Workload and Situational Awareness in the Emergency Department

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Outline

- Objective
- Background
  - ED Crowding and Patient Safety
  - Measuring Situational Awareness
  - Measuring Workload
- Study Design & Methods
- Results
- Conclusion

Objective

To measure and evaluate the relationship between situational awareness and workload in an emergency department

Background: ED Crowding & Patient Safety

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Impact on Patients

- The effect of emergency department crowding on clinically oriented outcomes (review 41 articles) (Bernstein et al, 2010 .)

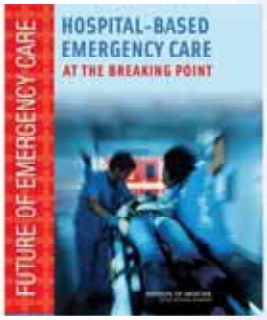
IOM Six Dimension of Quality of Care					
Safety	**Patient-Centered**	**Timeliness**	**Efficiency**	**Effectiveness**	**Equity**

  - **Safety Outcomes**: Mortality, Walk-outs
    - "ED crowding contribution to medical errors is largely anecdotal and inconclusive"
  - **Timeliness Outcomes**: Time to Antibiotic, Thrombolysis, Analgesic

Impact on Providers

- Factors affecting stress in emergency medicine residents (Wrenn et al, 2010.)
- High occupational stress and depression (Whitley et al, 1989.)
- High levels of burn-out and projected attrition (Wiggins et al, 1995.)

Background: ED Crowding & Patient Safety



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Background: Situational Awareness

- Situational Awareness Levels (Endsley 1995)
  - 1 = perception of current information
  - 2 = comprehension of current situation
  - 3 = projection of future state
- Situational Awareness Global Assessment Technique (SAGAT) (Endsley 1995)

Background: Workload

- "proportion of operators' limited capacity required to perform a particular task" (O'Donnel & Eggemeir)
- Measure objective workload (Levin et al. 2006)
  - Procedural measures
- Measure perceived workload (Levin et al. 2006)
  - Subjective Self Assessment
  - Physiological

Methods: Design

- ~50 hours of observation (Pilot)
- SA measured by: Situational Awareness Global Assessment Technique (SAGAT)
- Workload measured objectively through "electronic observation"
- SA and workload measured concurrently

Methods: Situational Awareness

Question Pool

- 106 unique questions
  - Diagnostic
  - Medical Intervention
  - Medical History
  - Management

  - Safety Factor: 1 (low) to 5 (high)

Methods: Situational Awareness

Diagnostic Question Examples

- Which of your patients has had a troponin > .06 during their visit?
- Which of your patients has had a sodium less than 126 during their visit?

Medical Intervention Question Examples

- Which of your patients has received or is currently being treated with IV pain medication during their visit?
- Which of your patients has peripheral IV access?

Methods: Situational Awareness

Medical History Question Examples

- Which of your patients has a primary chief complaint of chest pain listed?
- Which of your patients has a history of cancer?

Management Question Examples

- Which of your patients has been in the waiting room for over 3 hours?
- Which of your patients is currently waiting for hospital admission?

Methods: Workload Measurement

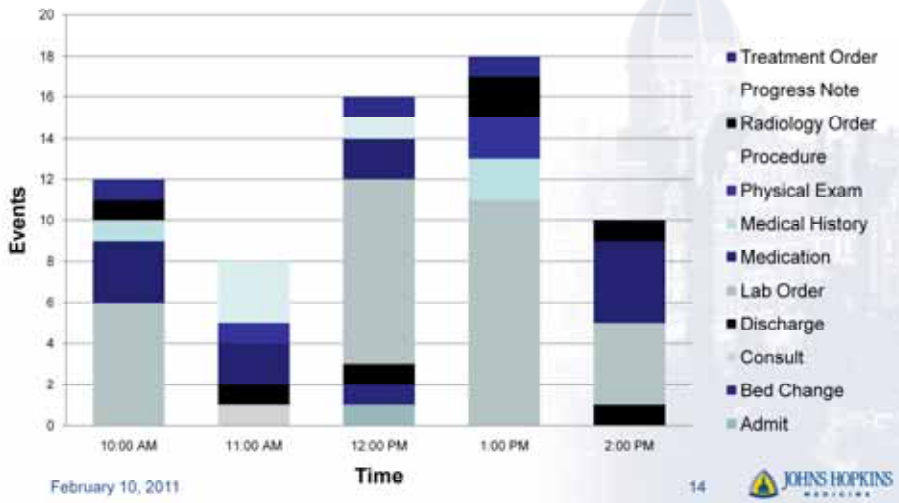
EVENT	WEIGHT
Admit	4.75
Bed Change	1.75
Consult	4.5
Discharge	3.5
Lab Order	1
Medication	1.5
Medical History	6.75
Physical Exam	5.25
Procedure	9.75
Radiology Order	1.25
Progress Note	4.25
Treatment Order	2

