Bringing Evidence-Based Protocols to the Bedside: Barriers and Strategies for Implementation

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Tokyo, JAPAN
Guidelines and protocols

• Example: ARDS, TBI and sepsis
• ARDS
• TBI
• Sepsis
Acute lung injury in children: Therapeutic practice and feasibility of international clinical trials

Miriam Santschi, MD; Philippe Jouvet, MD; Francis Leclerc, MD; France Gauvin, MD; Christopher J. L. Newth, MD; Christopher L. Carroll, MD; Heidi Flori, MD; Robert C. Tasker, MD; Peter C. Rimensberger, MD; Adrienne G. Randolph, MD; for the PALIVE Investigators, the Pediatric Acute Lung Injury and Sepsis Investigators Network (PALIS), and

Objectives: To describe acute lung injury and to identify eligibility criteria for clinical trials on mechanical ventilation in contrast to adult medicine, and to assess the feasibility of conducting international clinical trials on mechanical ventilation for acute lung injury.


Setting: Fifty-nine pediatric ICUs in North America and Europe.

Patients: We identified patients with inclusion/exclusion criteria and collected demographic data as part of the PALIVE study.

Interventions: None.

Measurements and Main Results: A total of 414 patients (10.8%) were diagnosed with acute lung injury by the treating physician, but only 15% met inclusion/exclusion criteria. The remaining patients were considered eligible for a clinical trial. The bar graph illustrates the distribution of tidal volumes (mL/kg) across different age groups.
Tidal Volume Delivery

Recommendations:

3.2.1 In any mechanically ventilated pediatric patient, we recommend in controlled ventilation to use tidal volumes in or below the range of physiologic tidal volumes for age/body weight (i.e., 5 to 8 mL/kg predicted body weight [PBW]) according to lung pathology and respiratory system compliance. *Weak agreement (88% agreement)*

3.2.2 We recommend to use patient-specific tidal volumes according to disease severity. Tidal volumes should be 3–6 mL/kg PBW for patients with poor respiratory system compliance and closer to the physiologic range (5–8 mL/kg ideal body weight) for patients with better preserved respiratory system compliance. *Weak agreement (84% agreement)*
Guidelines and protocols

- Example: ARDS, TBI and sepsis
- ARDS
- TBI
- Sepsis
Acute Care Clinical Indicators Associated With Discharge Outcomes in Children With Severe Traumatic Brain Injury

Monica S. Yavich, Richard B. Miller, Michael J. Bell, Linda Ng Boyce for the Pediatric Brain Trauma Research Network.
Guidelines and protocols

• Example: ARDS and sepsis
• ARDS
• Sepsis
  – Surviving sepsis campaign guidelines
  – Japanese sepsis guidelines

R. Phillip Dellinger, MD¹; Mitchell M. Levy, MD²; Andrew Rhodes, MB BS³; Djillali Annane, MD⁴; Herwig Gerlach, MD, PhD⁵; Steven M. Opal, MD⁶; Jonathan E. Sevransky, MD⁷; Charles L. Sprung, MD⁸; Ivor S. Douglas, MD⁹; Roman Jaeschke, MD¹⁰; Tiffany M. Osborn, MD, MPH¹¹; Mark E. Nunnally, MD¹²; Sean R. Townsend, MD¹³; Konrad Reinhart, MD¹⁴; Ruth M. Kleinpell, PhD, RN-CS¹⁵; Derek C. Angus, MD, MPH¹⁶; Clifford S. Deutschman, MD, MS¹⁷; Flavia R. Machado, MD, PhD¹⁸; Gordon D. Rubenfeld, MD¹⁹; Steven A. Webb, MB BS, PhD²⁰; Richard J. Beale, MB BS²¹; Jean-Louis Vincent, MD, PhD²²; Rui Moreno, MD, PhD²³; and the Surviving Sepsis Campaign Guidelines Committee including the Pediatric Subgroup*

(Crit Care Med 2013; 41:580–637)
Sepsis Management (ACCM-PALS)

0 min
- Recognize decreased mental status and perfusion.
  - Begin high flow O₂. Establish IV/IO access.

5 min
- Initial resuscitation: Push boluses of 20 cc/kg isotonic saline or colloid up to & over 60 cc/kg until perfusion improves or unless rales or hepatomegaly develop.
  - Correct hypoglycemia & hypocalcemia. Begin antibiotics.
  - shock not reversed?

