Increasing efficiency in the ED: Evidence based guidelines as a driver for quality

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Disclosures

- I do not have any relevant financial relationships with the manufacturers of any commercial products and/or provider of commercial services discussed in this presentation.
Future of Emergency Care
Emergency medical care in the United States is on the verge of collapse...

...As a system...it provides care of variable and often unknown **quality**...
One definition of quality

- The degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge

Evidence

Scientific judgment

Analyze Evidence

Outcomes

Preference Judgment

Benefits, harms and costs

Decisions

Adapted from D Eddy MD, PhD
Decision making and quality

Evidence & Recommendation Evaluation

Shared baseline

Transparency: values and preferences

Data transformation

Performance measures

High quality care
Why does it matter?  
A parallel example

- RCT of treatment of hypertension on the jobsite (a steel mill) versus referral to the PCP
- No difference in compliance between the groups
- Exploration of factors relating to therapy revealed specific determinants of the clinical decision to treat some, but not other, hypertensive patients:
  1. The level of diastolic blood pressure.
  2. The patient’s age.
  3. ????
  4. The amount of target-organ damage.
A parallel example

- RCT of treatment of hypertension on the jobsite (a steel mill) versus referral to the PCP
- No difference in compliance between the groups
- Exploration of factors relating to therapy revealed specific determinants of the clinical decision to treat some, but not other, hypertensive patients:

1. The level of diastolic blood pressure.
2. The patient’s age.
3. The year the physician graduated from medical school
4. The amount of target-organ damage.
The purpose of EBGs: minimizing variation

- Wide variations in practice are often not related to differences among patients
- Minimizing variations in practice can improve quality of health care delivery
  - Variation in beliefs
  - Variation in interpretation of evidence
  - Variation in response when evidence is lacking
- Does this variation exist in emergency medicine?
## Variation in ED practice

<table>
<thead>
<tr>
<th>Entity</th>
<th>Population</th>
<th>Study</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute asthma</td>
<td>Eastern Ontario</td>
<td>Lougheed, Chest 2009</td>
<td>Systemic steroids, PEFR, referrals to asthma services</td>
</tr>
<tr>
<td>Asthma admissions</td>
<td>Ontario</td>
<td>Lougheed Chest 2006</td>
<td>3 fold variation in hospitalization rates for asthma influenced by variation in % ED pts admitted</td>
</tr>
<tr>
<td>Trauma facility utilization</td>
<td>California</td>
<td>Wang Ann Emerg Med 2008</td>
<td>Trauma center hospitalization varied by distance of residence, presence of private insurance</td>
</tr>
<tr>
<td>Periorbital cellulitis</td>
<td>Vancouver</td>
<td>Goldman Ped Emerg Care 2008</td>
<td>po vs IV antibiotics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Variation in decision for hospitalization</td>
</tr>
<tr>
<td>AGE</td>
<td>PHIS</td>
<td>Tieder Pediatrics 2009</td>
<td>Variation in resource use: electrolytes, stool studies, UA/Ucx, antibiotics, antiemetics</td>
</tr>
<tr>
<td>Retropharyngeal abscess</td>
<td>KID 2003</td>
<td>Lander Int J Pediatr Oto 2008</td>
<td>Variation in hospitalization; Midwest had decreased total charges and LOS</td>
</tr>
</tbody>
</table>
Empowering the “art” of medicine

- Evidence based guidelines help control complexity
  - Analytic methods to understand outcomes
  - Divide and conquer for different personnel
  - Reductionism to a more efficient functioning

- Pareto principle
  - 80/20 rule
  - 20% of the problems cause 80% of the trouble
  - 80% of the benefit will come from 20% of the opportunities
“Art” is in the eye of the beholder
Creating EBGs:
1. Identifying the quality gaps

- Targeting areas for quality improvement
  - High prevalence
  - Marked variations in care
  - Resource intensive care
  - High morbidity or mortality
# Clinical Guidelines and Order Sets

