Tales of a Team

Building a Better Trauma Team

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PURPOSE

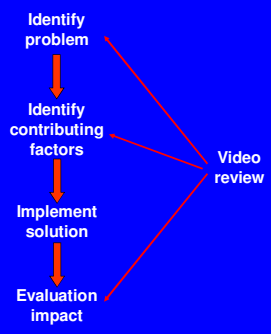
- Describe our approach for assessing team performance
- Present results of our studies on team performance
- Describe approaches that we have used for improving team performance

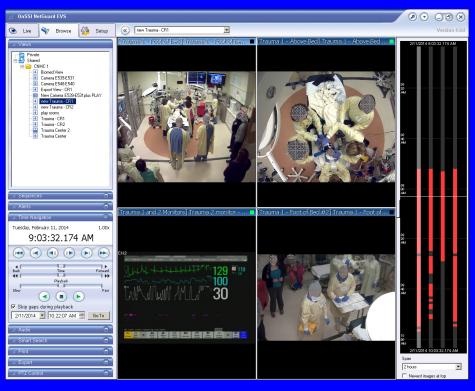
Our Story

TOPICS

- What determines team size? How can you make it smaller?
- Which members of the team are working hardest? Why?
- How does leadership structure impact patient care?
- What interventions can reduce performance variability?

Performance Improvement Path





APPROACHES USED

- Video analysis of completion/timeliness of tasks
- Ethnographic analysis
- Psychometric surveys
- Real-time behavioral analysis

OUR RESEARCH TEAM

- Pediatric surgeons
- Pediatric emergency medicine physicians
- Critical care physicians
- Psychologists (human factors)
- Computer scientists
- Mathematicians

Who is in the trauma bay?

Why are they there?

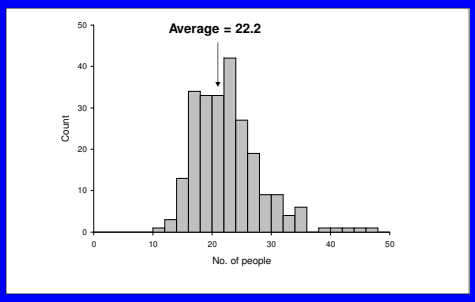
	Trauma Activation Level		
Role	Attending Stat	Stat	Transfer
Attending surgeon	X		
Surgical fellow	X	X	X
Surgical resident	X	X	X
Emergency medicine physician	X	X	X
Critical care physician	X		
Anesthesiologist	X	X	
Respiratory therapist	X	X	X
Nurse right	X	X	X
Nurse left	X	X	
Medication nurse	X	X	
Recording nurse	X	X	X
Nurse administrator	X	X	X
Radiology technician	X	X	
Social worker	X	X	X
Total members	14	12	8

?

Smart Car
18

VW Beetle
27

TOTAL NUMBER OF PEOPLE IN TRAUMA BAY



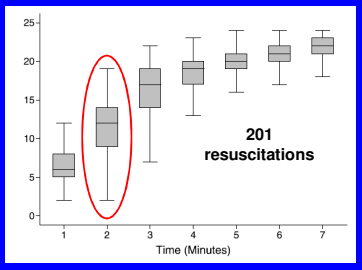
FACTORS INFLUENCING TEAM SIZE
MULTIVARIATE ANALYSIS

- Age
- Female
- Advanced notification ←
- Highest level activation ←
- Transfer ←
- Weekend
- Daytime ←
- Penetrating injury ←

201 resuscitations

A	Airway assessment
	Cervical spine immobilization with Miami J
B	Breath sounds assessment
	Oxygen administration
	Pulse oximeter placement
C	Heart sounds assessment
	Distal pulses assessment
	Central pulses assessment
	ECG lead placement
	Automatic blood pressure cuff placement
	Manual blood pressure measurement
	Blood pressure stated aloud to team
	Intravenous line placement
D	Glasgow Coma Scale assessment
	Pupil assessment
E	Clothing removal
	Warm blanket placement
	Temperature measurement
	Logroll (back exposure)
Vitals on monitor	Heart rate
	Respiratory rate
	Oxygen saturation
	Blood pressure
	End tidal CO_2

