Implementing Evidence-Based Sepsis Best Practices

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Disclosure

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-None

Educational Objectives

1) Define the evidence-based sepsis best practices as defined by the “Surviving Sepsis Campaign”.
2) Outline controversies identified in recent studies of guideline implementation.
3) Describe the application of sepsis best practices in oncology patients.
4) Describe the nurse-sensitive activities where nursing can influence patient outcomes.
**Problem**

- Sepsis is a common life-threatening complication in this population.
- Missed sepsis can result in death of patients.
- Most cancer settings do not formally screen patients or have a planned implementation process.
- International sepsis best practices are standard for patients presenting to Emergency.
- Sepsis management planned for Joint Commission (US) safety goals, Core measure, MD Patient Safety Center initiative

**Evidence Summary**

Evidence Review: sepsis best practices, sepsis bundle interventions, febrile neutropenia, nurse managed

- MedLine, EMBASE, Cochrane, CINAHL

Final inclusion

- Implementation strategies (69)
- Risks, prognosis (15)
- Fever and neutropenia (50)
- SIRS criteria & cancer (1)
- Sepsis/ septic shock cancer (1)

Key Evidence Summary

- Level I-3, Level II-25, Level III-30, Level IV-3, Level V-20

Specific bundled interventions (High)
- Education (Moderate)
- Protocols and algorithms (Moderate)
- Electronic orders (Moderate)
- Rapid response teams, Champions, Integrated monitoring alarms (Low)
- Combining interventions (Moderate)

**Febrile Neutropenia (FN) Evidence**

- **Problem**
  - Fever and neutropenia = sepsis
  - Potential for poor outcomes
  - Unclear outcome predictability

- **Serious medical Consequences (SMC)**
  - Hypotension/ dysrhythmias/ CHF
  - Respiratory distress/ hypoxemia
  - Bleeding requiring transfusion
  - Confusion/ delirium
  - Renal failure
  - ICU admission/ other clinical instability
Febrile Neutropenia Evidence Synthesis

**Interpretation**
- Not date or nation-unique
- Some grouped patients into low risk/ high risk based on risk factors and/or MASCC score
- MASCC as predictor for poor outcomes - 12 studies, all statistically significant, OR 2.5-23.2, 95% CI 1.7-35.8
- MASCC as predictor for poor outcomes - 12 studies, statistically significant, OR 2.5-23.2

**Incidence**
- Present in up to 100% of patients
- SMC* Overall - 35.8%
- SMC High risk - 43-85%
- SMC Low risk - 0-12.5%
- Mortality overall - 12.6%
- Mortality High risk - 9-77%
- Mortality Low risk - 1-10%

*SMC = Serious Medical Consequences

Febrile Neutropenia: Outcomes

<table>
<thead>
<tr>
<th>Citation</th>
<th>Sample</th>
<th>Serious medical consequences (SMC)/Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahn, et al, 2011</td>
<td>United States</td>
<td>396 FN events, 346 pts, 113 hematologic malignancy, 233 ST</td>
</tr>
<tr>
<td>Baskaran, et al, Malaysia</td>
<td>Malaysia</td>
<td>116 FN events, 68 hematologic malignancy</td>
</tr>
<tr>
<td>Horasa, et al, 2011</td>
<td>Turkey</td>
<td>90 FN events, 90 pts, 12 ST, 78 hematologic malignancy</td>
</tr>
<tr>
<td>Hui, et al, 2011</td>
<td>Hong Kong</td>
<td>227 FN events, 227 pts, 70% low risk</td>
</tr>
<tr>
<td>Innes, et al, 2008</td>
<td>Britain</td>
<td>100 FN events, 83 pts, 77 ST, 6 hematologic malignancy</td>
</tr>
<tr>
<td>Jin, et al, 2010</td>
<td>United States</td>
<td>178 FN events, 102 pts, 50 ST, 52 hematologic malignancy</td>
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<tr>
<td>Klastersky, et al, 2007</td>
<td>Multinational</td>
<td>499 pts with bacteremia</td>
</tr>
<tr>
<td>Klastersky, et al, 2000</td>
<td>Multinational</td>
<td>1139 FN pts, Multinational</td>
</tr>
<tr>
<td>Lal, et al, 2008</td>
<td>Pakistan</td>
<td>80 FN events, 80 pts</td>
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<tr>
<td>Moon, et al, 2009</td>
<td>Korea</td>
<td>198 FN events</td>
</tr>
<tr>
<td>Osmani, et al, Pakistan</td>
<td>Pakistan</td>
<td>131 FN events, 131 pts, 75 ST, 53 hematologic malignancy</td>
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<tr>
<td>Uys, et al, 2004</td>
<td>Africa</td>
<td>80 FN episodes, 64 pts, 70% outpatients</td>
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</tbody>
</table>

Apparently Stable FN with Bacteremia

- 861 consecutive episodes in patients with solid malignancies
- 492 apparently stable pts (using MASCC study criteria) for evaluation
- Bacteremia 6%
- Other complications 7.3%
- Death 1.3%
- Bacteremia pts had more complications
- Bacteremia and MASCC score combined: ROC .74, sensitivity 36%, specificity 94%
- Predictors of bacteremia from time of presentation
  - T > 39.0
  - Rigors
  - ECOG PS ≥ 2
  - Advanced cancer
- Other predictors in the literature
  - Increased respiratory rate
  - Lactate
  - Procalcitonin
- Other biomarkers