**EB Medicine Course** - Click here for information on the Evidence-Based Medicine course.

<table>
<thead>
<tr>
<th>EVIDENCE-BASED OUTCOMES CENTER</th>
<th>Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Chest Syndrome - SCD</td>
<td>11/2008</td>
</tr>
<tr>
<td>Acute Gastroenteritis</td>
<td>07/2009</td>
</tr>
<tr>
<td>Acute Heart Failure</td>
<td>08/2009</td>
</tr>
<tr>
<td>Acute Otitis Media</td>
<td>07/2008</td>
</tr>
<tr>
<td>Appendicitis/Appendectomy</td>
<td>11/2008</td>
</tr>
<tr>
<td>Asthma</td>
<td>10/2008</td>
</tr>
<tr>
<td>Bronchiolitis</td>
<td>01/2008</td>
</tr>
<tr>
<td>Cancer Center Procedural Management</td>
<td>11/2009</td>
</tr>
<tr>
<td>Cardiac Thrombosis</td>
<td>08/2009</td>
</tr>
<tr>
<td>Community Acquired Pneumonia</td>
<td>02/2009</td>
</tr>
<tr>
<td>Deep Vein Thrombosis</td>
<td>03/2009</td>
</tr>
<tr>
<td>DKA</td>
<td>11/2009</td>
</tr>
<tr>
<td>Fever and Neutropenia in Children with Cancer Newly Revised</td>
<td>05/2010</td>
</tr>
<tr>
<td>Fever Without Localizing Signs 0-60 d</td>
<td>03/2009</td>
</tr>
<tr>
<td>Fever Without Localizing Signs 2-36 mo</td>
<td>03/2009</td>
</tr>
<tr>
<td>Hyperbilirubinemia</td>
<td>02/2010</td>
</tr>
<tr>
<td>Neonatal Thrombosis</td>
<td>10/2009</td>
</tr>
<tr>
<td>Nutrition/Feeding in the Infant Post-Cardiac Surgery</td>
<td>02/2010</td>
</tr>
<tr>
<td>Rapid Sequence Intubation</td>
<td></td>
</tr>
<tr>
<td>Skin and Soft Tissue Infection - Cellulitis</td>
<td>03/2010</td>
</tr>
<tr>
<td>Status Epilepticus</td>
<td>06/2009</td>
</tr>
<tr>
<td>Stroke</td>
<td>03/2010</td>
</tr>
<tr>
<td>Tracheostomy Management</td>
<td></td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>05/2008</td>
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- Acute Heart Failure
- Acute OM Guideline
- ACS Guideline
- AGD Guideline
- Apyr Clinical Guideline
- Asthma Guideline
- Bronchiolitis Guideline
- CAP Guideline
- Cardiac Thrombosis
- Cellulitis Guideline
Creating EBGs:
2. Assembling a team

- Team
  - Community or Subject Area Practitioner Leader
  - Champion of Guideline topic
  - Sub-specialists in the area of focus
  - Nurses
  - Pharmacist
  - Other Allied Healthcare providers (RTs, OT/PT, etc.)
  - Family / patient

- Clinical Effectiveness and other support
  - Facilitator
  - Methodologist
  - Librarian
  - Data analyst and outcomes coordinator
  - Educator

“Bottom-up” team building and interdisciplinary care are fundamentals of quality improvement
Creating EBGs:

3. Identifying the questions in *PICO format*

- **P** – population
  - “In **ED patients** with bronchiolitis…”
- **I** – intervention
  - “…does nebulized hypertonic saline…”
- **C** – comparison
  - “when compared to standard therapy…”
- **O** – outcome of interest
  - “**prevent admission, shorten ED stay, etc.**”
Creating EBGs: 4. Conducting the search

   PMID: 19446715 [PubMed - indexed for MEDLINE]

2. Bronchiolitis: from empiricism to scientific evidence.
   PMID: 19332125 [PubMed - indexed for MEDLINE]

3. Nebulized hypertonic saline solution for acute bronchiolitis in infants.
   PMID: 18943731 [PubMed - indexed for MEDLINE]

   PMID: 12677643 [PubMed - indexed for MEDLINE]