15 min
- Fluid refractory shock: Begin inotrope IV/IO.
  - Use atropine/ketamine IV/IO/IM to obtain central access & airway if needed.
  - Reverse cold shock by titrating central dopamine or, if resistant, titrate central epinephrine
  - Reverse warm shock by titrating central norepinephrine.
  - shock not reversed?

60 min
- Catecholamine resistant shock: Begin hydrocortisone if at risk for absolute adrenal insufficiency

If 2nd PIV start inotrope.

Dose range: dopamine up to 10 mcg/kg/min, epinephrine 0.05 to 0.3 mcg/kg/min.
Catecholamine resistant shock: Begin hydrocortisone if at risk for absolute adrenal insufficiency.

Monitor CVP in PICU, attain normal MAP-CVP & ScvO₂ > 70%.

Cold shock with normal blood pressure:
1. Titrate fluid & epinephrine, ScvO₂ > 70%, Hgb > 10 g/dL
2. If ScvO₂ still < 70%
   Add vasodilator with volume loading (nitrosovasodilators, milrinone, imrinone, & others)
   Consider levosimendan

Cold shock with low blood pressure:
1. Titrate fluid & epinephrine, ScvO₂ > 70%, Hgb > 10 g/dL
2. If still hypotensive consider norepinephrine
3. If ScvO₂ still < 70% consider
dobutamine, milrinone, enoximone or levosimendan

Warm shock with low blood pressure:
1. Titrate fluid & norepinephrine, ScvO₂ > 70%,
2. If still hypotensive consider vasopressin, terlipressin or angiotensin
3. If ScvO₂ still < 70% consider low dose epinephrine

**shock not reversed?**

Persistent catecholamine resistant shock: Rule out and correct pericardial effusion, pneumothorax, & intra-abdominal pressure >12 mm/Hg.
Consider pulmonary artery, PICCO, or FATD catheter, &/or doppler ultrasound to guide fluid, inotrope, vasopressor, vasodilator and hormonal therapies.
Goal C.I. > 3.3 & < 6.0 L/min/m²

**shock not reversed?**

Refactory shock: ECMO
Experts’ Opinion and Recommendation on Management of Pediatric Severe Sepsis

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- **shock not reversed?**

60 min
- **Catecholamine resistant shock:** Begin hydrocortisone if at risk for absolute adrenal insufficiency

If 2nd PIV start inotrope.
- Dose range: dopamine up to 10 mcg/kg/min, epinephrine 0.05 to 0.3 mcg/kg/min.
5分以内に

1. 意識低下および組織灌流悪化
   - 気道確保後、高流量酸素投与
   - 静脈路あるいは骨髄路確保
   - 循環不全の評価（主記）
   - 全身性炎症反応の評価

2. 発症性ショックの疑い
   - 初期治療と反応性評価
     - 20mL/kgの等張晶質液
     - 組織灌流が改善するか、湿性ラ音や肝腫大が出現するまで最大60mL/kg（またはそれ以上）ポラール投与
     - 低血糖と低カルシウム血症の補正
     - 血液培養後、抗菌薬を投与

3. 輸液に反応なし
   - 輸液不応性ショック
     - 追加治療と反応性評価
       - 中心静脈路確保
       - 腎血圧動脈圧測定
       - 気管挿管／人工呼吸開始を考慮
       - 末梢が冷たければドパミンあるいはアドレナリンを使用
       - 末梢が温かければノルアドレナリンを使用

4. 反応なし
   - カテコラミン不応性ショック

5. 15分以内に

- 末梢、中枢の脈拍触知
- 末梢温と中枢温の差
- 皮膚の色、温度
- 毛細血管再充満時間
- 血圧、心拍数
- 意識レベル
- 尿量
- 心臓超音波検査

ドパミン：5～10μg/kg/min
アドレナリン：0.05～0.3μg/kg/min
ノルアドレナリン：0.05～0.3μg/kg/min

Echocardiography
Early Reversal of Pediatric-Neonatal Septic Shock by Community Physicians Is Associated With Improved Outcome

Yong Y. Han, MD§; Joseph A. Carcillo, MD†§; Michelle A. Dragotta, RNS; Debra M. Bills, RNS; R. Scott Watson, MD, MPH†§; Mark H. Westerman, RT§; and Richard A. Orr, MD†§

ABSTRACT. Objective. Experimental and clinical studies of septic shock support the concept that early resuscitation with fluid and inotropic therapies improves survival in a time-dependent manner. The new American College of Critical Care Medicine-Pediatric Advanced Life Support (ACCM-PALS) Guidelines for hemodynamic support of newborns and children in septic shock recommend this therapeutic approach. The objective of this study was to determine whether early septic shock reversal and use of resuscitation practice consistent with the new ACCM-PALS Guidelines by community physicians is associated with improved outcome.

