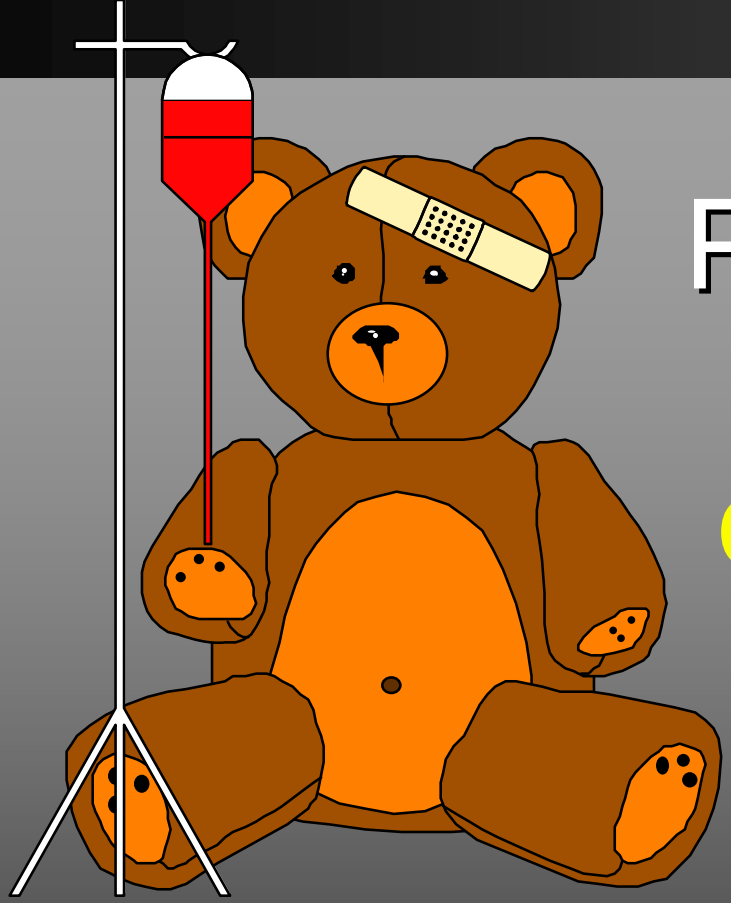


Prehospital Pediatric Trauma Care

Controversies in Care

William E. Hauda, II, MD

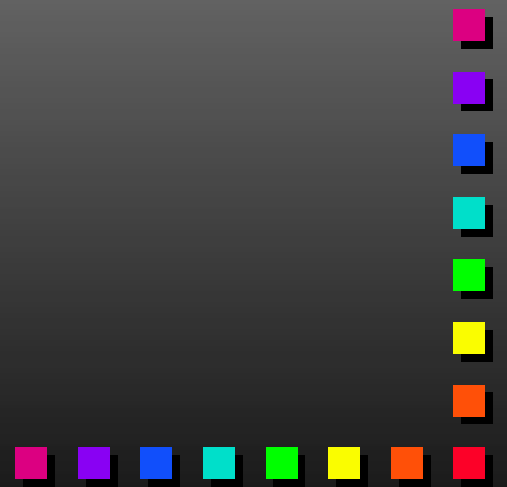
Prehospital Pediatric Trauma

- Spinal immobilization selection criteria
- Prehospital airway management intubation or not?
- Criteria for transport to a pediatric trauma center

Injuries

are not

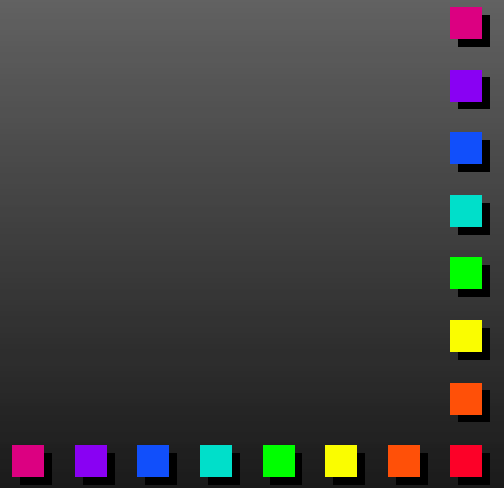
Accidents



Injuries in Children

- **Half the children who die in the U.S. die from the effects of injuries**
- For every 1 injury related death
  - 42 hospitalizations
  - 1120 ED visits
- **Around eighth month of life, injuries exceed all other causes of death.** It remains so until the 5th decade of life.