Display Settings: Summary, Sorted by Recently Added
Creating EBGs:
5. Evaluating the Evidence

Evidence hierarchy
Grading of Recommendations, Assessment, Development and Evaluation

- Recommendations
  - Strong
  - Weak

- Evidence quality
  - High
  - Moderate
  - Low
  - Very low
Guideline appraisal of existing guidelines

- AGREE (Appraisal of Guidelines Research and Evaluation)
  - Becoming “industry standard”
- 23 item list with six domains
  - scope and purpose
  - stakeholder involvement
  - rigor of development
  - clarity and presentation
  - applicability
  - editorial independence
When the evidence is lacking

- Standardize (goal of a guideline)
- Revisit evidence frequently and rigorously
- Clinical/outcomes research to increase evidence base
Age-specific goal directed therapy

- ER: 1st hour fluid resuscitation and inotrope therapy
  - Therapeutic endpoints:
    - Threshold heart rate
    - Normal blood pressure
- Capillary refill ≤2 sec
  - Normal pulses
  - Warm extremities
  - Normal glucose and ionized calcium
- Monitoring
- Recommendations:
  - Airway and breathing
  - Circulation
  - Fluid resuscitation
  - Hemodynamic support
  - Hydrocortisone therapy
- Ongoing ICU hemodynamic support
  - Central venous oxygen saturation >70%
  - Cardiac Index 3.3-6.0 L/min/m²

Shock reversal resulted in better survival

Multiple logistic regression analyses revealed time-dependent relationships between persistent shock and delayed ACCCM-PALS-directed resuscitation with poor outcome.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mortality Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of persistent shock (per 1-hour increment)</td>
<td>2.29</td>
<td>1.19 – 4.44</td>
</tr>
<tr>
<td>Delay in resuscitation consistent with ACCCM-PALS Guidelines (per 1-hour increment)</td>
<td>1.53</td>
<td>1.08 – 2.16</td>
</tr>
</tbody>
</table>

- Improved mortality by 38%
- Number Needed to Treat = 3.3

Han et al., Pediatrics 2003
Evidence for *goal directed therapy*

<table>
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<tr>
<td>Ninis</td>
<td><em>BMJ</em> 2005</td>
<td>Meningococcal septic shock</td>
<td>22.6 adjusted mortality OR with delay in inotrope resuscitation</td>
</tr>
<tr>
<td>de Oliveira</td>
<td><em>Intensive Care Med</em> 2008</td>
<td>Shock with continuous central venous oxygen sat monitoring</td>
<td>RCT: Goal directed therapy via 2002 guidelines decreased mortality from 39% to 12% (NNT 3.6)</td>
</tr>
<tr>
<td>Karapinar</td>
<td><em>Crit Care Med</em> 2004</td>
<td>Tertiary care center patients in fluid refractory shock</td>
<td>Before/after 28 day mortality of targeted goal: 3% otherwise healthy and 9% chronically ill</td>
</tr>
<tr>
<td>Maat</td>
<td><em>Crit Care</em> 2007</td>
<td>Referral, transport and tertiary care center</td>
<td>Reduction in mortality rate from purpura and severe sepsis to 1% (ARR of 19%)</td>
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Shock management at TCH: 2009

- Time to FIRST bolus: 53 min
- Time to THIRD bolus: 152 min
- Time to first antibiotic: 127 min
- Time to PICU: 260 min
The team

- ED: B Patel MD
- ED: A Perry MD
- ED/ID: A Cruz MD, MPH
- Nursing: E Wuestner RN
- PICU: E Williams MD
- Transport: J Graf MD
- Nursing administration: E Fredeboelling RN
Model for communication
I hate you more!