Events tracked in each patient chart

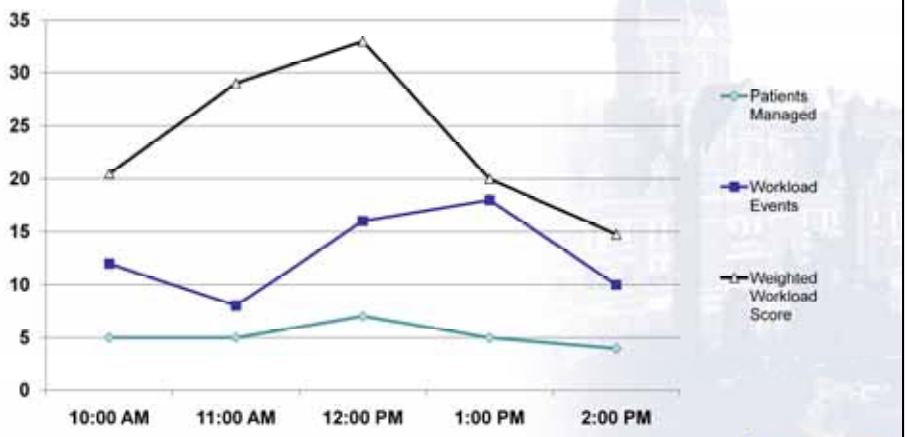
- Time-stamped
- Tagged by provider

Average weight provided by physician panel

Methods: Workload Tracked



Methods: Workload Tracked



Results: Situational Awareness

	N	Correct (%)	Incorrect (%)	Don't Know (%)	Sig
ALL Questions	508	74.8	25.2	3.9	-
Cat: Diagnostic	203	75.9	24.1	0.5	-
Cat: History	102	71.6	28.4	4.9	-
Cat: Management	107	70.1	29.9	12.1	-
Cat: Med Intervention	96	81.3	18.8	1.0	-
Safety Factor: 1	42	64.3	35.7	0.0	-
Safety Factor: 2	134	76.9	23.1	3.7	-
Safety Factor: 3	123	66.7	33.3	8.9	-
Safety Factor: 4	131	82.4	17.6	2.3	-
Safety Factor: 5	78	76.9	23.1	1.3	-

Results: Situational Awareness

Top 5 most incorrectly answered questions:

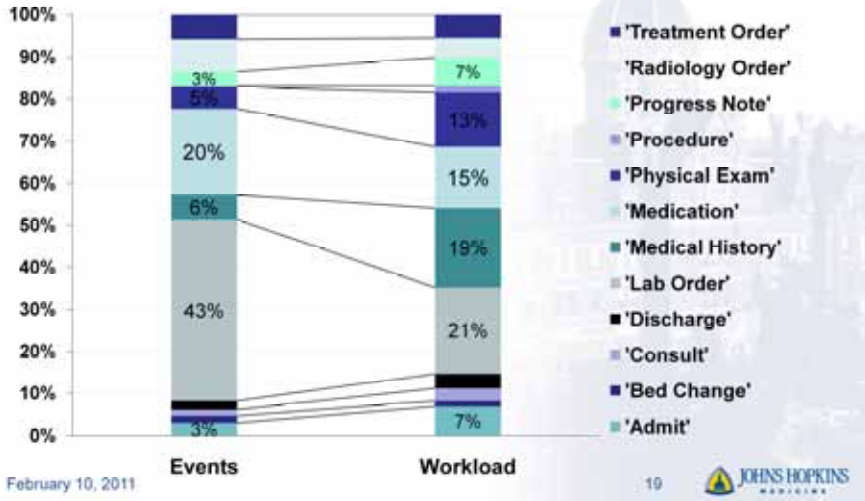
- Which of your patients have a drug allergy listed?
- Which of your patients have a primary care physician documented?
- Which of your patients has had a heart rate of 100 or greater during their visit?
- Which of your patients was in the waiting room for over 2 hours?
- Which of your patients has a history of previous abdominal surgery?