Selective Spinal Immobilization

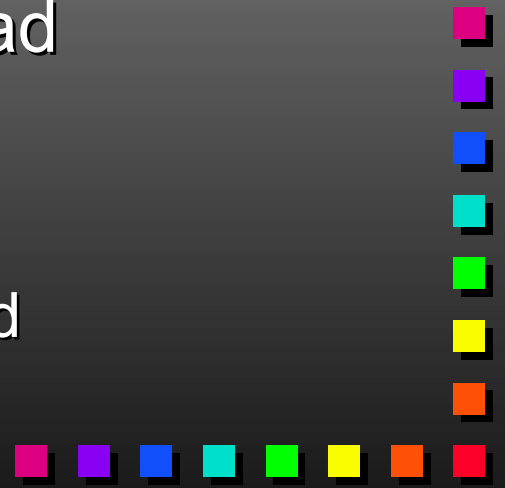


Spinal Immobilization

- Techniques are taught to EMTs
- Teaching began in the 1970's
- Based upon the principle to prevent further injury by limiting spinal movement
- Decline in patients presenting with spinal cord injury from 1972 – 1986

Spinal Immobilization

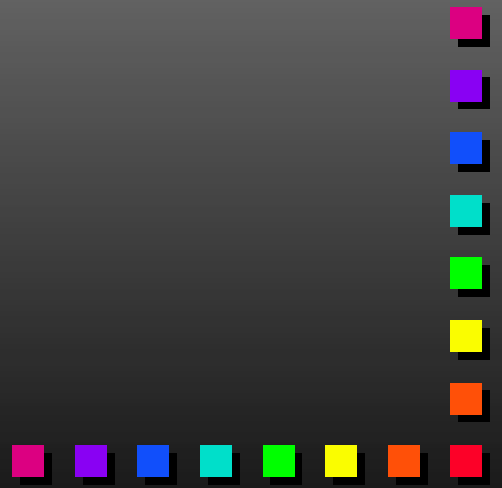
- Technique
  - Log-rolling the patient
  - Hard cervical collar
  - Long board
  - Restraint devices for body and head
  - Requires 3 or more providers
    - 1 – head, 2 or more – body and board



Challenges

- Requires multiple providers
- Requires time
- Increased risk for airway compromise
- Patient discomfort
- Equipment may not fit pediatric patients

There is a huge lack of clinical data to support this practice!



Selective Spinal Immobilization

- May decrease the use of spinal immobilization by 40%
- Spinal injury is rare
  - Only 1.6% of children admitted to trauma centers have spinal injury
  - Most studies have few persons with spinal injury
- Unknown danger in withholding spinal immobilization

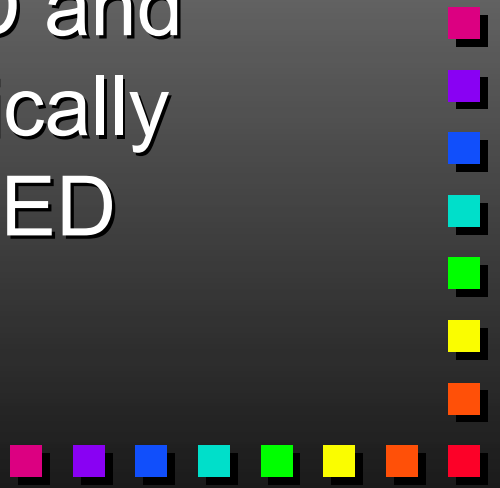
Cochrane Review

- Kwan, Bunn, and Roberts 2001

  "We did not find any randomised controlled trials that met the inclusion criteria. The effect of spinal immobilisation on mortality, neurological injury, spinal stability and adverse effects in trauma patients remains uncertain. Because airway obstruction is a major cause of preventable death in trauma patients, and spinal immobilisation, particularly of the cervical spine, can contribute to airway compromise, the possibility that immobilisation may increase mortality and morbidity cannot be excluded."