Emergency center

Intensive care unit

Courtesy of Eric Williams MD
If high risk patient (malignancy, BMT, transplant, aspasia, sickle cell disease, central line, or immunodeficiency), consider SHOCK PROTOCOL
From 53 to 23 min
I Chart of Triage to 3rd bolus

From 152 to 67 min
From 127 to 37 min
Balance measures

Tests performed with unequal sample sizes
The outcome

- A reduction in morbidity
- A projected 38% reduction in mortality
- 10 year costs of sepsis related lawsuit settlements:
  - TCH: $2.5 million (actual costs)
  - BCM: $1.25 million (estimated costs)
  - Total projected 10 year savings: $1.4 million

Costs of lawsuits courtesy of L Sessions
LOS in ED for AGE

Moving Average Chart of Length of Stay in ED Before and After Introduction of ORT

- **UCL** = 257.8
- $$\bar{X}$$ = 221.9
- **LCL** = 185.9

ED patients with chief complaint of vomiting or diarrhea and dx of AGE, vomiting or diarrhea
Gains: capacity measures

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Financial implications: $250,000 to 1.3 million contribution to margin

Financial planning and reporting: Alec King and Carolyn Smith
Bronchiolitis measures

![Graph showing ED LOS for RSV-LOS and Bronch-LOS over years 2006 to 2009. The graph indicates a decrease in ED LOS from 2006 to 2009.]
Cost savings (bronchiolitis)

Calculating cost savings inpatient
- Use # of Admits for Bronchiolitis (2009 = 583)
- Calculate days saved per year based upon ALOS decrease from 2006 pre EBG year
  - Building capacity
- Use 2009 data to determine “variable direct cost” per day ($2011)
- Calculate savings in 2008 - $128,965
- Assumption: filling beds in early days with patients with higher margin per case

Calculating capacity ED
- Building ED capacity because of shorter LOS in ED
- 2006 to 2009: ED LOS decreased 2.91 hours for bronchiolitis
  - x 1430 patients = 4161 hours
  - x avg LOS in 2009 (5.27 hrs) = 789 additional patients
- Could multiple by per patient revenue/margin for financial impact
  - Contribution margin: 1.57 million
  - Complex model with multiple caveats

Financial planning and reporting: Alec King and Carolyn Smith
Not all EBGs are created equal

Evidence

Scientific judgment

Analyze Evidence

Outcomes

Preferences

Benefits, harms and costs

Outcomes

Evidence

Consensus

Based

Adapted from D Eddy MD, PhD
Questions?

The Center for Clinical Effectiveness
Knowledge translation research
Process mapping/AGE
Bronchiolitis/financial measures
the Center for Clinical Effectiveness

Centers of Excellence

Health Services Research

Data Transformation

Education and Community Outreach

Health Information Technology Integration

Policy and Advocacy

Patient Safety

Evidence Based Outcomes Center

Baylor College of Medicine

Texas Children’s Hospital
Knowledge translation

Adapted from Tugwell J Chron Dis 1985
Acute Gastroenteritis EBG

AGE multi-disciplinary team included:
- P Nag MD
- J Tran MD
- C Allen MD
- S Patel MD
- M Gilger MD
- C Davis RN
- A Hope
- C Conkin, MS, RD
- EBOC specialist: Q Franklin, MS
- EBOC implementation specialist: E Crabtree

Definitions: Acute gastroenteritis (AGE) is a decrease in the consistency of stools (loose or liquid) and/or an increase in the frequency of stools (typically >3 in 24 hours), with or without fever or vomiting. However, vomiting alone is typical of early presentation. Duration of illness is typically less than 14 days.

Epidemiology: In the United States, approximately 1.5 million outpatient visits, 200,000 hospitalizations and 300 deaths are recorded each year for children with gastroenteritis. Approximately one-third of all hospitalizations for diarrhea (children <5 years) were due to rotavirus. In February 2002, routine use of a pentavalent human-bovine rotavirus vaccine was recommended. Since these recommendations have been implemented, there has been a delayed season and a statistically low percentage of rotavirus positive tests. In children seen in the Emergency Center at Texas Children’s Hospital, pentavalent rotavirus vaccine (Rivar) was noted to be highly effective in preventing rotavirus disease.

