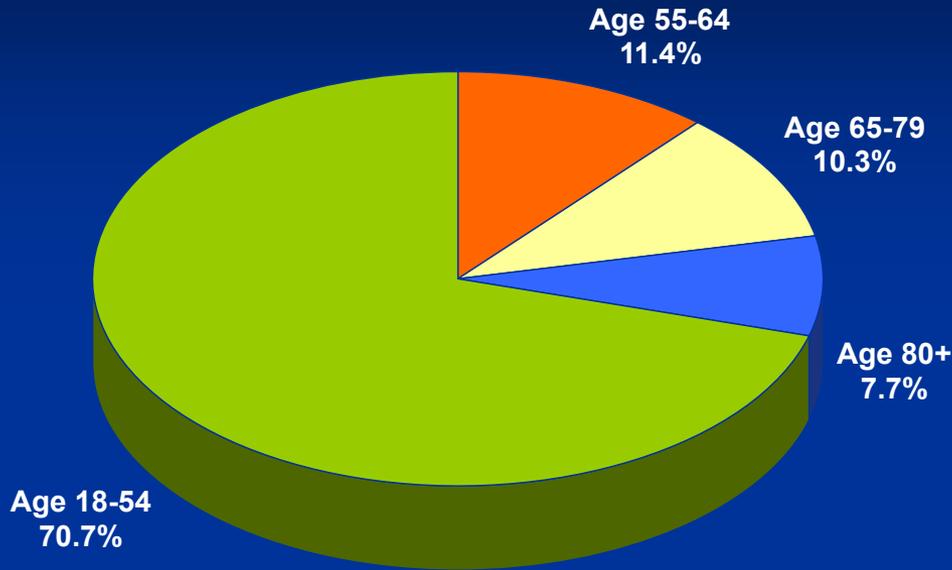
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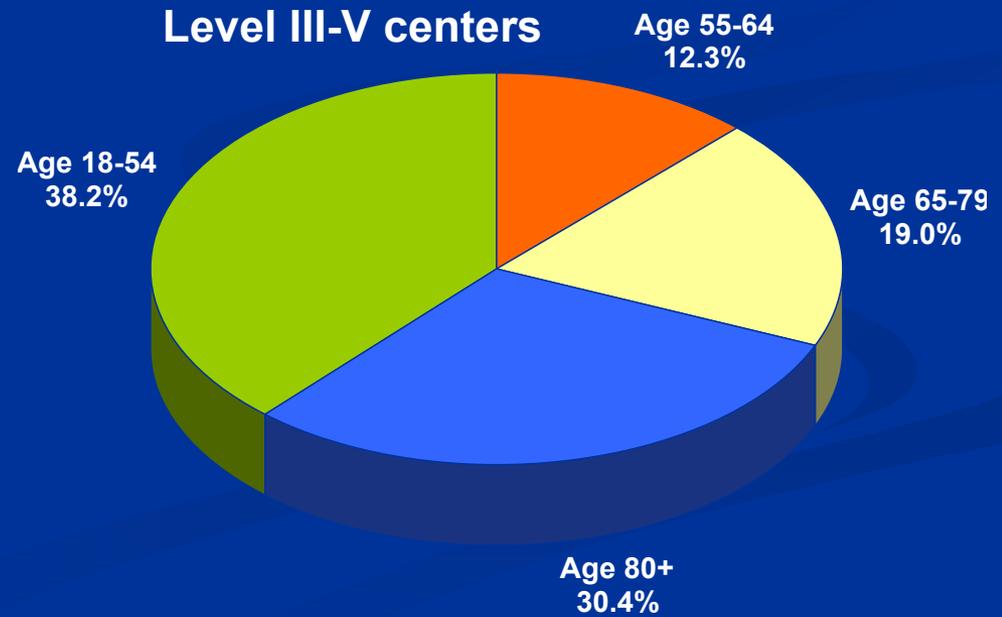
Washington State Trauma Registry