How do we decided who gets immobilized?

Most criteria come from how ED and trauma surgeons decide to clinically clear the cervical spine in the ED



If they don't need an x-ray then they shouldn't be immobilized

Corollary: Just because they were immobilized doesn't mean they have to get an x-ray

NEXUS and Canadian Rules

- National Emergency X-Radiography Utilization Study
  - Only 2.5% were children 8 years or younger
  - Absence of all of the following
    - Midline posterior cervical spine tenderness
    - Focal neurological deficit
    - Altered level of consciousness
    - Intoxication
    - Painful distracting injury

NEXUS and Canadian Rules

- Canadian Cervical Spine Rule *Not designed for children*
  - Any one:
    - Absence of cervical spine tenderness
    - Delayed neck pain
    - Sitting position in ED
    - Ambulatory after trauma
    - Simple rear-end MVC
  - Absence of:
    - Fall > 3 feet
    - Fall > 5 steps
    - MVC Rollover
    - MVC Ejection
    - Bicycle/ATV/Other
    - Axial load to head
    - Paresthesias
    - Inability to rotate neck

Challenges in Children

- Cervical spine tenderness can be difficult to assess in young children
- What are considered distracting injuries?
- Are fear and anxiety distractions?
- Can the child verbalize paresthesias?

SCIWORA

- Most commonly due to motor vehicle crashes
- Paresthesia may be the only clinical finding
- Predictors of poor prognosis
  - Complete spinal cord injury
  - Delayed onset of deficits
  - Delayed deterioration of function
  - Recurrent injury

SCIWORA

- Injury to cervical and thoracic cord with equal frequency
- Rare injury to lumbar cord
- 2/3 are less than 8 years old
- 75% are complete in children < 8 yrs
  75% are incomplete in children > 8 yrs
- Thoracic injuries are more often complete

Immobilization Realities

- Many more children will be immobilized than will benefit from it
- Young children are difficult to clinically clear from immobilization
- Prospective research in children on selective immobilization will be difficult
- No validated criteria for selective immobilization in children

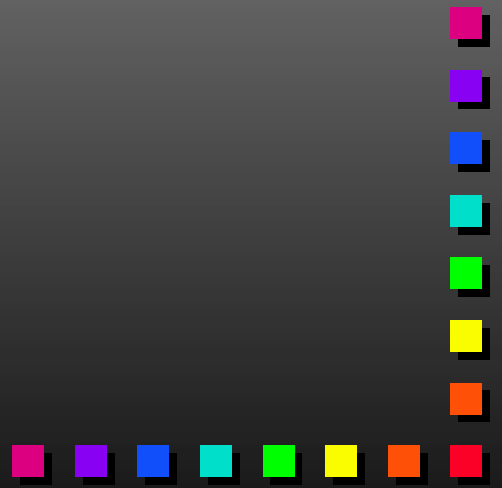
Prehospital Airway Management

Airway Management in Trauma

- Failure to manage the airway properly is the leading cause of preventable death due to trauma
- Urgent intervention needed in
  - Impending airway obstruction
  - Upper airway burns
  - Neck trauma
  - Inability to protect the airway (TBI)