NUMBER OF PRIMARY SURVEY TASKS COMPLETED

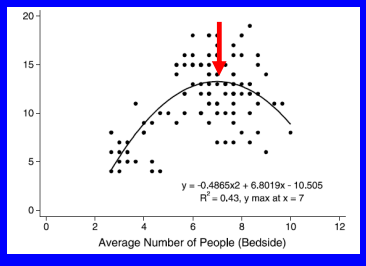


Kelleher DC, Kovler ML, Waterhouse LJ, Carter EA, Burd RS. Factors affecting team size and task performance in pediatric trauma resuscitation. Pediatr Emerg Care. 2014 Apr;30(4):248-53.

TASKS COMPLETED IN TWO MINUTES
MULTIVARIATE ANALYSIS

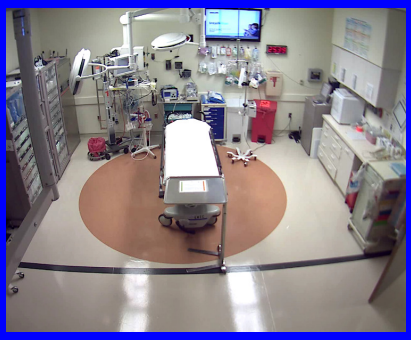
- Age
- Female
- No notification ←
- Highest level activation ←
- Transfer
- Weekend
- Night
- Penetrating injury
- High ISS
- Team size ←

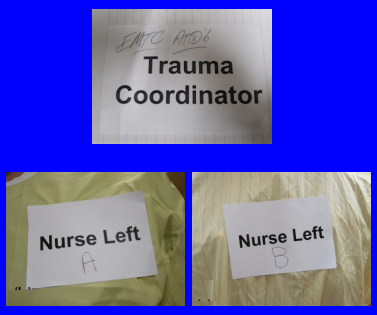
EFFECT OF NUMBER OF PEOPLE ON TASK PERFORMANCE AT TWO MINUTES



POTENTIAL FACTORS INFLUENCING TASK PERFORMANCE IN CROWDS

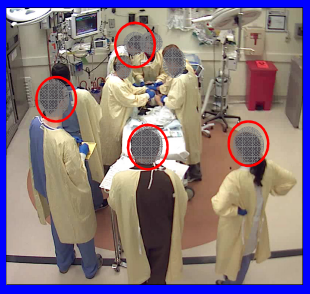
- Physical crowding
- Social loafing
- "Hiding in the crowd"
- Role confusion
- Ambient noise





Sarcevic A. Palen LA, Burd RS. "Coordinating time-critical work with role-tagging," in Proceedings of the ACM 2011 Conference on Computer Supported Cooperative Work (CSCW 2011), pp. 465-474, 2011.

Who is working hardest?



66 resuscitations

NASA-TLX

DIRECTIONS: For each of the six scales below, please put an "X" at the point which matches your experience for this specific trauma resuscitation.

1. MENTAL DEMAND: How mentally demanding (e.g. thinking, deciding, calculating) was this specific trauma resuscitation?

Very Low — Very High

2. PHYSICAL DEMAND: How physically demanding (e.g. pushing, turning, controlling) was this specific trauma resuscitation?

Very Low — Very High

3. TEMPORAL DEMAND: How hurried or rushed did you feel due to the pace of this specific trauma team resuscitation?

Very Low — Very High

4. PERFORMANCE: How successful were you in accomplishing what you were asked to do during this specific trauma resuscitation? ("Perfect" is on the left)

Perfect — Failure

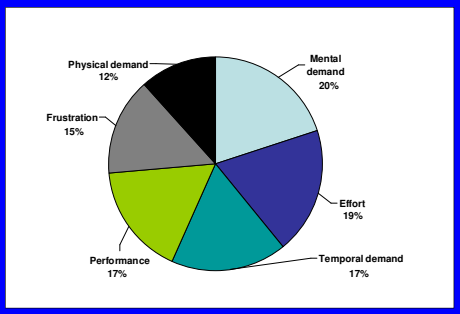
5. EFFORT: How hard did you have to work to accomplish your level of performance during this specific trauma resuscitation?