Age group distribution by Level, all years -- Central Region

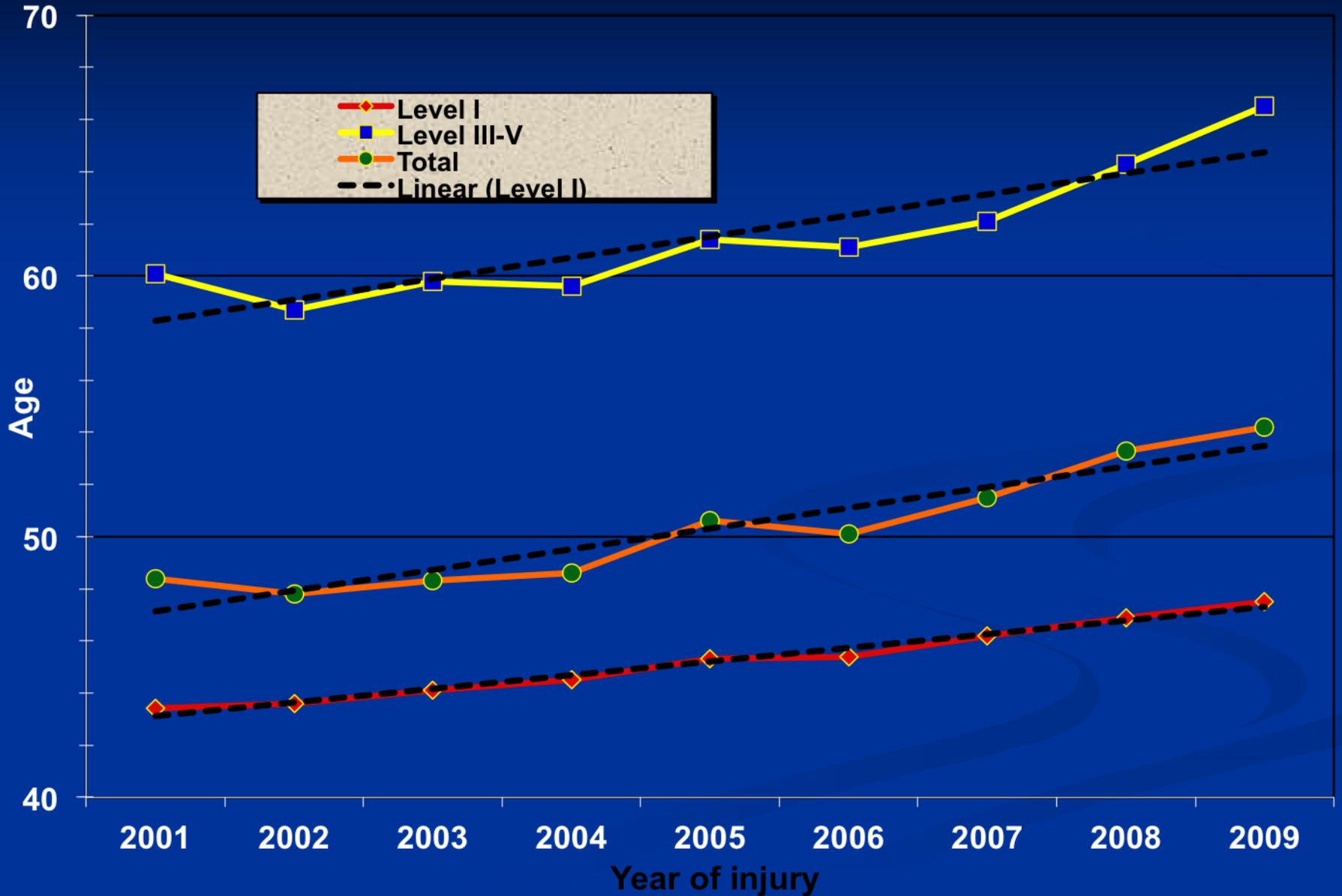


Level I center



Level III-V centers

Mean age by Level and year – Central Region



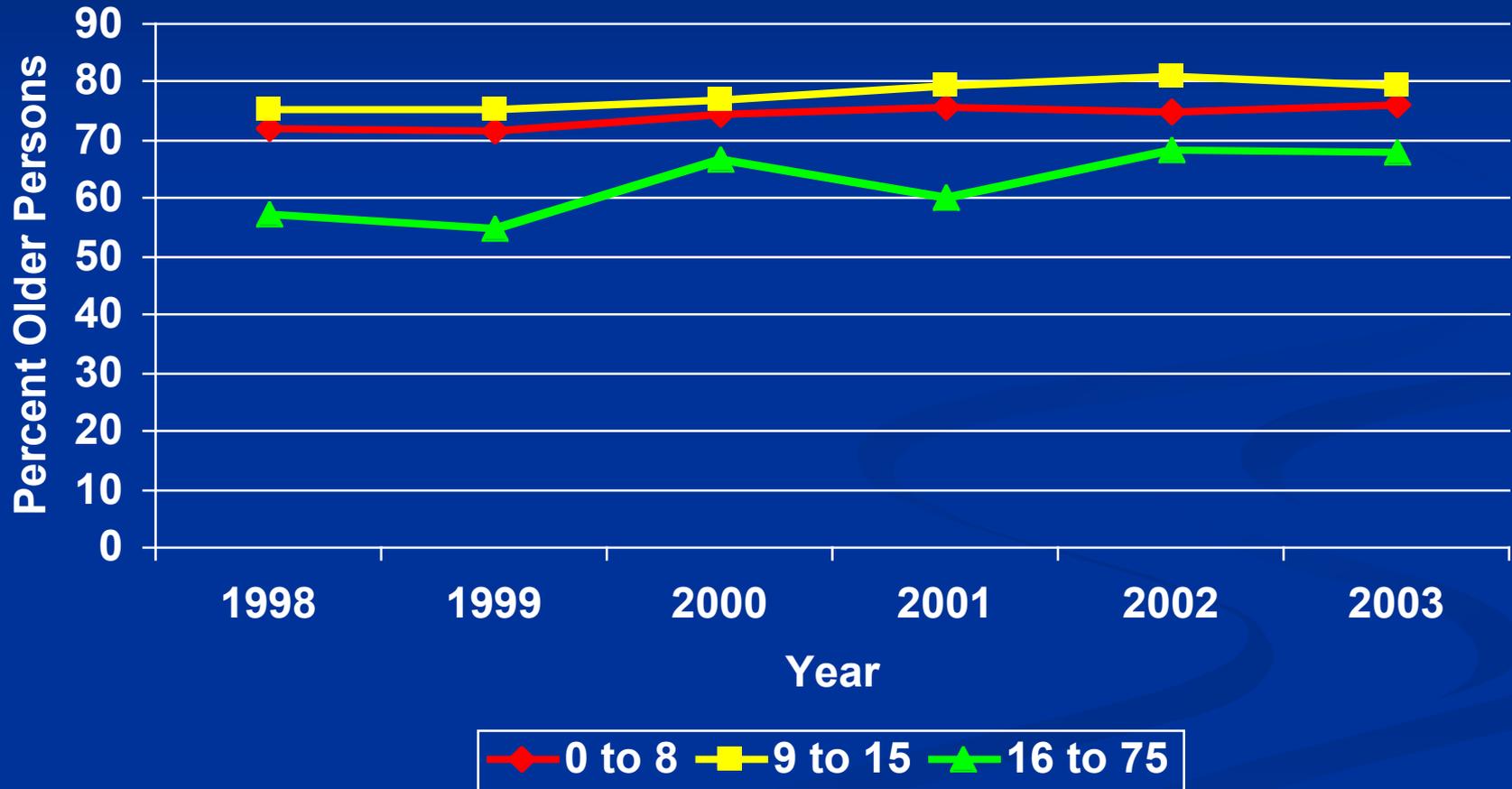
Mechanism of Injury

■ #1 Falls

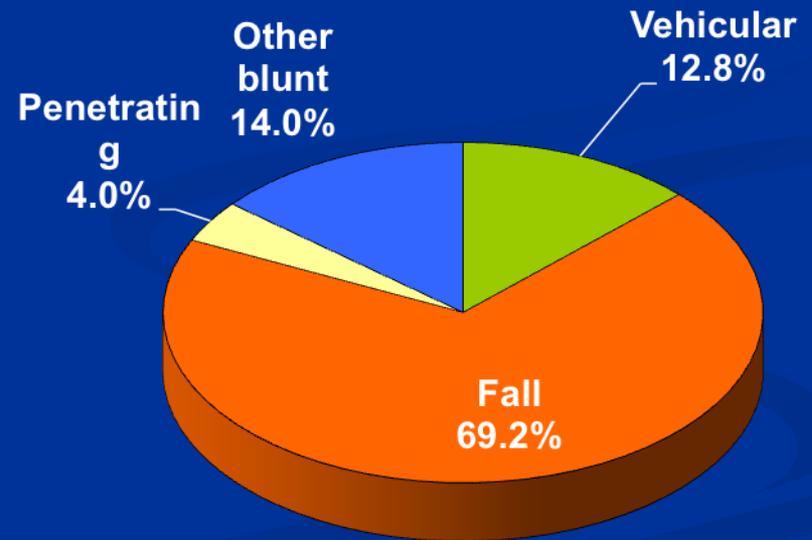
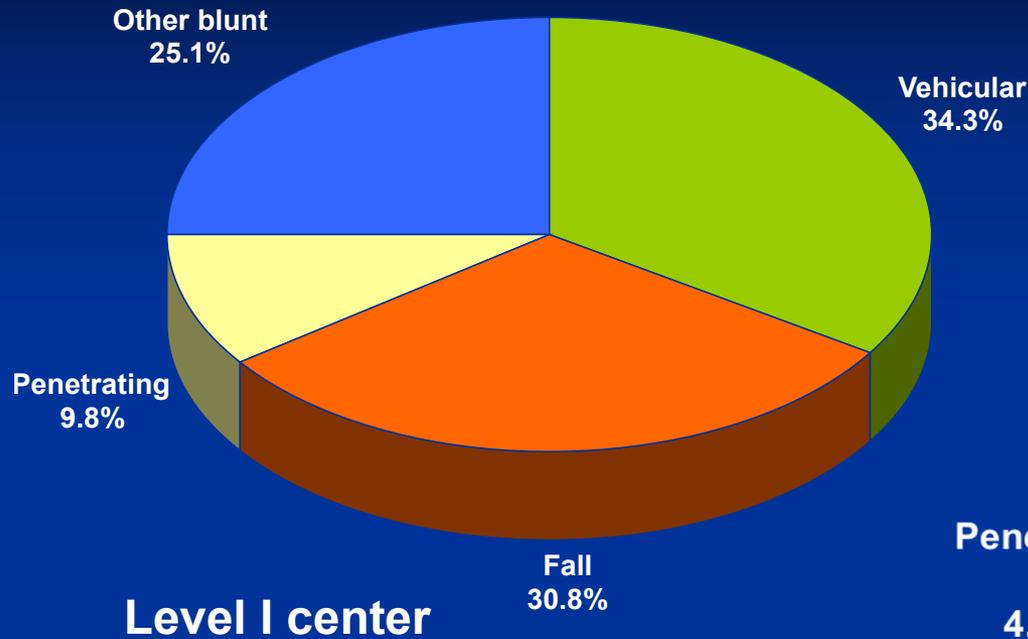
- 30-40% of those > age 65 fall at least once per year, > 50% if over age 80
- 2005:Falls > 65 y/o 15,800 deaths, 1.8 million ED visits, 433,000 hospitalized
- Increased risk of major injury with even ground level fall
 - TBI: coumadin
 - C spine fracture
 - Rib fractures
 - Hip fractures



Washington State % with Fall Mechanism by ISS



Injury mechanism distribution by Level -- Central Region



Mechanism of Injury

- #2 MVC
 - 26 million drivers over age 65 to 40 million by 2020
 - 1990-1997 14% increase in deaths and 19% increase in non-fatal injury
 - 81% daytime, 72% weekdays, 75% involve another vehicle