Airway Management in Trauma

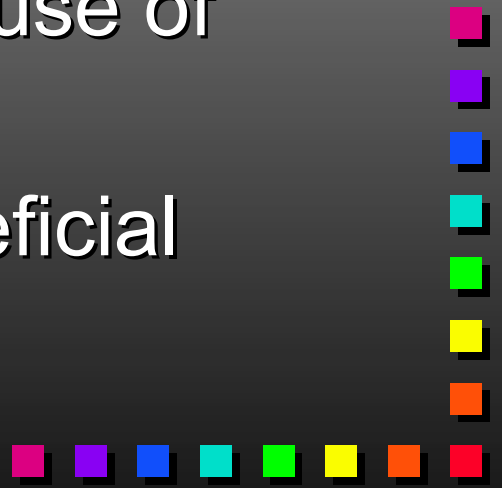
- Endotracheal intubation is performed in the ED
  - Decreased mental status
  - Respiratory difficulty
  - Need for prolonged ventilation
  - Facial or neck trauma
  - Multisystem trauma



If the patient requires intubation in the ED upon arrival, then shouldn't intubation have been performed before arrival?

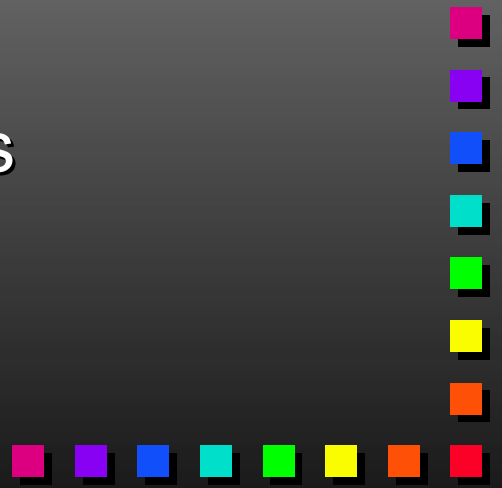
Airway compromise is the #1 cause of preventable death

Endotracheal intubation is beneficial



Prehospital ETI Challenges

- Primary reason for failed intubation
  - Muscle trismus – clenched jaw
- Additional factors include
  - Inadequate visualization
  - Inexperienced provider
  - Inadequate confirmatory resources

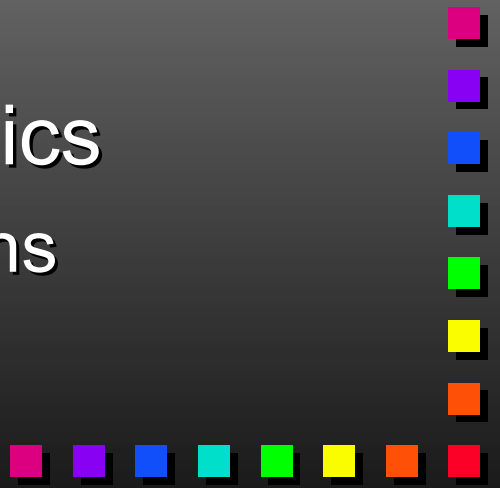


Prehospital ETI Outcomes

- Patients are intubated upon arrival to the ED – so why not in the field?
- Does it improve outcome?
  - Decreased mortality with ETI upon retrospective review (Davis)
  - Increased mortality with RSI upon prospective review (Davis)
  - Decreased mortality with RSI (Domier)

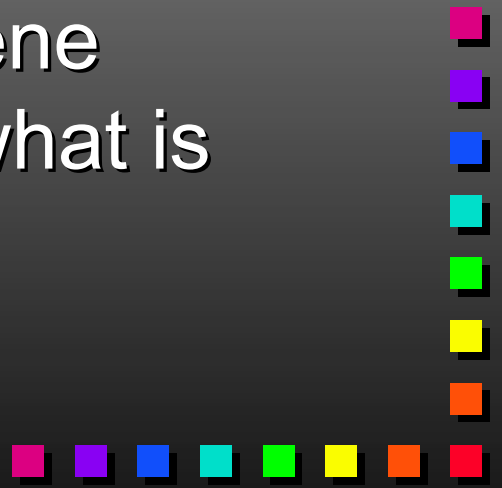
Pediatric Prehospital ETI

- No difference in outcome with ETI vs BVM (Gausche-Hill Study)
  - Paramedics recently trained in peds ETI
  - Only 1 intubation per 6 paramedics
  - ETI success was only 57%
- Very infrequent skill for paramedics
  - Challenging skill for most physicians



Prehospital ETI Limitations

- Patients who require ETI are more severely injured than those that don't
- Most paramedics get infrequent exposure to ETI
- Prehospital ETI will lengthen scene times – what is the benefit and what is the risk?