Very Low — Very High

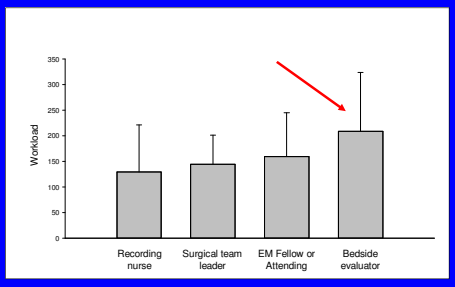
6. FRUSTRATION: How insecure, discouraged, irritated, stressed, and annoyed were you during this specific trauma resuscitation?

Very Low — Very High

WORKLOAD DISTRIBUTION



WORKLOAD BY ROLE



MULTIVARIATE ANALYSIS

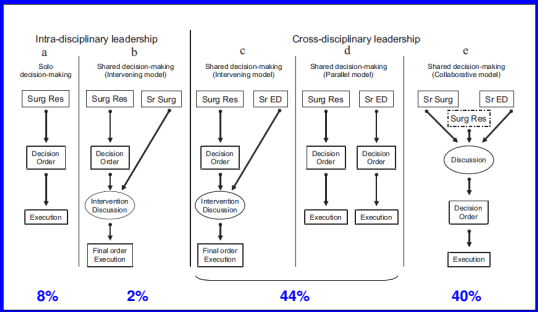
- Higher activation level ←
- No advanced notification ←
- Younger patient age
- Higher injury severity
- Weekend (vs. weekday)
- Night (vs. day) shift
- Team member role ←

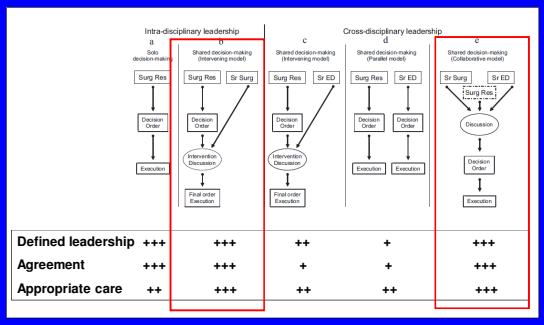
Parsons SE, Carter EA, Waterhouse LJ, Sarcevic A, O'Connell KJ, Burd RS. Assessment of workload during pediatric trauma resuscitation. J Trauma Acute Care Surg. 2012 Nov;73(5):1267-72.

REDISTRIBUTING WORKLOAD

- Disseminate study findings
- Redistribute tasks
- Simply tasks
- Focused training

How does leadership structure influence team performance?





Sarcevic A, Marsic I, Waterhouse LJ, Stockwell DC, Burd RS. Leadership structures in emergency care settings: a study of two trauma centers. Int J Med Inform. 2011 Apr;80(4):227-38.

PROMOTING SHARED LEADERSHIP

- Acknowledge role expertise
  - *Surgeons*: surgical care
  - *Pediatricians*: pediatric care
- One voice
- Make it easy
  - Introductions
  - Stand together

How are our teams doing at performing basic components of ATLS?

What factors influence basic ATLS task performance?