Mechanism of Injury

- Pedestrians
 - Higher risk than all other age groups
- Assault
 - 500,000 elder abuse victims per yr in US
- Suicide
 - 2001: 5393 Americans > age 65 committed suicide
 - 85% male, 73% used firearms
 - Risk factors: physical illness, divorced/widowed. Recent diagnosis depression



Challenges of Geriatric Trauma

- Acute resuscitation issues
- Triage issues
 - Undertriage associated with 2 fold increase in mortality!
- Specific High Risk Injury patterns

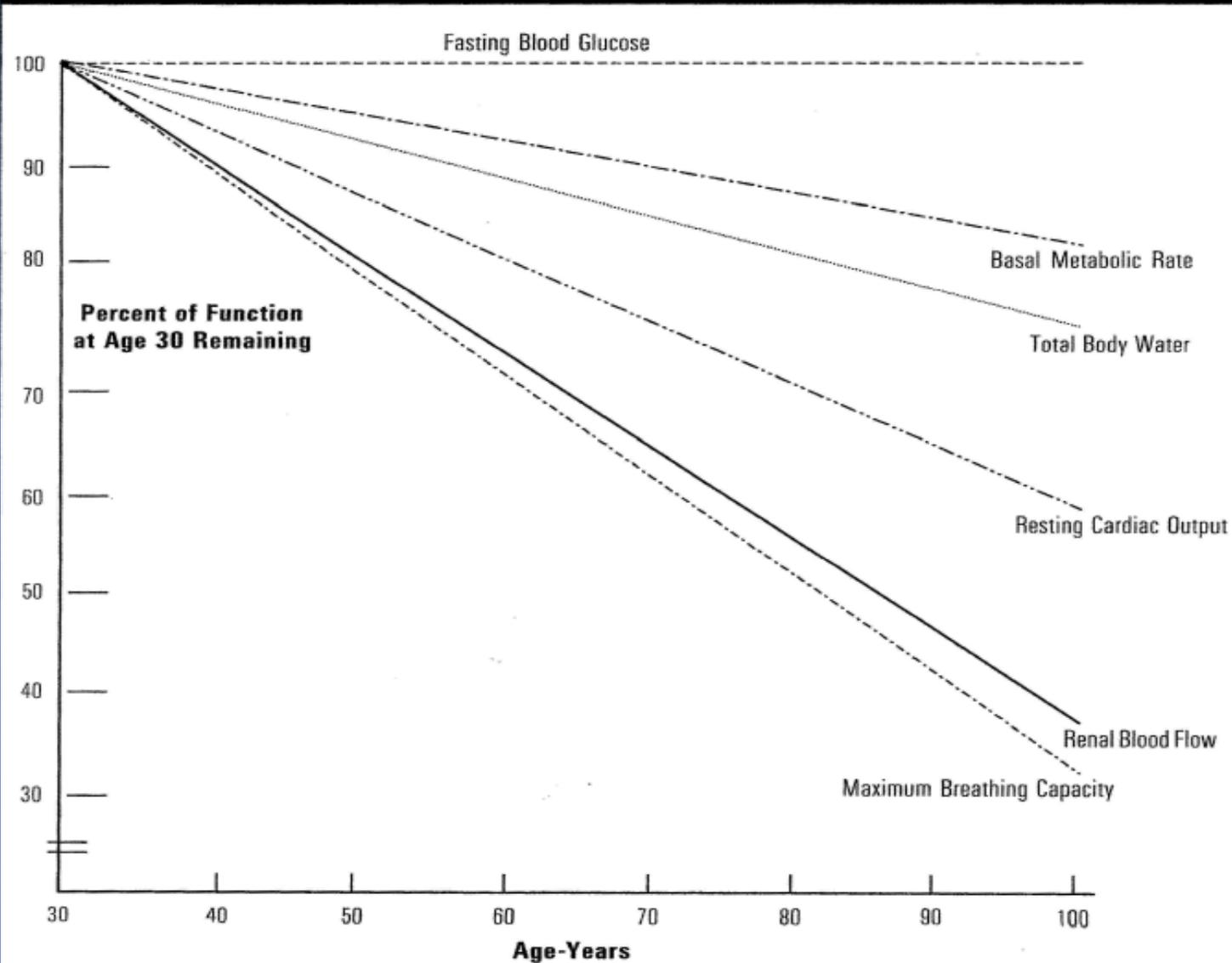


Acute Resuscitation

- Medical Co-morbidities & medications
 - COPD, CAD, CRF, Liver disease
 - Prevalence of co-morbidities
 - 6th Decade 40%
 - 7th Decade 69%
 - 9th Decade 80%
 - Coumadin, beta-blockers, diuretics
- Deceptive vital signs
 - Baseline HTN, relative hypotension
- “ Diminished Physiologic Reserve ”

“ Physiologic Reserve ”

Effects of Aging on Organ Systems



Precipitating Medical Event?

- Syncope
- Stroke
- Acute coronary syndrome
- Infection: UTI, pneumonia
- Hypovolemia/Dehydration

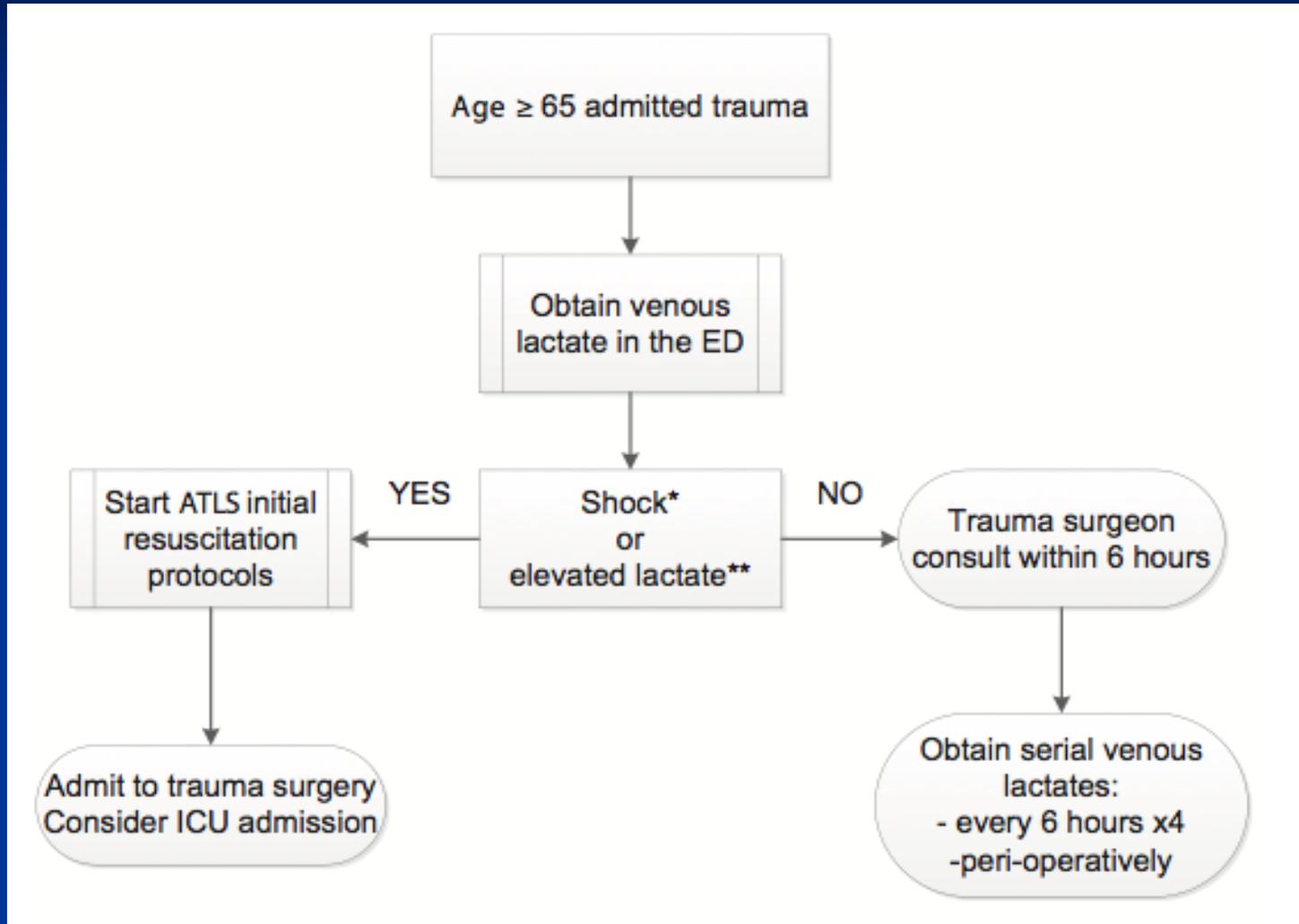


Occult Hypoperfusion

- Routine laboratory assessment
 - Assess base deficit and/or lactate (ABG)*
 - CBC, Coag screen
 - Renal function (BUN, Cr)
 - Electrolytes
 - Blood alcohol level
 - Urine toxicology screen