Etiology: The most common causes of AGE are infectious agents. In the developed world, viruses are responsible for 70% to 80% of infectious diarrhea cases. Rotavirus and norovirus are the leading viral pathogens with nearly every child in the U.S. being infected with rotavirus by 5 years of age. Various bacterial pathogens account for another 10% to 20% of cases and as many as 10% may be attributable to diarrheagenic Escherichia coli. Parasitic organisms such as Giardia species cause fever less than 10% of cases. Incidence is affected by climate and season. Other factors that increase the risk of AGE in children include day care attendance and impoverished living conditions with poor sanitation.

Guideline Eligibility Criteria:
- Age: 2-52 days to 11 years
- Healthy children without underlying conditions

Clinical Findings of AGE:
- Clinical features: Diarrhea, vomiting, fever, dehydration, and abdominal pain
- Laboratory findings: Stool culture, blood tests, and imaging studies

Diagnosis:
- Rotavirus disease typically begins abruptly. Vomiting often precedes the onset of diarrhea. Norwalk-like virus is characterized by acute onset of nausea, vomiting, abdominal cramps, and diarrhea. Vomiting can appear alone in Norwalk-like disease.

Physical Examination:
- Severity of dehydration (none/mild, moderate, or severe) is the key factor in determining the severity of AGE which is primarily based on the child’s dehydration status. Management requires a rapid risk assessment of dehydration.
- A complete physical exam should be performed assessing:
  - Weight loss (pre-illness weight minus acute body weight)
  - Protracted capillary refill time (> 2 seconds)
  - Dry mucous membranes
  - Absent tears
  - Poor overall appearance
  - Abdominal skin turgor
  - Sunken eyes
  - Abnormal radial pulse
  - Tachypnea (HR > 30, acute validated in children 1 month to 5 years)
  - Abnormal respirations
  - Decreased urine output

Accurate body weight is considered the gold standard in determining fluid deficit (pre-illness weight minus acute body weight).

The presence of at least 3 out of 4 predicts a fluid deficit of 10% or more.

Combination of clinical findings improves diagnostic characteristics.

Laboratory Tests:
- Routine laboratory tests are NOT recommended for children with mild/moderate dehydration.
- Consider stool culture with bloody stools, prolonged symptoms, suspicion of epidemic, and/or travel exposure.
- Consider urinalysis (UA) with micro and culture when concerned for UTI.
- Consider Clostridium difficile if previous use of antibiotics.
- Serum sodium level is an unreliable predictor for determining the severity of dehydration.
- Stool specimen for enteric pathogens.
- Non-acid-fast stained: transmural small bacterial.
- Urine specimen for electrolyte analysis.
- EBOC specialist: Q Franklin, MS
- EBOC implementation specialist: E Crabtree

LOS in ED for the diagnosis: Vomiting (787.03)
Patient presents to Emergency Dept (ED).

Patient registers

Patient waiting

Patient evaluated by triage nurse

Does patient have vomiting & or diarrhea

Evaluate per clinical symptoms

Triage nurse does the following:
- Vitals

What is the patient's level of dehydration?

Severe dehydration

Mild or Moderate dehydration

Is the patient vomiting?

Put patient in ED room

Follow TCH AGE clinical algorithm

Patient waiting

Patient put in ED room

Patient evaluated by nurse

Patient evaluated by Medical student

Patient evaluated by ED resident

Patient evaluated by ED fellow

Patient evaluated by ED attending

Decision to discharge patient

Nurse discharges patient

PCA checks vital signs

MD does discharge orders

Decision to admit patient

Fellow/ Attending does pre-transfer check

Bed approved

ED secretary requests bed

MD does admission orders

Patient discharged home

Patient transferred to inpatient bed

1 Outcome: Time in ED
2 Outcome: Time to inpatient bed
3 Outcome: Length of stay (LOS)
4 Outcome: Revisit from ED discharge
4 Outcome: Revisit from inpatient discharge

Key:
- Solid arrow indicates “yes”
- Broken arrow indicates “no”

1. Process map before EBG


3. Flow chart of a patient with acute gastroenteritis through the TCH Emergency Department: Existing process

4. Process map before EBG

Modified: 7/21/2009
EBG leverage points
Parents: Your child has been vomiting and/or has diarrhea and needs clear fluid by a syringe. Your child needs small frequent amounts so they will not vomit. Follow the 5 steps below.