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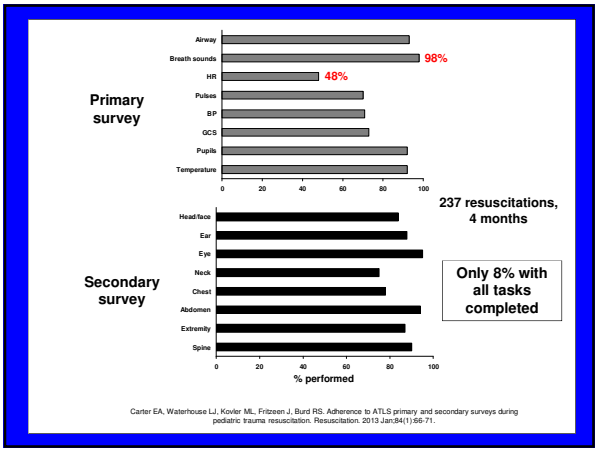
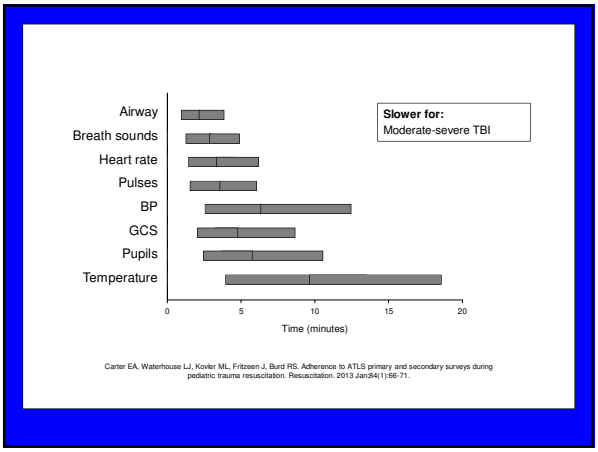
Why Care about ATLS Compliance?

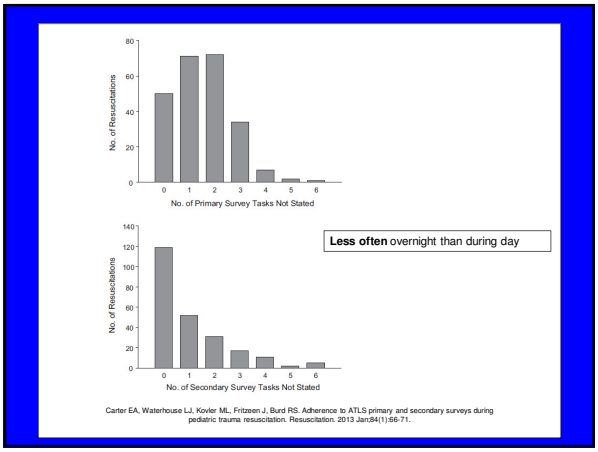
- ATLS compliance and outcome
  - Adoption of the ATLS protocol reduces mortality
  - ATLS compliance is associated with fewer errors, less severe errors
- Up to 50% of preventable trauma deaths related to omissions in the resuscitation phase

Why Care About ATLS Protocol Adherence? *Examples*

- Delayed measurement of blood pressure and fluid administration in child with hemorrhagic shock
- Failure to calculate GCS in child with severe head injury
- No oxygen administration in hypoxic child with severe head injury requiring intubation
- No temperature measurement or external warming measurement in profoundly hypothermic child
- No extremity evaluation in severely injured child with a femur fracture







What Can We Do to Increase Protocol Compliance in the Trauma Bay?

- ✔ Try harder (M and M, video review)
- ✔ Training-simulation (proficiency)
- ✔ Get skilled leaders

Checklists

- Used in protocol-driven domains
- Introduced in medical domains
  - WHO Surgical Safety Checklist
  - Infection control procedures
- Increase protocol adherence
- Improve team communication
- Improve outcomes

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Spontaneous Behaviors

- Nurse summary
- Team leader direction

RESEARCH QUESTIONS

- What items should be on the checklist
- Who should administer the checklist?
- Will the checklist be a burden to the team?
- Will the checklist improve the process or outcome of care?