Evidence of metabolic acidosis suggests hypoperfusion
Rapid Assessment and ICU admission for resuscitation

Geriatric Specific Resuscitation Protocols



**Elevated Lactate ≥ 2.5

J Am Geriatr Soc 61:1358– 1364, 2013.

Does “ Aggressive” Resuscitation Improve Outcome?

- Shultz et al, 1985
 - Invasive monitoring for hip fracture patients associated with reduced mortality (2.9% vs 29%)
- Scalea et al, 1990
 - Reduced mortality compared to historical controls with early invasive monitoring and targeted resuscitation.
- Demetriades et al, 2002
 - Institution of protocol for trauma team activation and early invasive monitoring for pts over age 70 yrs
 - Pre-protocol mortality 54%, post-protocol 34%

Triage Issues

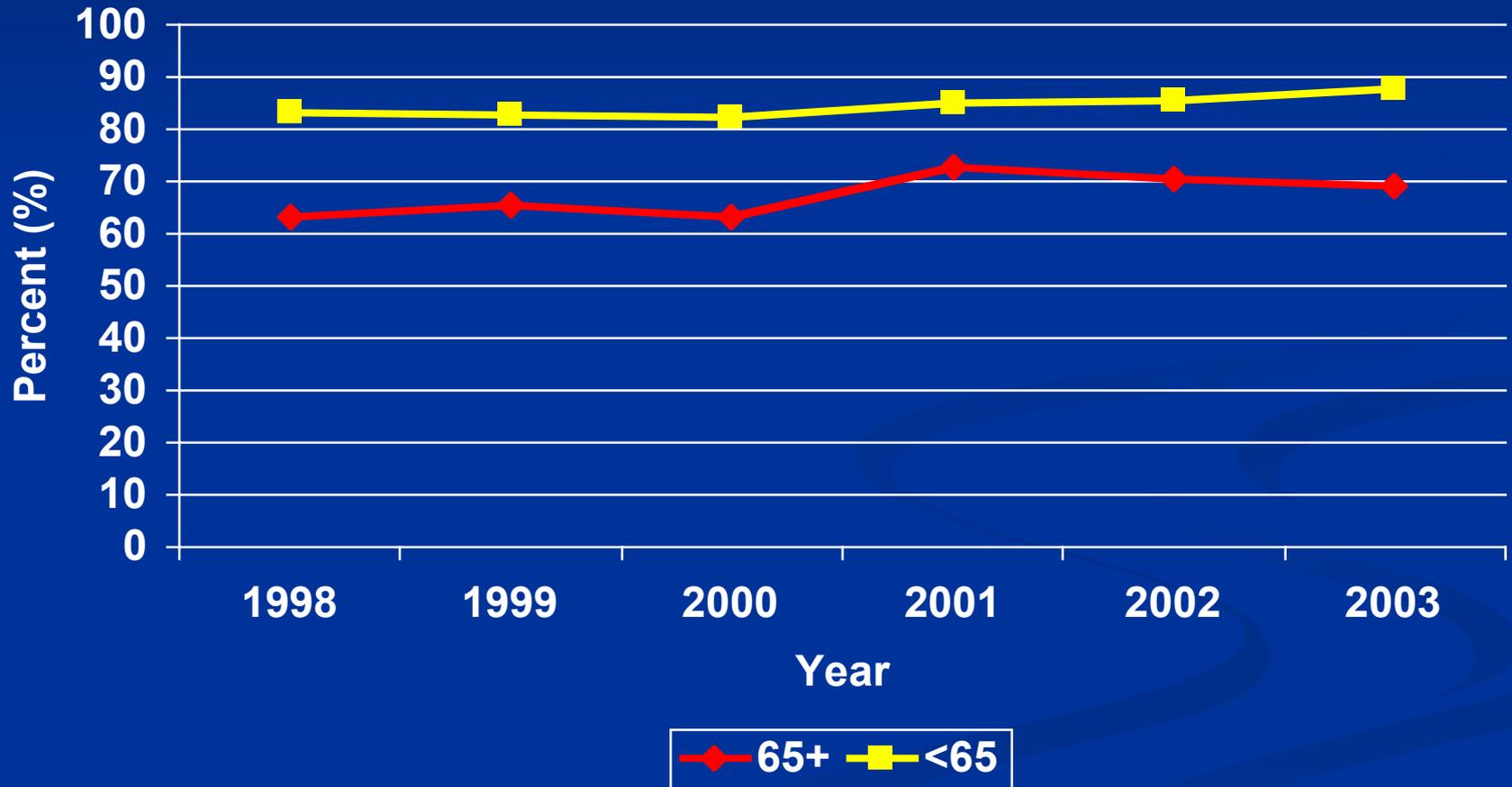
- Prehospital
 - 1997: Pennsylvania
 - Only 36.6% of elderly patients with ISS > 15 received trauma center care
 - 2013: Western US
 - 30% undertriage rate ISS > 15
- Trauma Team Activation
 - Demetriades et al, 2001
 - For Age > 70 yrs: 63% w/ ISS > 15 and 25% w/ ISS > 30 did not meet standard HD criteria for TTA



Geriatric revisions to Field Triage Criteria?