Methods. A 9-year (January 1993–December 2001) retrospective cohort study was conducted of 91 infants and children who presented to local community hospitals with septic shock and required transport to Children’s Hospital of Pittsburgh. Shock reversal (defined by return of normal systolic blood pressure and capillary refill time), resuscitation practice concurrence with ACCM-PALS Guidelines, and hospital mortality were measured.

Results. Overall, 26 (29%) patients died. Community physicians successfully achieved shock reversal in 24 (26%) patients at a median time of 75 minutes (when the transport team arrived at the patient’s bedside), which was associated with 96% survival and >9-fold increased odds of survival (9.49 [1.07–83.89]). Each additional hour of persistent shock was associated with >2-fold increased odds of mortality (2.29 [1.19–4.44]). Nonsurvivors, compared with survivors, were treated with more inotropic therapies (dopamine/dobutamine [42% vs 20%] and epinephrine/norepinephrine [42% vs 6%]) but not increased fluid therapy (median volume; 32.9 mL/kg vs 20.0 mL/kg). Resuscitation practice was consistent with ACCM-PALS Guidelines in only 27 (30%) patients; however, when practice was in agreement with guideline recommendations, a lower mortality was observed (8% vs 38%).

Conclusions. Early recognition and aggressive resuscitation of pediatric-neonatal septic shock by community physicians can save lives. Educational programs that promote ACCM-PALS recommended rapid, stepwise escalations in fluid as well as inotropic therapies may have value in improving outcomes in these children. Pediatrics 2003;112:793–799; fluid resuscitation, inotropes, interfacility transport, hydrocortisone.

ABBREVIATIONS. ACCM, American College of Critical Care Medicine; AIHA, American Heart Association; PALS, Pediatric Advanced Life Support; CHP, Children’s Hospital of Pittsburgh; SBP, systolic blood pressure; PRISM, Pediatric Risk of Mortality; PICU, pediatric intensive care unit.

Experimental and clinical studies of septic shock support the concept that persistent shock has an adverse impact on survival in a time-dependent manner.1–4 Recently, a randomized, controlled study of adult septic shock showed that early aggressive goal-directed resuscitation in the emergency department improves outcome.5 Although comparable randomized studies in children are lacking, the reported pediatric literature has been consistent with both experimental studies and the adult experience. We previously reported a role for early, aggressive fluid resuscitation in pediatric septic shock.6 Nadel et al7 (at St. Mary’s Hospital in London, England) attributed poor outcome from severe meningococcal disease to delayed recognition and treatment. Borry et al8 extended their findings at St. Mary’s Hospital by reporting decreased mortality from meningococcal disease over a 6-year period from 23% to 2% after they had implemented a community hospital-based education and resuscitation program with specialized, pediatric critical care transport.

In this regard, the American College of Critical Care Medicine (ACCM) recently published its Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Patients in Septic Shock,9 which has
Early Reversal of Pediatric-Neonatal Septic Shock by Community Physicians Is Associated With Improved Outcome

Yong Y. Han, MD*; Joseph A. Carcillo, MD*†; Michelle A. Dragotta, RN§; Debra M. Bills, RNS; R. Scott Watson, MD, MPH*‡; Mark E. Westerman, RJ§; and Richard A. Orr, MD*‡