Checklist design

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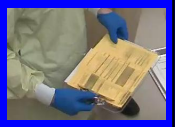
Simulation testing



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Pilot implementation

3 months

↓

Testing

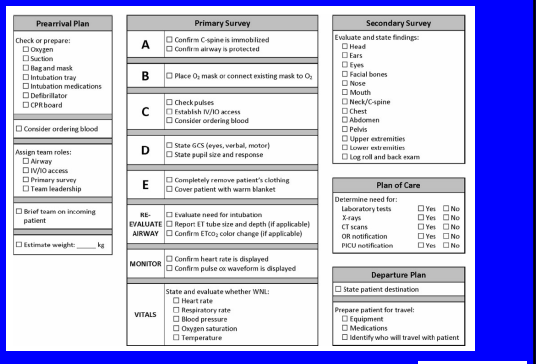
4 months

Checklist Development

- Focus groups – items and format
- Included all disciplines

Simulation Testing

- Twelve simulation sessions
- Four scenarios: two with checklist, two without
- Outcomes measured:
  - ATLS task completion (ATLS Performance Score)
  - Compliance with checklist use
  - Workload (NASA TLX) surveys



Prearrival Plan
Check or prepare: ☐ Oxygen ☐ Suction ☐ Bag and mask ☐ Intubation tray ☐ Intubation medications ☐ Defibrillator ☐ CPR board
☐ Consider ordering blood
Assign team roles: ☐ Airway ☐ IV/IO access ☐ Primary survey ☐ Team leadership
☐ Brief team on incoming patient
☐ Estimate weight: _____ kg

Primary Survey	
A	☐ Confirm C-spine is immobilized ☐ Confirm airway is protected
B	☐ Place O_2 mask or connect existing mask to O_2
C	☐ Check pulses ☐ Establish IV/IO access ☐ Consider ordering blood
D	☐ State GCS (eyes, verbal, motor) ☐ State pupil size and response
E	☐ Completely remove patient's clothing ☐ Cover patient with warm blanket
RE-EVALUATE AIRWAY	☐ Evaluate need for intubation ☐ Report ET tube size and depth (if applicable) ☐ Confirm $ETCO_2$ color change (if applicable)
MONITOR	☐ Confirm heart rate is displayed ☐ Confirm pulse ox waveform is displayed
VITALS	State and evaluate whether WNL: ☐ Heart rate ☐ Respiratory rate ☐ Blood pressure ☐ Oxygen saturation ☐ Temperature

Secondary Survey
Evaluate and state findings: ☐ Head ☐ Ears ☐ Eyes ☐ Facial bones ☐ Nose ☐ Mouth ☐ Neck/C-spine ☐ Chest ☐ Abdomen ☐ Pelvis ☐ Upper extremities ☐ Lower extremities ☐ Log roll and back exam

Plan of Care		
Determine need for:		
Laboratory tests	☐ Yes	☐ No
X-rays	☐ Yes	☐ No
CT scans	☐ Yes	☐ No
OR notification	☐ Yes	☐ No
PICU notification	☐ Yes	☐ No

Departure Plan
☐ State patient destination
Prepare patient for travel: ☐ Equipment ☐ Medications ☐ Identify who will travel with patient

Primary survey tasks
Airway assessment
Breath sounds
Extremity pulses
Blood pressure
Pupil exam
Temperature

Secondary survey tasks
Head/face exam
Ear exam
Eye exam
Neck/cervical spine exam
Chest exam
Abdominal exam
Extremity exams
Spine exam

ATLS Performance Score (60 points)

- Primary survey: 11 tasks, 32 points
  - 0 points if not completed
  - 1 point if done later than median time
  - 2 points if done between 1st quartile & median time
  - 3 points if done earlier than 1st quartile time
- Secondary survey: 14 tasks, 28 points
  - 0 points if not completed
  - 1 point if done but not stated
  - 2 points if done and stated