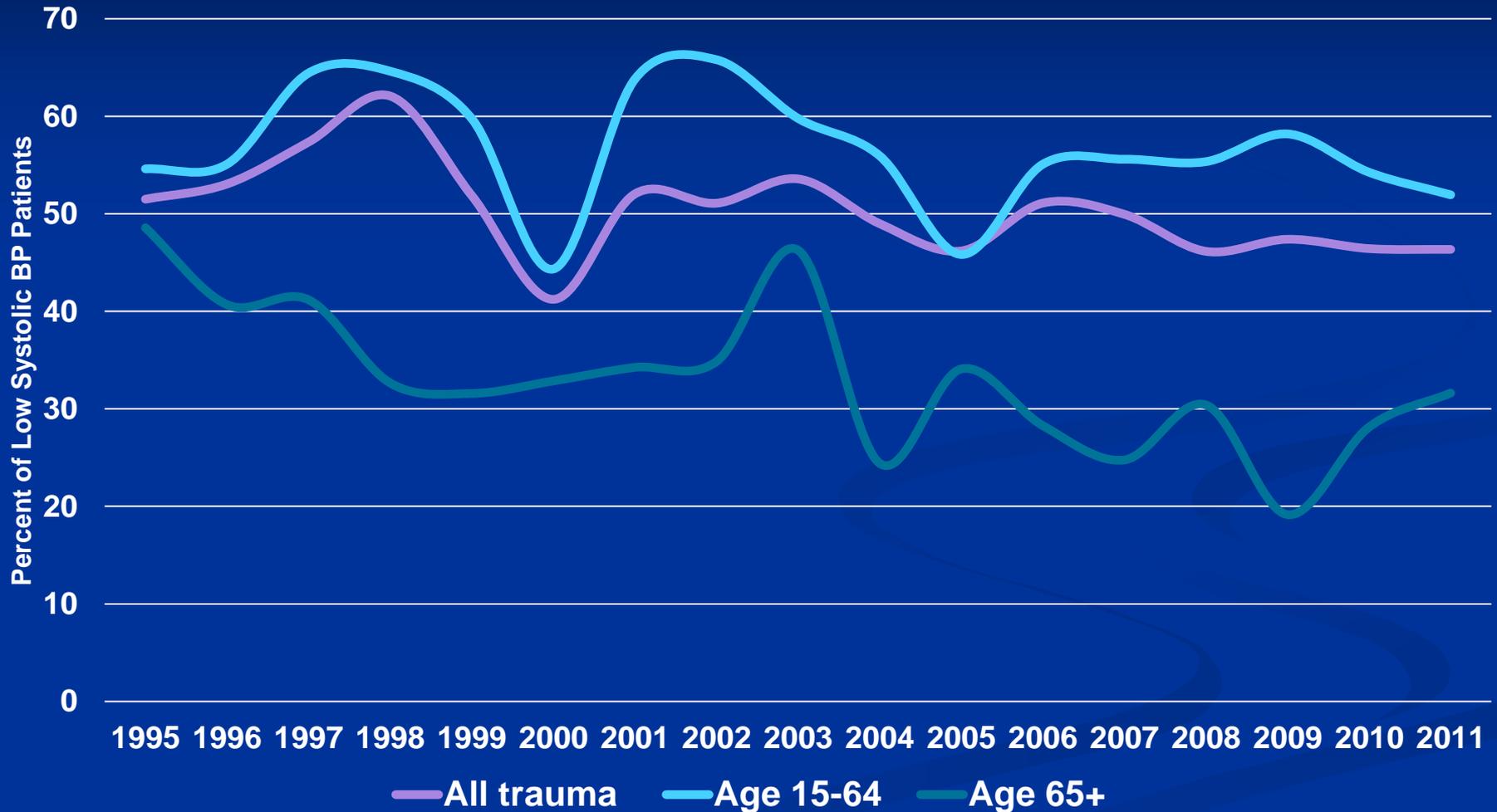
- Newgard et al: Study of 44,890 older, injured adults triaged by EMS
 - 5.6% ISS \geq 16
 - Revised physiologic criteria
 - GCS \leq 14
 - RR < 10 or > 24 or assisted ventilation
 - SBP < 110 or > 200 mmHg
 - Increase triage sensitivity from 78.6% to 86.3%
 - Reduce specificity 75% to 61%

Definitive Care for Major Trauma at a Level I or II Hospital (WA State)



Trauma Team Activation by Age

Hypotensive patients: Washington State



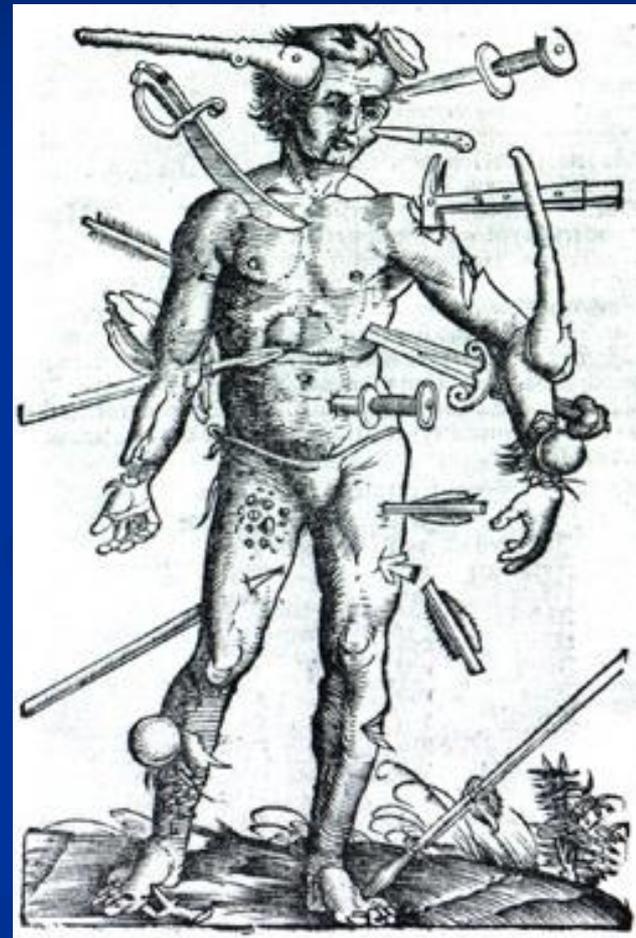
ED LOS also prolonged for elderly patients

Summary Elderly Triage Issues

- Under-triage of elderly to Level I/II trauma centers is common
- Need to explore reasons for under-triage
- Consider revised criteria for trauma team activation specific to the elderly
- Need to focus high index of suspicion on elderly trauma patients and work to reduce ED times

High Risk Injury Patterns

- Traumatic Brain Injury
- Chest wall trauma/Rib fractures
- Spleen injury
- Pelvic fracture
- C-spine injury



Traumatic Brain Injury

- High rate of injury with minor mechanism (Fall from standing)
- Mack et al 2003:
 - Elderly w/ GCS 13-15
 - 14% Injury identified on CT
 - 20% of these required intervention
- Cohen et al 2006
 - On coumadin
 - GCS < 8, mean INR 6, Mortality 92%
 - GCS 13-15, INR 4.4, Mortality 81%



TBI on Coumadin

- Blunt head trauma with minimal symptoms: ICH 7-14%
- Coumadin is an independent predictor of mortality (5-10 fold increase)
- Elderly more likely to present with supratherapeutic INR

Mortality for TBI on Coumadin

- Mortality varies based on neurologic status of patient
- Swedish multicenter study: 30 day mortality rates
 - Unconscious on admission: 96%
 - Unconscious before start of reversal therapy: 80%
 - Treatment with reversal therapy while still conscious: 28%

Does rapid correction of coagulopathy improve outcome?

- Ivascu et al, J Trauma 59:1113, 2005
 - ICH patients on coumadin 48% mortality vs 10% for those not on coumadin
 - 40% of patients on coumadin had progression of bleed despite reversal of anticoagulation (65% mortality)
 - “Coumadin protocol”: immediate triage and MD eval, urgent head CT & administration of FFP
 - Time to CT reduced from 120 to 60 min
 - Time to initial FFP reduced from 4.3 hrs to 1.7 hrs
 - No progression of bleed in protocol pts
 - 9% mortality in protocol patients (48% pre-protocol)

Prothrombin Concentrate Complex

- 4 factor complex: II, VII, IX, X (KCentra)
- 3 factor complex: II, IX, X (Bebulin)
 - Lacks factor VII so still need to give some plasma
- Advantages
 - Long shelf life, Immediately available
 - Small volume (40-120cc), Infusion 5-15 min
 - Viral inactivation

Head Injury in Anticoagulated Patients

Patient at risk for TBI:

Blunt trauma (including ground level fall) w/ any loss of consciousness, any mental status changes, h/o direct impact to head or neck, any signs of external injury head/neck

ED Triage:

Screen for anticoagulant use, if positive:
Rapid triage to treatment area

Emergent order for Head CT

Emergent evaluation by ED physician

Stat coagulation screen and Type and Screen (w/in 10 min of arrival)

Order 2 units FFP from blood bank

If CT confirms intracranial hemorrhage:

Give 10mg Vitamin K IV over 15-30min

If INR > 1.5 Administer 2 units FFP and order 2 more units

If INR > 2.0 Consider PCC, Dose 25U/kg for INR 2-4; 40-50U/kg INR > 4 (max 200IU/min)

Initiate Neurosurgical Consult or Transfer

What about other agents?