Results: Situational Awareness

	N	False Negative (%)	False Positive (%)	True Negative (%)	True Positive (%)	Sensitivity (%)	Specificity (%)	Sig
All Patients	2262	5.2	2.2	79.2	13.4	97.3	72.1	-
Handoffs	825	8.2	2.5	75.9	13.2	96.8	61.6	*
Non-Handoffs	1437	3.4	2.0	81.1	13.5	97.6	79.8	*
Training Level (Yr 1)	585	5.1	2.7	76.8	15.4	96.6	75.0	-
Training Level (Yr 2)	973	6.5	2.9	78.4	12.1	96.5	65.2	-
Training Level (Yr 3)	704	3.4	0.9	82.2	13.5	99.0	79.8	*

*acuity, question category, safety factor all not significant

Results: Workload



Results: Workload/SA Relationship

Mixed Effects Logistic Regression (False Response)

Fixed Effects Tested	Random Effects Tested
Patient handed-off	Provider
Patient acuity	Patient
Resident training level (1,2,3)	Question
Question category	Observation session
Question safety factor	
Time from resident start of shift (hrs)	
Time from patient arrival to bed (hrs)	
Number of patients being managed	
Work event count	
Weighted workload score	

Results: Workload/SA Relationship

Mixed Effects Logistic Regression (False Response)

Fixed Variable	Odds Ratio (95% CI)	p
Hand-off	1.56 (1.08 – 2.27)	< .001 ***
Training level	0.53 (0.33 – 0.88)	.021 **
Patients managed	1.18 (1.00 – 1.41)	.085 *
Work events	0.97 (0.95 – 1.00)	.082 *

Random Variable	Variance
Question	.737
Patient	.025

Limitations

- Small sample size (pilot study)
- Better method to measure workload objectively?
  - Variability in charting
  - Timing of events
- Link between SA and patient safety difficult to establish

Conclusion: Methodological

- Measurement of SA in an emergency department introduced
- Mixed-effects analysis well suited to control for correlation in patient, provider, and random questions
- Measuring workload
  - Are PATIENT/COMPLEXITY based measures more feasible and accurate than EVENT based measures?

Conclusions: Practical

- Continuity of care within the ED
  - Hand-offs highly associated with false responses
- Methods able to diagnose deficiencies in information flow
  - By patient type
  - By information type

Contact Info

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Bio

Dr. Levin is an Assistant Professor in the Department of Emergency and holds a joint appointment in the Department of Applied Mathematics and Statistics. He also works as a member of the Department of Operations Integration to forward operational, quality, and financial improvement initiatives within the Johns Hopkins Health System.

Upon finishing his PhD in biomedical engineering at Vanderbilt University, Dr. Levin joined the Hopkins faculty in 2008. Dr. Levin's research focuses on the use and development of systems engineering tools to study and improve the effectiveness, safety and efficiency of health care delivery. Research is directed toward determining how scarce health care resources may be managed and deployed to best care for patient populations. This includes an emphasis on systems engineering techniques aimed at improving quality of care, access to care, and medical decision making.

Dr. Levin is actively involved in research efforts for the National Science Foundation (NSF), National Institutes of Health (NIH), and Department of Homeland Security National Study Center for Preparedness and Catastrophic Event Response (PACER). Dr. Levin has authored and reviewed numerous publications which apply systems engineering methods to medicine.