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Methods. A 9-year (January 1995–December 2003) retrospective cohort study was conducted of 91 infants and children who presented to local community hospitals with septic shock and required transport to Children's Hospital of Pittsburgh. Shock reversal was defined as return of normal systolic blood pressure and capillary refill time, resuscitation practice concurrence with ACCM-PALS Guidelines, and hospital mortality was measured. Results. Overall, 26 (29%) patients died. Community physicians successfully achieved shock reversal in 24 (26%) patients at a median time of 75 minutes (when the transport team arrived at the patient's bedside), which was associated with 96% survival and 2.9-fold increased odds of survival (9.49 [1.07–83.89]). Each additional hour of persistent shock was associated with >2-fold increased odds of mortality (5.29 [1.19–4.44]). Non-survivors, compared with survivors, were treated with more inotropic therapies (dopamine/dobutamine [42% vs 20%] and epinephrine/norepinephrine [42% vs 6%]) but not increased fluid therapy (median volume: 32.9 mL/kg vs 20.0 mL/kg). Resuscitation practice was consistent with ACCM-PALS Guidelines in only 27 (30%) patients; however, when practice was in agreement with guideline recommendations, a lower mortality was observed (6% vs 38%).

Conclusions. Early recognition and aggressive resuscitation of pediatric-neonatal septic shock by community physicians can save lives. Educational programs that promote ACCM-PALS recommended rapid, stepwise actions in fluid as well as inotropic therapies may value in improving outcomes in these children. *P < .001 versus shock reversed; †P < .001 versus resuscitation consistent with ACCM-PALS Guidelines.
Results: 34/200 (17%) children died following referral. Although children defined as being in shock received significantly more fluid (p<0.001) than those who were not in shock, overall fluid and inotrope management suggested by the 2002 ACCM-PALS guideline was not followed in 62% of shocked children. Binary logistic regression analysis demonstrated that the odds ratio for death, if shock was present at PICU admission, was 3.8 (95% CI 1.4 to 10.2, p = 0.008).

Conclusions: The presence of shock at PICU admission is associated with an increased risk of death. Despite clear consensus guidelines for the emergency management of children with severe sepsis and septic shock, most children received inadequate fluid resuscitation and inotropic support in the crucial few hours following presentation.
Catecholamine resistant shock: Begin hydrocortisone if at risk for absolute adrenal insufficiency

Monitor CVP in PICU, attain normal MAP-CVP & ScvO₂ > 70%

Cold shock with normal blood pressure:
1. Titrate fluid & epinephrine, ScvO₂ > 70%, Hgb > 10 g/dL
2. If ScvO₂ still < 70%
   Add vasodilator with volume loading (nitrosovasodilators, milrinone, imrinone, & others)
   Consider levosimendan

Cold shock with low blood pressure:
1. Titrate fluid & epinephrine, ScvO₂ > 70%, Hgb > 10 g/dL
2. If still hypotensive consider norepinephrine
3. If ScvO₂ still < 70% consider dobutamine, milrinone, enoximone or levosimendan

Warm shock with low blood pressure:
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Persistent catecholamine resistant shock: Rule out and correct pericardial effusion, pneumothorax, & intra-abdominal pressure >12 mm/Hg.
Consider pulmonary artery, PICCO, or FATD catheter, &/or doppler ultrasound to guide fluid, inotrope, vasopressor, vasodilator and hormonal therapies.
Goal C.I. > 3.3 & < 6.0 L/min/m²

Shocks not reversed?

Refractory shock: ECMO
ACCM/PALS haemodynamic support guidelines for paediatric septic shock: an outcomes comparison with and without monitoring

Control versus intervention group

Survival probability (%)

Group
Control
Intervention

p = 0.002
HR=3.78 (1.58-7.52)
Adherence of PALS sepsis guidelines
Adherence of PALS sepsis guidelines

### TABLE 2 Association of Fluid Adherence With LOS

<table>
<thead>
<tr>
<th></th>
<th>Fluid Adherence, $n = 46$, Mean No. Days$^a$</th>
<th>Fluid Nonadherence, $n = 80$, Mean No. Days$^a$</th>
<th>Decrease, %</th>
<th>$P$ Value$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital LOS</td>
<td>8</td>
<td>11.2</td>
<td>57</td>
<td>.039</td>
</tr>
<tr>
<td>ICU LOS</td>
<td>5.5</td>
<td>7.2</td>
<td>42</td>
<td>.024</td>
</tr>
</tbody>
</table>

$^a$ Unadjusted means.

$^b$ $P$ value references “percent decrease in LOS” by using negative binomial regression, adjusting for PIM2 score at presentation and other comorbidities.