- Anti-platelet agents: NSAIDS, ASA, Plavix
 - ASA: Non-reversible inhibition of platelet aggregation
 - Plavix: Takes 5 days after cessation to restore normal bleeding time
 - Data is mixed: 4 studies noted increased hemorrhage, increased rates of craniotomy, impact on mortality less clear
 - Treatment options: Platelet transfusion, DDAVP, some reports of Facto VIIa

The Newer Drugs

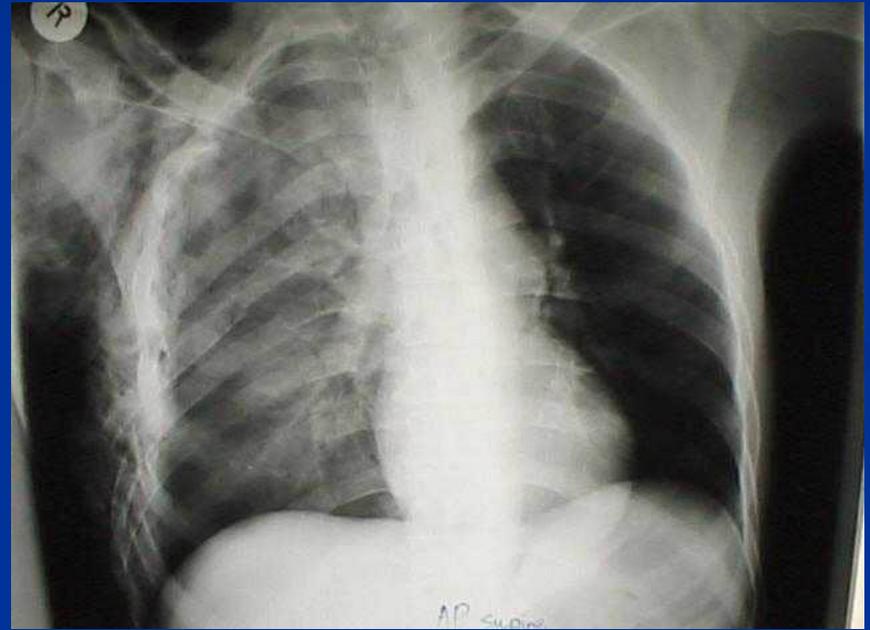
- Pradaxa (Dabagatran)
 - Direct thrombin inhibitor, Half life 12-17 hrs
 - RE-LY study: 34% relative risk reduction for stroke compared to warfarin
 - No monitoring required
 - INR may be only minimally increased, PTT prolonged
 - NO ANTIDOTE!
 - Only option is dialysis, removal of 60% over 2-3 hours
 - Can try PCC of Factor VIIa but no clinical data, consider tranexamic acid bolus
 - More are coming

Rivaroxiban

- Factor Xa Inhibitor, Half life 8-15hrs
- INR will be increased at therapeutic levels but correlation not the same as coumadin
- No reversal agent
- Some animal studies suggest partial reversal with PCC

Rib Fractures in the Elderly

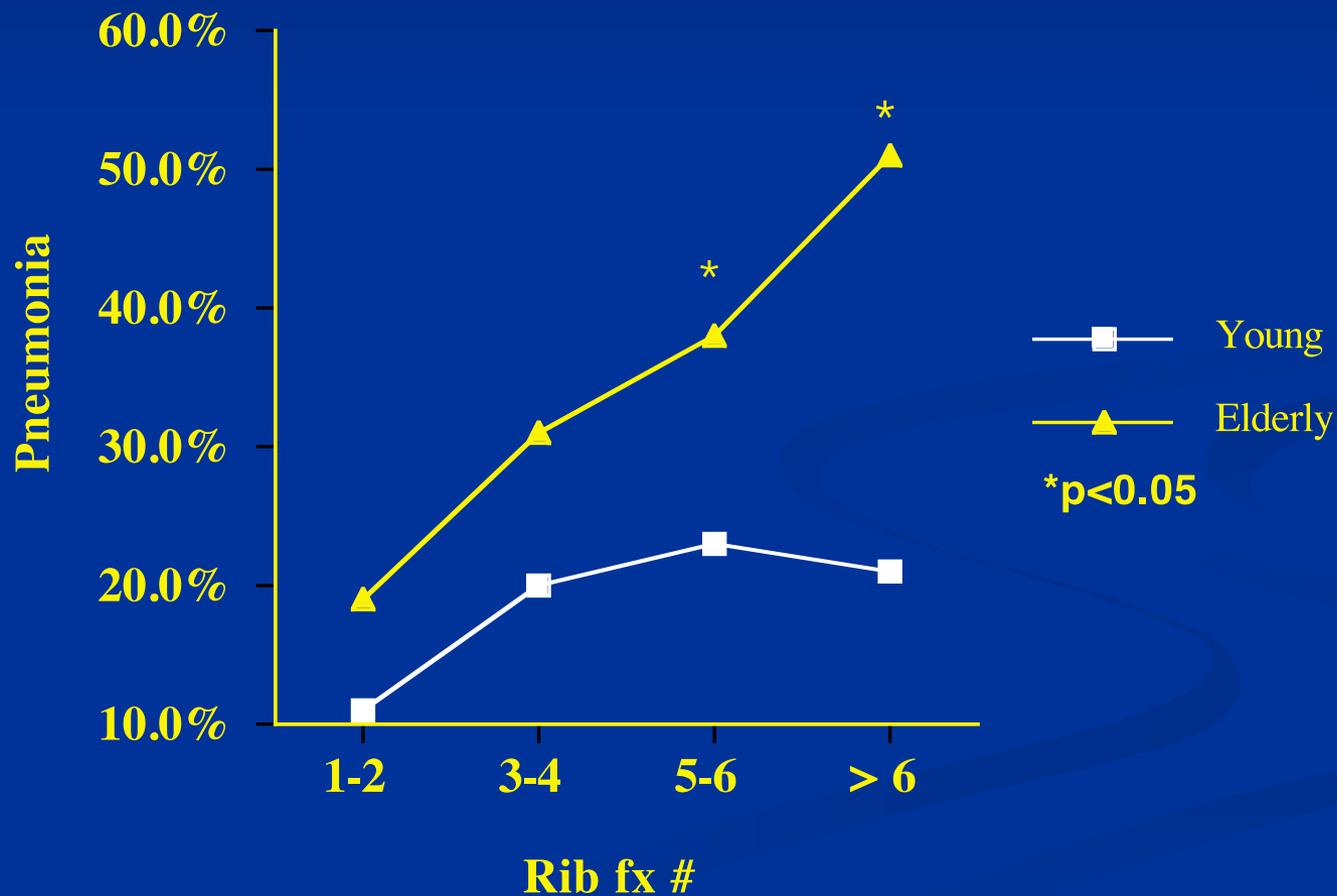
- Common Injury
- ≥ 3 rib fractures*
 - Increased mortality
 - Increased ICU stay
- Elderly patients:
 - 31% pneumonia rate**
- Treatment Focus
 - Pain Management
 - Clearance of respiratory secretions