Results of Simulation Testing

- Surgical team leader **best** as administrator
- ATLS Performance Score **improves** with checklist use
  Total score: 38.3 vs 42.0 (p<0.001)
- ATLS Performance Score **improves** with compliance
- **No difference** between "do list" and "challenge response"
- **No change** in overall workload of team members

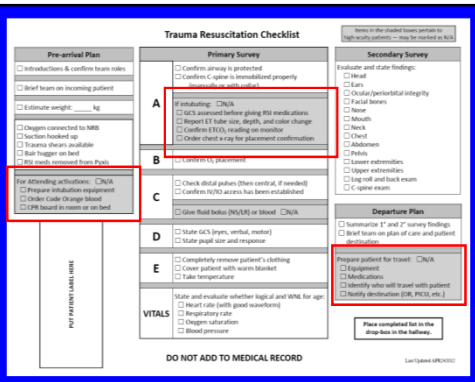
Conclusions

- Checklist improves ATLS performance in simulation
- Safe to implement and evaluate in actual resuscitations

Parsons SE, Carter EA, Waterhouse LJ, Fritzeen J, Kelleher DC, O'connell KJ, Sarcevic A, Baker KM, Nelson E, Werner NE, Boehm-Davis DA, Burd RS. Improving ATLS Performance in Simulated Pediatric Trauma Resuscitation Using a Checklist. Ann Surg. 2013 Oct 28. [Epub ahead of print]

Checklist Implementation:

- Three month introduction period
- Presented at Trauma Committee
- Training video for trauma team
- Team leaders oriented at start of rotation



Pre-Post Study

Two 4-month periods

- Pre-implementation: May-August 2011 (n=222)
- Post-implementation: May-August 2012 (n=215)

Video review of all trauma resuscitations

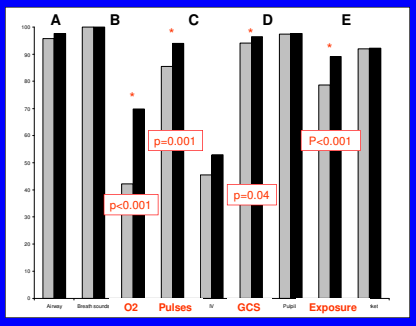
Differences between cohorts calculated

- Cohort characteristics
- Frequency of and mean time to task completion

Cohort Characteristics

	Pre (n=222)	Post (n=215)	P-value
Activation level			0.24
Attending	5.9	6.1	
Stat	61.7	68.8	
Transfer	32.4	25.1	
Weekend	30.2	32.6	0.59
No pre-notification	10.4	14.9	0.15
Team leader (% fellow)	44.6	40.2	0.35
Penetrating mechanism	8.1	3.3	0.03 ←
Intubated patient	5.9	7.4	0.51

Primary Survey
Task Performance



Primary Survey
Vital Signs

	Frequency (%)			Mean time (min)		
	Pre	Post	p-value	Pre	Post	p-value
Temperature	94.1	96.3	0.30	5.8	4.5	**<0.001**
Heart rate	100	100	NS	3.0	2.4	**<0.001**
Respiratory rate	99.1	99.5	0.58	2.6	2.0	**<0.001**
Oxygen saturation	100	100	NS	2.5	2.1	**<0.001**
Blood pressure	100	100	NS	3.1	2.7	**0.01**

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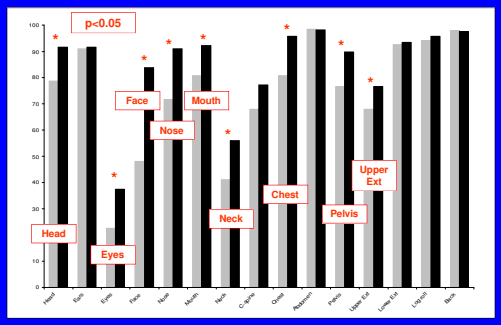
Secondary Survey