### TABLE 3 Association of Total Algorithm Adherence With LOS

<table>
<thead>
<tr>
<th></th>
<th>Algorithm Bundle Adherence, $n = 24$, Mean No. Days$^a$</th>
<th>Algorithm Bundle Nonadherence, $n = 102$, Mean No. Days$^a$</th>
<th>Decrease, %</th>
<th>$P$ Value$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital LOS</td>
<td>6.8</td>
<td>10.9</td>
<td>57</td>
<td>.009</td>
</tr>
<tr>
<td>ICU LOS</td>
<td>5.5</td>
<td>6.8</td>
<td>59</td>
<td>.035</td>
</tr>
</tbody>
</table>

$^a$ Unadjusted means.

$^b$ $P$ value references “percent decrease in LOS” by using negative binomial regression, adjusting for PIM2 score at presentation and other comorbidities.
An Emergency Department Septic Shock Protocol and Care Guideline for Children Initiated at Triage

abstract

BACKGROUND: Unrecognized and undertreated septic shock increases morbidity and mortality. Septic shock in children is defined as sepsis and cardiovascular organ dysfunction, not necessarily with hypotension.

OBJECTIVE: Cases of unrecognized and undertreated septic shock in our emergency department (ED) were reviewed with a focus on (1) increased recognition at triage and (2) more aggressive treatment once recognized. We hypothesized that septic shock protocol and care guideline would expedite identification of septic shock, increase compliance with recommended therapy, and improve outcomes.

METHODS: We developed an ED septic shock protocol and care guideline to improve recognition beginning at triage and evaluated all eligible ED patients from January 2005 to December 2009.

RESULTS: We identified 345 pediatric ED patients (49% male, median age: 5.6 years), and 297 (86.1%) met septic shock criteria at triage. One hundred ninety-six (56.8%) had ≥1 chronic complex condition. Hypotension was present in 34% (n = 120), the most common findings were tachycardia (n = 251 [73%]) and skin-color changes (n = 269 [78%]). The median hospital length of stay declined over the study period (median: 181–140 hours; P < .05); there was no change in mortality rate, which averaged 6.3% (22 of 345). The greatest gains in care included more complete recording of triage vital signs, timely fluid resuscitation and antibiotic administration, and serum lactate determination.

CONCLUSIONS: Implementation of an ED septic shock protocol and care guideline improved compliance in delivery of rapid, aggressive fluid resuscitation and early antibiotic and oxygen administration and was associated with decreased length of stay. Pediatrics 2011;127:e1585–e1592
An Emergency Department Septic Shock Protocol Care Guideline for Children Initiated at Tria

abstract

BACKGROUND: Unrecognized and undertreated septic shock increases morbidity and mortality. Septic shock, sepsis, and cardiovascular organ dysfunction, including hypotension.

OBJECTIVE: Cases of unrecognized and undertreated septic shock were revised at the time of presentation. We hypothesized that septic shock would expedite the identification of patients with recommended therapy, and improve outcomes.

METHODS: We developed an ED septic shock protocol to improve recognition beginning at triage and ED patients from January 2005 to December 2007.

RESULTS: We identified 345 pediatric ED patients (age: 5.8 years), and 297 (86.1%) met septic shock criteria. Ninety-six (56.8%) had ≥1 chronic conditions, and the median hospital stay was 34% (n = 120), of 299 (73%) and skin color (n = 299). The median hospital length of stay was 181–140 hours; P < .05). There was no significant difference in length of stay, and antibiotic administration, and serum lactate level.

CONCLUSIONS: Implementation of an ED septic shock protocol improved compliance with fluid resuscitation and early antibiotic administration, and serum lactate measurement.

IV bolus of 20 ml/kg

Lactate measurement

Antibiotics
Improving Adherence to PALS Septic Shock Guidelines

abstract

BACKGROUND AND OBJECTIVES: Few studies have demonstrated improvement in adherence to Pediatric Advanced Life Support guidelines for severe sepsis and septic shock. We sought to improve adherence to national guidelines for children with septic shock in a pediatric emergency department with poor guideline adherence.

METHODS: Prospective cohort study of children presenting to a tertiary care pediatric emergency department with septic shock. Quality improvement (QI) interventions, including repeated plan-do-study-act cycles, were used to improve adherence to a 5-component sepsis bundle, including timely (1) recognition of septic shock, (2) vascular access, (3) administration of intravenous (IV) fluid, (4) antibiotics, and (5) vasoactive agents. The intervention focused on IV fluid delivery as a key driver impacting bundle adherence, and adherence was measured using statistical process control methodology.