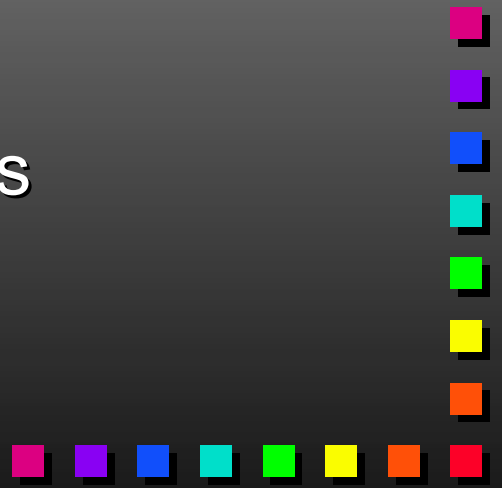


Alternatives to Intubation

- Bag-valve mask
  - Oropharyngeal airway
  - Nasopharyngeal airway
- King® airway
- Laryngeal mask airway

Prehospital ETI

- Procedural skill may be the factor which determines outcome
  - Minimize procedure time
  - Minimize non-ventilation time
  - Minimize hypoxia
  - Maintain eucarbia
  - Recognize intubation complications
  - Recognize failed intubation



Effective Prehospital ETI

- Strong medical direction and oversight
- Protocol development
- Cognitive and technical training
  - Airway and ventilation management
  - Critical decision making
- Skills maintenance program
- Performance improvement program

Prehospital Ventilation

- Bag-valve mask
  - Effective
  - Simple to operate
    - Requires monitoring the airway
    - Requires adjustment of mask seal
    - Requires monitoring of chest rise
  - Prepare for vomiting and gastric distention

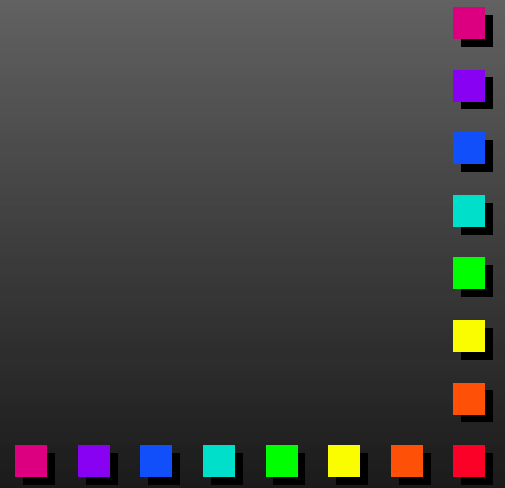
Referral to Pediatric Trauma Centers

Prehospital Issues

- Transport to definitive care within "Golden Hour"
- Definitive care
  - Right care for the right patient within the right time
- Must make decision based upon
  - Field primary and secondary survey
  - Knowledge of regional systems utilization

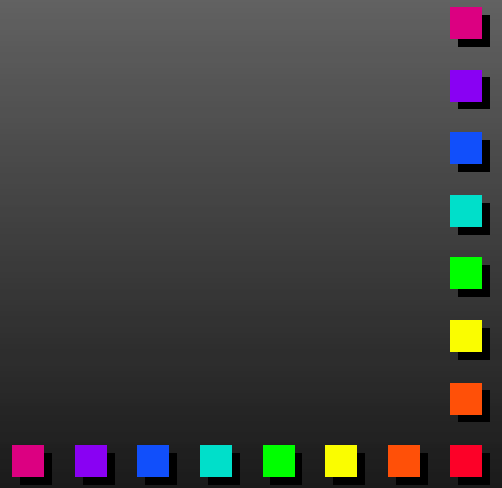
Challenges for Prehospital Care

- Lack of familiarity with pediatrics
- Lack of diagnostic equipment
- Immediate decision
- Transport time and mode
  - Ground or air?
  - How long will it take?
- Receiving facility capabilities