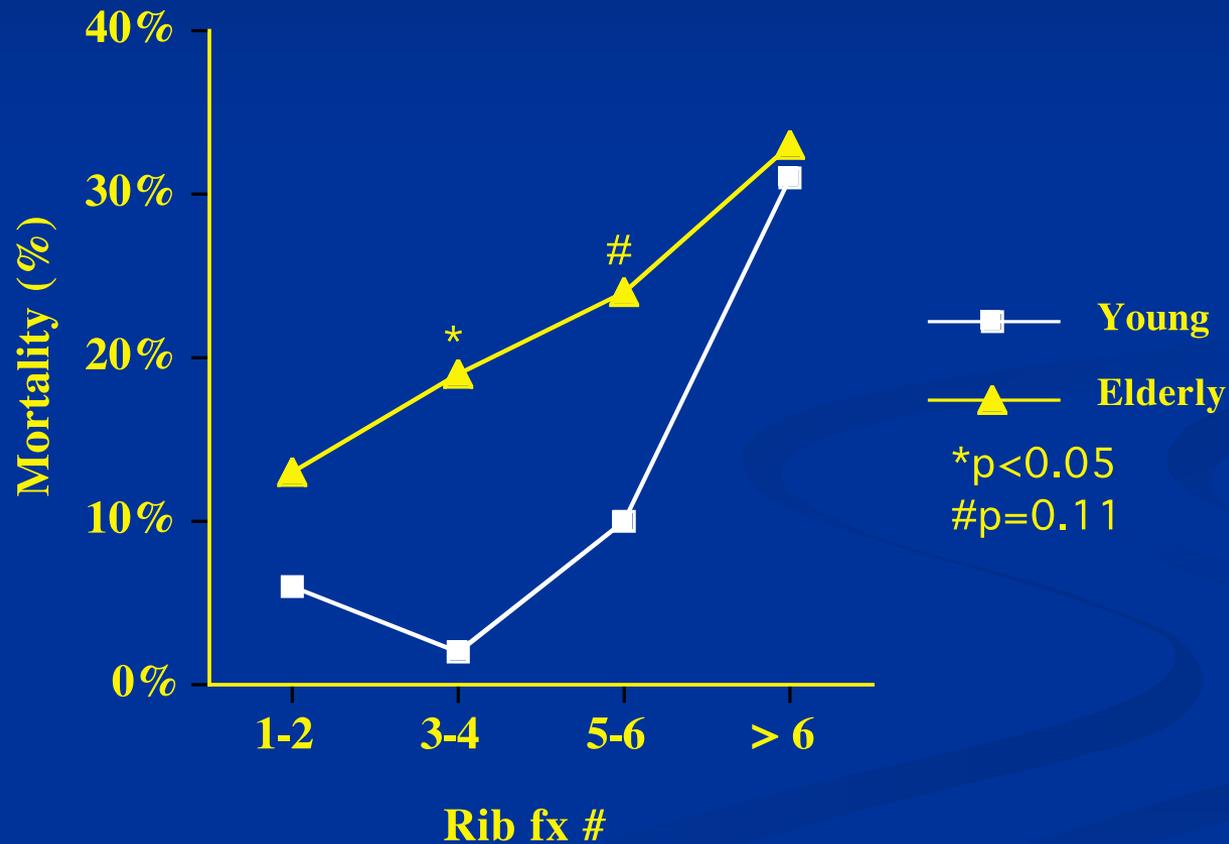
*Lee et al, J Trauma 1990

**Bulger et al, J Trauma 2000

Relationship of Pneumonia to Rib Fracture Number



Relationship of Mortality & Rib Fracture Number



What is the best pain management strategy?

- Mackersie et al, J Trauma 1991
 - Randomized comparison of epidural vs IV fentanyl
 - Improved pain scores and PFTs, no cases of nosocomial pneumonia in either group
- Wu et al, J Trauma 1999
 - Retrospective comparison of epidural vs PCA
 - Better pain scores in epidural group, no difference in pulmonary complications but significant selection bias
- Moon et al, Ann Surg 1999
 - Randomized comparison epidural vs PCA
 - Better pain scores & PFTs in epidural group

HMC study 2004

- Prospective, randomized study comparing IV narcotics to epidural catheter for pain management after multiple rib fractures

	OR/IRR	95% CI	P
Pneumonia*	OR 6.0	1.0-35	0.05
Ventilator Days**	IRR 2.0	1.62-2.55	<0.001

*Adjusted for: pulmonary contusion, flail segment, chest tube and Apache II

**Stratified for Pulmonary Contusion

Bulger et al, Surgery 2004

Treatment Plan for Elderly w/ Rib Fractures

- Consider ICU admission even in the absence of associated injuries
- Aggressive pulmonary therapy by bedside nurse and respiratory therapist
- Pain management by a dedicated team
 - Avoid benzodiazepines
- Early consideration for epidural placement to optimize pain control
- Development of Rib fracture management pathway

Rib Fracture Management Pathway

Inclusion criteria:

- Extubated or recently extubated
- GCS 13-15
- ≥14 years of age
- + Rib & Sternal fracture/s
- Absence of high spinal cord injury

- * Patient & Family Handout
- ** PIC Scoring Tool
- *** Bronchiole Hygiene Protocol
- **** APS Guidelines for Systemic Analgesia and Neuraxial Catheters

ACUTE CARE

(≥ 65 years and 3+ rib fractures)

ICU

Nursing:

- Notify Respiratory of patient admission
- Elevate HOB 30 degrees if not contraindicated
- Instruct patient and family on **PIC** scoring methods and rationale
 - Proper IS method and C&DB method
- *Give patient and family educational handout
- Place **PIC** scoring board in visible place in room
- Note goal (**80% of expected VC**) and alert levels (**15ml/kg or 1500ml max**) on board
- Routine clinical care
 - Chart PIC score, IS levels, & pain Q4hr in ORCA WA
 - Cough and Deep Breath (DB) 1hr WA
 - Mobilize as soon as possible
 - Incorporate reporting of PIC score and goals in daily team rounds
 - Record PIC score Q4hr on PIC score board
- **Notify provider & RT when total PIC score ≤ 4 and/or a score of 1 point in any category after intervention(s)

Respiratory Therapy:

- RT to assess patient within 6 hrs. of admission
- Measure initial IS volumes after pain control achieved
- Set goal (**80% of expected VC**) and alert levels (**15ml/kg or 1500ml max**)
- Routine clinical care
 - IS monitoring Q6hr & prn
 - Incorporate reporting of PIC score and goals in daily team rounds
- **Notify provider & RN when total PIC score ≤ 4 and/or a score of 1 point in any category after intervention(s)

Provider On admission order:

- IS, C&DB Q1hr & WA
- Nursing communication in power plan- Rib Fracture Management Pathway ordered. Document PIC score, pain & IS levels Q4hr in ORCA & on PIC score board.
- If possible, minimize IVFs.
- ***BHP protocol
- Mobilization at least T1D
- HOB at least 30 degrees if not contraindicated
- Notify provider if total PIC score is ≤ 4 and/or 1 point in any category after intervention(s)
- Pain medication plan ****See APS Guidelines
- Other:
 - Incorporate reporting of PIC score and goals in daily team rounds

Provider

On admission order:

- IS, C&DB Q1 hr. & WA
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- Pain medication plan ****See APS Guidelines
- Other:
 - Incorporate reporting of PIC score and goals in daily team rounds
 - ***Order BHP protocol on all patients transferring to acute care.

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****APS GUIDELINES

- PIC score ≤ 4 total and/or 1 in any category?
- Is it pain that limits the patient's recovery?

Consider Multimodal Systemic Analgesia per APS recommendations- >SEE PAGE 2

PIC Score

1 2 3 4 5 6 7 8 9 10

Pain

IS

Cough

Controlled 3



Moderate 2



Severe 1



Strong 3

Weak 2

Absent 1

Patient _____ Date & Time _____

Standardization of Pain Service Recommendations

Acute Pain Management Guidelines for Chest Trauma Patients

PROTOCOL PURPOSE: Appropriate pain management for chest trauma patients, enhanced recovery, disease prevention



Acute Pain Management Guideline for Chest Trauma Patients

PRIMARY TEAM to initiate: MULTIMODAL SYSTEMIC ANALGESIA

1. Home pain regimen restarted (psychoactive medications and long acting opioids)
2. Acetaminophen 1000mg Q6h PO/iv if NPO (lower for geriatric patients and with extreme liver impairment)
3. Gabapentin 300mg PO Q8h, renal and age appropriate dose adjustment as needed
4. Toradol 7,5-15mg iv Q6h or Celecoxib 200mg PO bid
5. PCA or PO opioid started, and titrated up to effect or side effects

Patient & Family Brochure

UW Medicine
HARBORVIEW
MEDICAL CENTER

Rib Fractures

What you should know

This handout explains what to expect after a rib fracture.

What is a rib fracture?

A rib fracture is a crack or break in one of the bones that protect your upper body. A break in the thick tissue (*cartilage*) that connects the ribs to the breastbone may also be called a *fractured rib*, even if the bone itself is not broken. The most common cause of a fractured rib is a direct blow to the chest, often from a car accident or a fall.