RESULTS: Two-hundred forty-two patients were included: 126 subjects before the intervention (November 2009 to March 2011), and 116 patients during the QI intervention (October 2011 to May 2013). We achieved 100% adherence for all metrics, including (1) administration of 60 mL/kg IV fluid within 60 minutes (increased from baseline adherence rate of 37%), (2) administration of vasoactive agents within 60 minutes (baseline rate of 35%), and (3) 5-component bundle adherence (baseline rate of 19%). Improvement was sustained over 9 months. The number of septic shock cases between each death from this condition increased after implementation of the QI intervention.

CONCLUSIONS: Using QI methodology, we have demonstrated improved adherence to national guidelines for severe sepsis and septic shock. Pediatrics 2014;133:e1358–e1366

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KEY WORDS
sepsis, severe sepsis, septic shock, PALS, quality improvement, adherence, guidelines

ABBREVIATIONS
ED—emergency department
IQR—interquartile range
IV—intravenous
LOS—length of stay
PALS—Pediatric Advanced Life Support
PIM2—Pediatric Index of Mortality Score, version 2
QI—quality improvement
SPC—statistical process control

Dr Paul conceived and designed the study, supervised the conduct of the trial and data collection, undertook acquisition of data of included patients and managed the data, including quality control, drafted the manuscript, including all revisions, and takes responsibility for the paper as a whole; Dr Melendez conceived and designed the study as well as supervised the conduct of the trial and data collection, undertook acquisition of data of included patients and managed the data, including quality control, assisted with drafting of the manuscript, including all revisions, and approved the manuscript as submitted; Dr Stack conceived and designed the study and undertook acquisition of data of included patients and managed the data, drafted the manuscript, including all revisions, and approved the manuscript as submitted; Dr Capraro conceived and designed the study and undertook acquisition of data of included patients and managed the data, assisted with drafting of the manuscript, including all revisions, and approved the manuscript as submitted; Dr Neuman conceived and supervised the study, contributed to the interpretation of the data, and approved the manuscript as submitted.
Improving Adherence to PALS Septic Shock Guidelines

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Improving Adherence to PALS Septic Shock Guidelines

**abstract**

**BACKGROUND AND CONTEXT**

Improvement in adherence for severe sepsis Care Bundle to national pediatric emergency guidelines is vital. A new Care Bundle, including timely interventions, was used to increase adherence.

**METHODS**

Prospective care pediatric emergency guidelines (PALS) improvement cycles were used to track adherence (baseline months). The number of patients who achieved 100% adherence to 60 mL/kg IV fluid was significantly higher than baseline months. The number of patients who achieved 100% adherence for 60 mL/kg IV fluid within 60 minutes was significantly higher than baseline months.

**RESULTS**

Two-hundred patients were included in the study. The percentage of patients who achieved 100% adherence to the Care Bundle within 60 minutes was significantly higher than baseline months.

**CONCLUSIONS**

Using adherence to national guidelines, a significant increase in adherence was observed.

**Figure 2**

Ishikawa fishbone diagram for fluid delivery. The barriers to delivery of 60 mL/kg of IV fluids within 60 minutes can be divided into four key contributors: each has subcomponents outlining barriers and potential solutions. CA, clinical assistant; MD, medical doctor; RN, registered nurse; IO, intravenous device.
Ishikawa Fishbone Diagram
石川 馨『品質管理入門』QCテキスト・シリーズ 1、日科技連出版社、1956年
Barriers

- People
  - Manpower
  - Leadership
- Process and Management
  - Knowledge
  - Communication
- Equipment
- Environment
Interventions at Boston Children’s

- Education including skills
- Algorithm Posters
- Pocket cards for algorithm, sepsis definition, medicine dosing and detailed care
- Standardized order sets in electrical medical record system and “bolt” alerts
- Big “Shock Clock”
Implementation strategy
The Canadian Critical Care Nutrition Guidelines in 2013: An Update on Current Recommendations and Implementation Strategies

Rupinder Dhaliwal, RD, BASc¹; Naomi Cahill, RD, PhD²; Margot Lemieux, RD, BSc¹; and Daren K. Heyland, MD, MSc²

Table 3. Questions Considered When Developing a Tailored Intervention.