1. Give your child \( \frac{1}{2} \) of a syringe \( \biggm/ \), then wait 5 minutes \( \biggm/ \).
2. Give your child 1 full syringe \( \biggm/ \), then wait 5 minutes \( \biggm/ \).
3. Give your child 2 full syringes \( \biggm/ \), then wait 5 minutes \( \biggm/ \).
   * If your child vomits \( \biggm/ \), wait 10 minutes \( \biggm/ \) and start again. If your child vomits 3 times \( \biggm/ \), tell a nurse.
4. If your child does not vomit, then give your child 3 full syringes \( \biggm/ \) \( \biggm/ \) \( \biggm/ \), every 5 minutes \( \biggm/ \).
   * Please mark a box below for every syringe your child takes.

5. Please come back to the nurse \( \biggm/ \), in 90 minutes at \( \biggm/ \) for them to check on your child.
Patient presents to Emergency Dept (ED).

Patient registers

Patient waiting

Patient evaluated by triage nurse

Triage nurse does the following:
- Vitals
- Assess dehydration (Gorelick score)**

What is the patient's level of dehydration?

- Severe dehydration
- Mild or Moderate dehydration

Is the patient vomiting?

Triage nurse does the following:
- Give Zofran
- Provide patient education on ORT
- Initiate ORT
- Give ORT tracking sheet**

What is the patient's level of dehydration?

Severe dehydration

Mild or Moderate dehydration

Triage nurse does the following:
- Provide patient education on ORT
- Initiate ORT
- Give ORT tracking sheet**

Triage nurse does the following:
- Assess vomiting &/or diarrhea
- Evaluate per clinical symptoms

Key:
- solid arrow indicates "yes"
- broken arrow indicates "no"

** New process
1 Outcome: Time in ED
2 Outcome: Time to inpatient bed
3 Outcome: Length of stay (LOS)
4 Outcome: Revisit from ED discharge
4 Outcome: Revisit from inpatient discharge

MD does discharge orders

Nurse discharges patient

PCA checks vital signs

Decision to discharge patient

Is the patient ok for discharge?

Fellow/ Attending does pre-transfer check

PCA checks vital signs

ED secretary requests bed

MD does admission orders

Decision to admit patient

Bed approved

Nurse-Nurse checkout occurs

Collect ORT tracking sheet

Modified: 5/9/2009

Fellow/ Attending does pre-transfer check

Process map after EBG

Flow chart of a patient with acute gastroenteritis through the TCH Emergency Department
LOS in ED for AGE

Moving Average Chart of Length of Stay in ED Before and After Introduction of ORT

ED patients with chief complaint of vomiting or diarrhea and dx of AGE, vomiting or diarrhea

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$250,000 to 1.3 million contribution to margin

Financial planning and reporting: Alec King and Carolyn Smith
Bronchiolitis EBG

- Multi-disciplinary team included:
  - Y Han MD
  - M McPherson MD
  - B Hogan MD
  - R Moore MD
  - R Wolf RN
  - S Iniquez RCP
  - S Kim PharmD
  - C Jones, EBOC specialist
Phase 1: Implementation focus on ED

ED Visits for Bronchiolitis

- 2006
- 2007: Highest visit count
- 2008
- 2009

Legend: Total
No change in severity by CRS score
Bronchiolitis measures

ED LOS

Hours

2006 2007 2008 2009

RSV-LOS

Bronch-LOS
Bronchiolitis measures across the continuum
Cost savings (bronchiolitis)

- **Calculating cost savings inpatient**
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Financial planning and reporting: Alec King and Carolyn Smith
Objectives

1. To define the role of evidence based guidelines in medical decision making.
2. To describe strategies for the effective creation and implementation of guidelines.
3. To understand the relationship of evidence based guidelines to quality improvement.
4. To discuss strategies for linking measures and outcomes to guideline implementation.

This discussion will focus on the merger of science and operations, both critical for high quality health care delivery.