Coughing and Deep Breathing

While your fracture is healing, it is important to cough or take the deepest breath you can at least once an hour. Doing this keeps your lungs open and clear. Coughing and deep breathing can help prevent pneumonia or a partial collapse of the lung.

Nurses and other members of your healthcare team will measure how deeply you can breathe. This is done using a device called an *incentive spirometer* (IS). The respiratory therapist will use your age and height to set your IS goal and your IS alert level.

My IS goal is: _____

Your healthcare team will help you breathe deeply, cough, and be as active as possible after your injury. They will also determine your "PIC" score.

What is a PIC score?

Your PIC score is based on your pain level and how well you are coughing and deep breathing:

- **P** = How much **pain** do you have?
- **I** = How deeply can you breathe using your **incentive spirometer** (IS)?
- **C** = How strongly can you **cough**?

My IS alert level is: _____



Talk with your healthcare provider if you have any questions about your rib fracture or recovery.



Your nurse will show you how to use the incentive spirometer to exercise your lungs.

Your PIC score will be between 3 and 10. As your score goes higher, it means you are improving.

Pain Control

Rib fractures can be very painful. Nurses will ask you to rate your pain on a scale from 0 to 10, with 0 being no pain and 10 being a lot of pain.

Your doctors will order medicine to help with your pain. Pain medicine may be in the form of liquid or pills that you take by mouth, or it may be given through an intravenous (IV) tube or other tubes. You will receive more information about pain control.

How to Use the IS

- Sit on the edge of your bed if you can, or sit up as far as you can in bed.
- Hold the IS in an upright position.
- Place the mouthpiece in your mouth and **seal your lips tightly around it**.
- **Breathe in slowly** and as deeply as possible. The yellow indicator disk should reach the blue outlined area.
- **Hold your breath as long as possible**. Then exhale slowly and allow the disk to fall to the bottom of the column.
- Rest for a few seconds. Repeat these steps at least 10 times every hour.

After you use the IS, position the yellow indicator tab on the left side of the device to show your best effort. Use the yellow tab as a goal to work toward during each slow deep breath.

One of the best times to cough is after you have done 10 deep breaths with your IS. After each set of 10 deep breaths, cough to be sure your lungs are clear. If you have an incision, place a pillow firmly against your incision to support it when you cough.

Activity

Being out of bed and walking is very important for your recovery. When your doctor says it is OK, your nurses and therapists will help you to get out of bed.

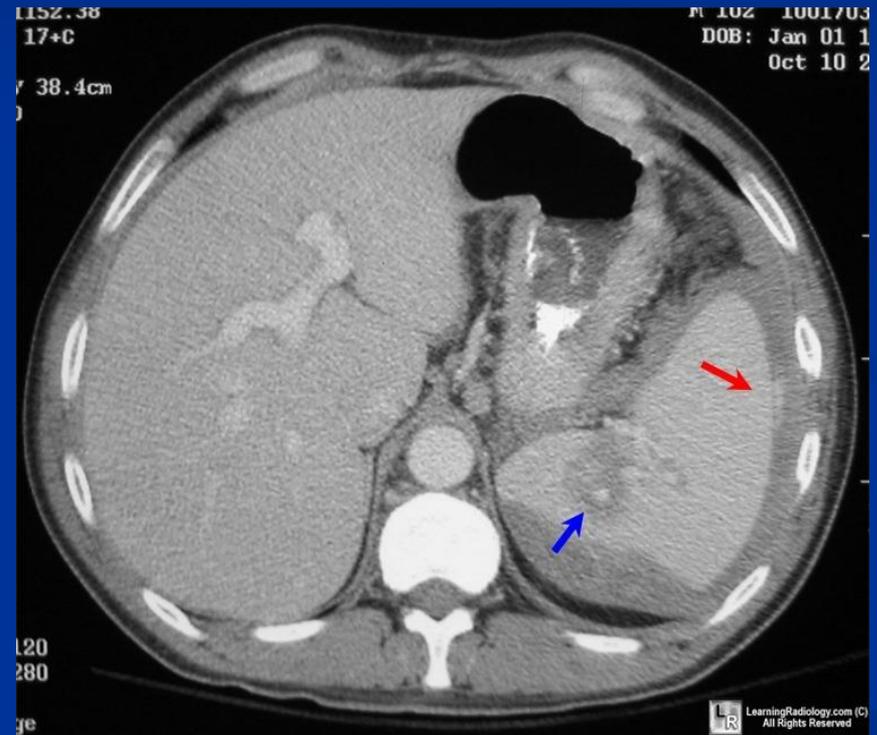
If you have any questions, please ask your nurse, doctor, or respiratory therapist.

Questions?

Your questions are important. Talk with your nurse or other care provider if you have questions or concerns.

Spleen Injury

- Early studies suggested higher failure rates for non-operative management Age > 55 years
- 3 studies after 2000 report comparable success rates with non-op management between young and old.
- Age should not be used as a criteria to deny patients a non-operative approach



Pelvic Fracture

- Mortality 3-5 times higher for patients over age 55
- Greater frequency of lateral compression injuries
- Higher rates of arterial hemorrhage
- Lower threshold for angiography



Henry et al, J Trauma 2002

Does Geriatric Focused Care improve outcome after Hip Fracture?

- Vidan et al, 2005, RCT of a Comprehensive Geriatric Intervention
 - Geriatric team: geriatrician, rehab specialist, social work specialist, initial evaluation, geriatrician responsible for medical care, structured PT, regular team meetings
 - N=319 patients, Age > 65, emergent hip fracture surgery
 - In-hospital mortality (5.8% vs 0.6%)
 - Major medical complication rate (62% vs 45%), LOS reduced 2 days
 - Adjusted analysis geriatric intervention associated with a 45% lower probability of death or major complication

Comprehensive Geriatric Assessment

- less likely to be institutionalized (OR 0.79, 95% CI 0.69 to 0.88, $P < 0.0001$)
- more likely to be “living at home” at 6 months (OR 1.25, 95% CI 1.11 to 1.42; $P = 0.000$)
- less likely to suffer death or deterioration (OR 0.76, 95% CI 0.64 to 0.90; $P = 0.001$)
- more likely to experience improved cognitive function (OR 1.11, 95% CI 0.20 to 2.01 ($P = 0.02$))

Cervical Spine Injury in the Elderly

- Common at C1/2 level, often involves more than one level, often unstable
- Ground level falls associated with upper C-spine injuries
- NEXUS criteria equally sensitive but not per Canadian C-spine criteria
- CT C spine is preferred imaging for elderly patients



HMC protocol: CT C spine for all patients ≥ 65 yrs

Summary Injury Patterns

- Traumatic Brain Injury
 - Low threshold for CT, rapid reversal of anticoagulation
- Chest wall trauma/Rib fractures
 - ICU admission, consider early epidural catheter, develop a care pathway
- Spleen injury
 - Non-operative management similar to younger pts
- Pelvic fracture
 - Anticipate need for angiography, consider multidisciplinary care plan
- C-spine injury
 - High Index of suspicion with minor mech, Image if Age >65, CT preferred imaging modality

Geriatric Trauma: Opportunities

- Factor age into triage, transfer and trauma team activation decisions
- Consider rapid evaluation and ICU admission to focus resuscitation efforts, explore new methods of assessing cardiac index and evaluation of occult hypoperfusion
- Develop geriatric care protocols to address common injuries
 - <http://www.doh.wa.gov/hsqa/emstrauma/traumaguidelines.htm>
 - https://mtqip.org/docs/Geriatric_Guide_TQIP_20130109.pdf

Geriatric Trauma: Opportunities

- Develop multidisciplinary care teams for geriatric trauma patients
 - Comprehensive Geriatric Assessments
- Expand rehab opportunities for geriatric patients with focus on long term independence
- Develop injury prevention programs targeted at the geriatric population, start screening in ED

THANKS