- What can we do better? That is, which guideline recommendations did we perform poorly on in the practice audit?
- What are the barriers to following these guideline recommendations; that is, as indicated by the staff responses to the barriers survey?
- What barriers do we want to target for change?
- What action can we take to overcome these barriers?
  - Is this feasible in our ICU?
  - Will it result in the desired change (i.e., impact of the action on the barrier)?
- What steps need to be taken to achieve this change?
  - Who will be responsible for each step?
  - When will each step be completed?
  - How will we know if the desired change has occurred (i.e., outcome measure)?
  - What method should we use to assess the outcome?
Use of Electronic Medical Record–Enhanced Checklist and Electronic Dashboard to Decrease CLABSIs

abstract

OBJECTIVES: We hypothesized that a checklist enhanced by the electronic medical record and a unit-wide dashboard would improve compliance with an evidence-based, pediatric-specific catheter care bundle and decrease central line–associated bloodstream infections (CLABSI).

METHODS: We performed a cohort study with historical controls that included all patients with a central venous catheter in a 24-bed PICU in an academic children's hospital. Postintervention CLABSI rates, compliance with bundle elements, and staff perceptions of communication were evaluated and compared with preintervention data.

RESULTS: CLABSI rates decreased from 2.6 CLABSI per 1000 line-days before intervention to 0.7 CLABSI per 1000 line-days after intervention. Analysis of specific bundle elements demonstrated increased daily documentation of line necessity from 30% to 73% (P < .001), increased compliance with dressing changes from 87% to 90% (P = .003), increased compliance with cap changes from 87% to 93% (P < .001), increased compliance with port needle changes from 89% to 95% (P < .001), but decreased compliance with insertion bundle documentation from 67% to 62% (P = .001). Changes in the care plan were made during review of the electronic medical record checklist on 39% of patient rounds episodes.

CONCLUSIONS: Use of an electronic medical record–enhanced CLABSI prevention checklist coupled with a unit-wide real-time display of adherence was associated with increased compliance with evidence-based catheter care and sustained decrease in CLABSI rates. These data underscore the potential for computerized interventions to promote compliance with proven best practices and prevent patient harm. Pediatrics 2014;133:e738–e746

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KEY WORDS

CLABSI, EMR, dashboard, evidence-based guidelines, maintenance bundle

ABBREVIATIONS

ARIMA—autoregressive integrated moving average
CLABSI—central line–associated bloodstream infection
EMR—electronic medical record
IV—intravenous
LPCH—Lucile Packard Children's Hospital
NACHRI—National Association of Children's Hospitals and Related Institutions
PRISM III—Pediatric Risk of Mortality III

Drs Pageler and Franzon conceptualized and designed the project, designed the data collection instruments, coordinated and supervised data collection, and drafted the initial manuscript; Drs Longhurst and Sharek conceptualized and designed the project, participated in designing the data collection instruments, and critically reviewed and revised the manuscript; Dr Wood carried out the final analyses and critically reviewed and revised the manuscript; Drs Cornfield and Suermann conceptualized and designed the project and critically reviewed and revised the manuscript, and all authors approved the final manuscript as submitted.

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Line Necessity

Current Documented Lines
- 1 - Non-Tunneled Double lumen, PICC Arm, right upper

Reason for Red Alert
Line necessity has not been reviewed today.

Required Action
Team should discuss line necessity and document that each line is still necessary or remove unnecessary lines.

Considerations for line necessity include:
- There is indication of infection (fever, positive blood cx, elevated WBC), or there is an issue with line integrity.

Education
Removal of unnecessary central lines is recommended by the CDC and is part of the intervention bundle that has been associated with significantly reduced rates of catheter-associated bloodstream infections.

Why Don’t Physicians Follow Clinical Practice Guidelines?
A Framework for Improvement

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Clinical practice guidelines are “systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances.” Their successful implementation should improve quality of care by decreasing inappropriate variation and expediting the

Context Despite wide promulgation, clinical practice guidelines have had limited effect on changing physician behavior. Little is known about the process and factors involved in changing physician practices in response to guidelines.

Objective To review barriers to physician adherence to clinical practice guidelines.

Data Sources We searched the MEDLINE, Educational Resources Information Center (ERIC), and HealthSTAR databases (January 1966 to January 1998); bibliographies; textbooks on health behavior or public health; and references supplied by experts to find English-language article titles that describe barriers to guideline adherence.