Prehospital Trauma Triage

- Blood pressure ≤ 90
- Burns
- Penetrating trauma
- Ejection / roll-over MVC
- Pedestrian
- Fall > 20 feet
- Glasgow Coma Score
- Spinal Injury
- Respiratory rate
  - < 10
  - ≥ 30



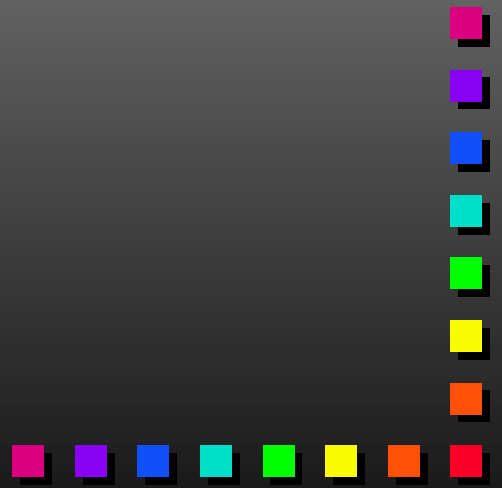
Most Accurate Criteria

- (death or need for ICU or surgery)
  - BP ≤ 90
  - Burn > 15%
  - GCS ≤ 12
  - Resp Rate < 10 or >= 30
  - Paralysis

Engum SA, et al. Prehospital triage in the injured pediatric patient. J Pediatr Surg 2000;35:82-87.

American College of Surgeons

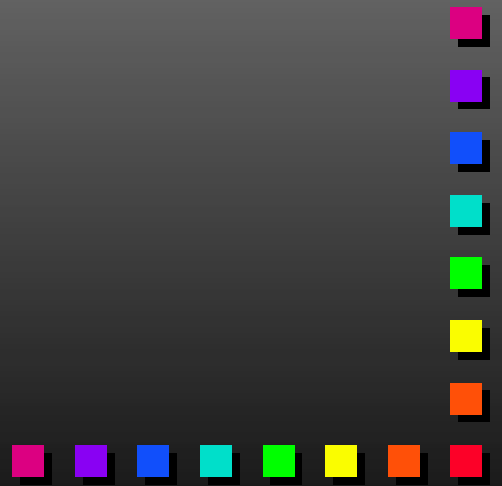
- Presence of surgeon on arrival for
  - BP < 90 or age-specific hypotension
  - Respiratory compromise or intubation
  - Blood required to maintain vital signs
  - GSW to abdomen, neck, or chest
  - GCS < 8 (due to trauma)
  - Discretion of ED physician



ACS Trauma Criteria

- Does it correlate with need for OR within 1 hour of arrival?
  - Hypotension 2.8%
  - Resp compromise 0.8%
  - GSW 14.4%
  - GCS < 8 0.3%

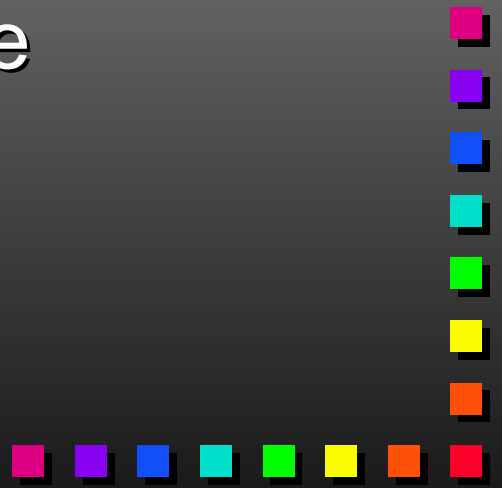
Children don't need to go to the OR after major trauma!



Steele R, Ann Emerg Med 2007; 50:1-6.