Resuscitation Length

No significant reduction in total resuscitation time
26 vs. 24.3 minutes p=0.14

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Multivariate Analysis

Adjusted measures of task performance after checklist implementation			
Task completion	**OR**	**95% CI**	**P-value**
Primary survey (n=5,983)	2.66	2.07, 3.42	<0.001
Secondary survey (n=,6090)	2.47	2.04, 2.98	<0.001
Time to task completion	**beta**	**95% CI**	**P-value**
Primary survey (n=5,142)	-0.15m	-0.23m, -0.08m	<0.001

GEE models nested within each resuscitation event, adjusted for injury mechanism, ISS, GCS-M, intubation, level of activation, night, weekend, pre-arrival notification, and type of task

Kelleher DC, Carter EA, Waterhouse LJ, Parson SA, Fritzeen JL, Burd RS. Impact of a checklist on Advanced Trauma Life Support task performance during pediatric trauma resuscitation. Acad Emerg Med, in press.

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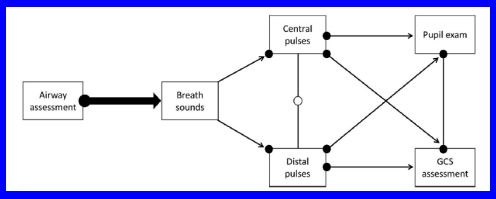
CHECKLISTS AND WORKFLOW VARIABILITY



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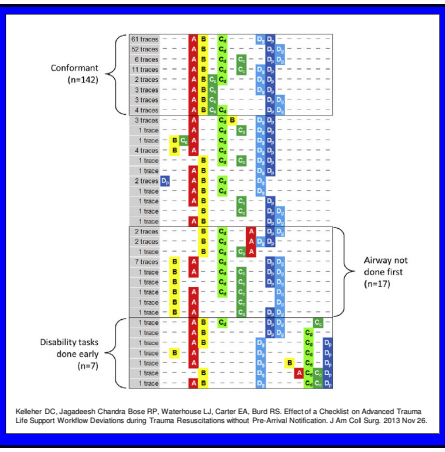
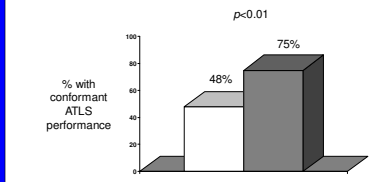


Kelleher DC, Jagadeesh Chandra Bose RP, Waterhouse LJ, Carter EA, Burd RS. Effect of a Checklist on Advanced Trauma Life Support Workflow Deviations during Trauma Resuscitations without Pre-Arrival Notification. J Am Coll Surg. 2013 Nov 26.



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SUMMARY

A checklist for trauma resuscitation:

- Increased compliance with key components of the primary and secondary survey
- Increased the speed of primary survey task and vital sign performance
- Reduced the variability of primary survey task performance

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Interesting Discoveries

- Checklist as handoff tool
- The trainee myth
- Fellows: resistors to supporters
- Empowered rotating residents

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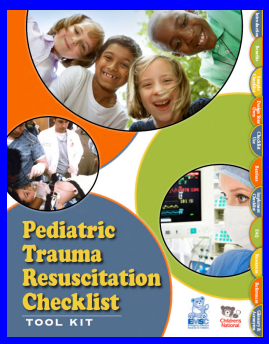
Does Increased ATLS Compliance Improve Outcome?



Supported by funding from:
Health Resources and Service Administration
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CHECKLIST FAQ

Have you thought about an iPad app?

How can I get a copy of your checklist?
http://www.childrensnational.org/files/PDF/EMSC-PubRes/Pediatric_Trauma_Resuscitation_Checklist.zip

How can I see how it is used?

Summary

- Despite individual and team training, ATLS protocol deviations persist during pediatric trauma resuscitation.
- Video analysis can be used to identify patient and resuscitation features that increase the likelihood of protocol deviation.
- A checklist for trauma resuscitation can improve compliance with the ATLS protocol, particularly for teams treating injured patients at high-risk for protocol violations.