Study Selection Of 5658 articles initially identified, we selected 76 published studies describing at least 1 barrier to adherence to clinical practice guidelines, practice parameters, clinical policies, or national consensus statements. One investigator screened titles to identify candidate articles, then 2 investigators independently reviewed the texts to exclude articles that did not match the criteria. Differences were resolved by consensus with a third investigator.

Data Extraction Two investigators organized barriers to adherence into a framework according to their effect on physician knowledge, attitudes, or behavior. This organization was validated by 3 additional investigators.

Data Synthesis The 76 articles included 120 different surveys investigating 293 potential barriers to physician guideline adherence, including awareness (n = 46), familiar-

Conclusions Studies on improving physician guideline adherence may not be generalizable, since barriers in one setting may not be present in another. Our review offers a differential diagnosis for why physicians do not follow practice guidelines, as well as a rational approach toward improving guideline adherence and a framework for future research.

when they become aware of a guideline.59 Physician adherence to guide-

JAMA. 1999;282:1458-1465 www.jama.com
Implementing guidelines and protocols

- What are the barriers?
  - This may be different in different hospitals
  - Analysis of barriers

- Prioritize the strategy to improve
<table>
<thead>
<tr>
<th>Therapeutic Intervention</th>
<th>All Patients (n = 91)</th>
<th>Shock Reversed (n = 24)</th>
<th>Persistent Shock (n = 67)</th>
<th>Survivors (n = 65)</th>
<th>Nonsurvivors (n = 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical ventilation (n [%])</td>
<td>44 (48)</td>
<td>9 (38)</td>
<td>35 (52)</td>
<td>25 (38)</td>
<td>19 (73)§ P &lt; .01</td>
</tr>
<tr>
<td>Intraosseous line (n [%])</td>
<td>8 (9)</td>
<td>1 (4)</td>
<td>7 (10)</td>
<td>5 (8)</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Central venous line (n [%])</td>
<td>27 (30)</td>
<td>8 (33)</td>
<td>19 (28)</td>
<td>17 (26)</td>
<td>10 (38)</td>
</tr>
<tr>
<td>Fluid therapy (mL/kg)#</td>
<td>20.0 [9.2–49.2]</td>
<td>23.9 [12.2–44.7]</td>
<td>20.0 [8.2–57.5]</td>
<td>20.0 [9.3–40.0]</td>
<td>32.9 [6.4–64.1]</td>
</tr>
<tr>
<td>Appropriate fluid therapy (n [%])</td>
<td>41 (45)</td>
<td>24 (100)</td>
<td>17 (25)* P &lt; .001</td>
<td>32 (49)</td>
<td>9 (35)</td>
</tr>
<tr>
<td>Dopamine or dobutamine (n [%])</td>
<td>24 (26)</td>
<td>5 (21)</td>
<td>19 (28)</td>
<td>13 (20)</td>
<td>11 (42)† P &lt; .05</td>
</tr>
<tr>
<td>Epinephrine or norepinephrine (n [%])</td>
<td>15 (16)</td>
<td>2 (8)</td>
<td>13 (19)</td>
<td>4 (6)</td>
<td>11 (42)† P &lt; .001</td>
</tr>
<tr>
<td>Glucose (n [%])</td>
<td>9 (10)</td>
<td>1 (4)</td>
<td>8 (12)</td>
<td>6 (9)</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Bicarbonate (n [%])</td>
<td>23 (25)</td>
<td>5 (21)</td>
<td>18 (27)</td>
<td>13 (18)</td>
<td>10 (38)¶ P = .059</td>
</tr>
<tr>
<td>Hydrocortisone (n [%])</td>
<td>12 (13)</td>
<td>6 (25)</td>
<td>6 (9)† P = .074</td>
<td>8 (12)</td>
<td>4 (15)</td>
</tr>
<tr>
<td>Resuscitation consistent with ACCM-PALS</td>
<td>27 (30)</td>
<td>24 (100)</td>
<td>3 (4)* P &lt; .001</td>
<td>25 (38)</td>
<td>2 (8)§ P &lt; .01</td>
</tr>
</tbody>
</table>

* P < .001, † P = .074 versus shock reversed.
‡ P < .001, § P < .01, ‖ P < .05, ¶ P = .059 versus survivors.
# Data are expressed as median (25th–75th percentile).