Challenges in Children

- GCS can be challenging to determine in young children
- Blood pressure is normally less than 90 mmHg in young children
- Expectation of pediatric expertise



Physical Examination

- Relative risk of intra-abdominal injury
  - Hypotension 4.4 (2.9 – 6.6)
  - Abd tenderness 2.2 (1.6 – 2.9)
  - Seatbelt sign 2.6 (1.8 – 3.7)
  - GCS < 14 2.6 (2.0 – 3.5)
  - Femur fracture 0.78 (0.41 – 1.5)

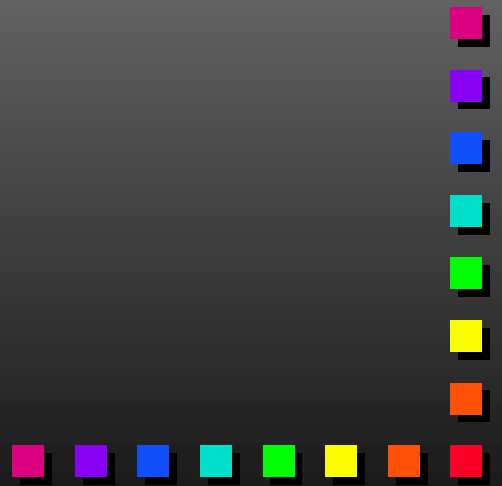
Holmes JF, Ann Emerg Med 2009; 54:528-533

Pediatric patients treated at an adult trauma center have worse outcomes than if treated at a pediatric trauma center.

True or False

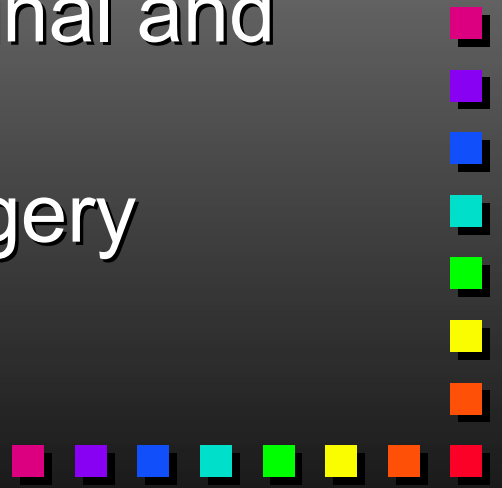
No Difference

- Bensard: TRISS prob and Obs rate
- Osler: Survival not different when controlling for
  - Injury severity score
  - Pediatric trauma score
  - Mechanism of injury
  - Age



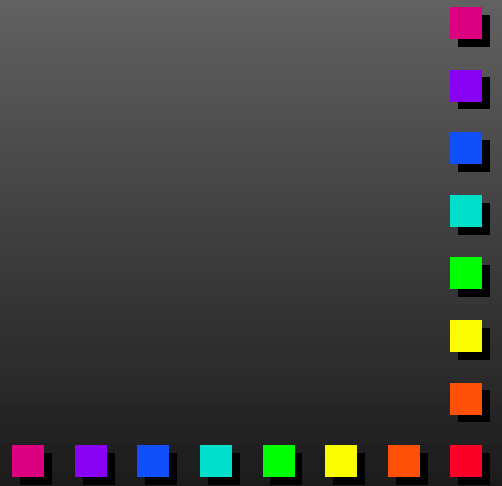
PTC Benefits

- Densmore: mortality rate of 0.9% PTC and 2.4% children unit in adult hospital
  - Similar trends found for hospital charges and length of stay
- Potoka: Overall survival (abdominal and head trauma), neurosurgical intervention, less abdominal surgery



Implications for EMS

- Trauma patient should go to a trauma center
- What is a trauma patient?
- Level 1 or Level 2?
- Air or ground?



Summary

- EMS practices are not always based upon science
- Clinical judgment
- Quick decisions based upon little information

Summary

- Prevent hypoxia with effective ventilation management skills
- Consider the risks of spinal immobilization
- Trauma patients need a trauma center
  - Operative management is uncommon
  - Multidisciplinary team approach