Application of these findings and sepsis screening

- Bacteremia is only one form of infectious complication
- Bacteremia is only apparent in ~20-50% of patients who are actually infected
- Other definitions may produce higher yield
- Extending the time of evaluation from initial screening may show higher specificity
- Is there an acceptable sensitivity that is "worth the risk of missing patients"?
- Is there an acceptable specificity that is "worth over-evaluating patients"?
- Should cost versus yield be considered in obtaining blood cultures and lactate in possible sepsis?
Multinational Association Supportive Care in Cancer (MASCC)

• Scale published (2000) to predict low-risk post-chemotherapy febrile neutropenia patients who can be managed with outpatient oral antimicrobials.
• Follow-up studies validate broader use
  • Heme malignancies (lymphoma, myeloma, leukemia)
  • Confirm that “low score” predicts for poor outcomes in FN—some suggest < 21, others say < 15
• Not tested in:
  • Non-chemotherapy-treatment related immune suppression
  • Not used late post-transplant, few immediate post-transplant
  • Not clear if MDS patients have been included or excluded in studies of leukemia patients

Why MASCC Score

• Evidence to support use to predict low-risk and high-risk FN pts (16 articles)
  • Perception of FN and sepsis surrogacy
  • Research post-chemotherapy
    • Solid tumors
    • Heme malignancy
  • No research
    • Disease-related myelosuppression
    • Late post-HSCT (e.g. loss of graft, failure to engraft)

• Easy to perform
• Scored
  • Total score
    • 3 category (low risk, high risk, very high risk)
    • 2 category (low risk, high risk)
  • Helpful to understand pts who do poorly even if bundle elements performed.
  • Helpful clinically to decide whether to admit sepsis positive pts.

MASCC Score Instructions

• To perform MASCC score, go through each component and give your patient points based on the listed criteria.
• Total all points.
• Lower scores are more at risk for sepsis:    A score ≥ 21 is low risk for sepsis,  A score of 15-20 is at moderate risk for sepsis,  A score < 15 is at severe risk for sepsis

<table>
<thead>
<tr>
<th>Component &amp; Criteria</th>
<th>Point Value</th>
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<tbody>
<tr>
<td>Hypotension: SBP &lt; 90 mmHg or MAP &lt; 70 mmHg or a SBP decrease &gt; 40 mmHg or less than two standard deviations below normal for age in the absence of other causes of hypotension</td>
<td>0= if present; 5= if absent</td>
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<td>COPD: if yes, COPD comorbidity give 0 points, if no/yes are present, pt is scored 4 points</td>
<td>0= if present; 4= if absent</td>
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<tr>
<td>Solid tumor or hematological malignancy without prior fungal infection</td>
<td>0= if present; 4= if absent</td>
</tr>
<tr>
<td>Dehydration: pt is dehydrated or has 5% of dehydration such as dry mucous membranes, poor skin turgor, orthostasis; score 0 points. No/sx, pt scores 3 pts</td>
<td>0= if present; 3= if absent</td>
</tr>
<tr>
<td>Outpatient Status: all IPOP patients are outpatients &amp; therefore will receive 3 pts</td>
<td>0= in-pt; 3= out-pt</td>
</tr>
<tr>
<td>Age: if pt is &gt; 60 y/o they score 0 pts. Pt is younger than 60 they score 2 pts</td>
<td>0= &gt;60 y/o; 2= &lt; 60 y/o</td>
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Sepsis Continuum

Syndrome (SIRS)
- Temp > 38.3 or < 36
- HR > 90
- RR > 20
- Altered mental status
- Hyperglycemia (non-DM)
- WBC < 4000 or > 12,000, > 10% band
- Positive fluid balance (> 20 mL/kg/24 hr)

Systemic Inflammatory Response Syndrome (SIRS)

Severe Sepsis
- PO2 < 62 mm
- Hypotension/CHF/dysrhythmias
- Oliguria
- Coagulation abnormalities
- Thrombocytopenia
- ↑ Bilirubin
- Hyperlactemia (> 1.0 mmol/L)
- Cap refill > 3 sec
- Mottling

Septic Shock
- Systolic BP < 90, OR Systolic BP > 40 mm lower than baseline OR MAP < 65 mm
- After adequate fluid resuscitation

Surviving Sepsis Campaign

- Initial publication of EBP recommendations 2001 in United Kingdom
  - Endorsed by organizations internationally
  - Goal to reduce sepsis mortality 25% in 5 years
- Publication of sepsis guideline bundles- 2004
- Revised guidelines; separation of bundled interventions (2008)
  - Early goal directed therapy [EGDT] (initial 3 hr and 6 hr interventions)
  - First 24 hrs
- Revised guidelines; performance measures, emphasis on continuous screening, establishment of “time zero”- 2012

Implementing Sepsis Bundle Interventions: Challenges in Evaluation

- Excluded from most studies: CHF (35%), Cancer patients (30%) (Claessens, Aegerter, Boudaiker, Guadet, Carieu, & Cub Rea Network, 2013)
- Bundle variability among Quality Measurement Organizations (Fong, Cecere, Unterborn, Garpestad, Klee, & Devlin, 2007)
  - The Joint Commission (TJC)
  - Institute for Healthcare Improvement (IHI)
  - Voluntary Hospitals of America (VHA)
- Randomized controlled trial compared a) bundled EGDT, b) protocol-based care without central venous catheter, ScvO2, inotropes or transfusions, and c) usual care (ProCESS investigators, 2014)
  - Setting: 1341 patients, 31 Emergency departments
  - Outcome measure: 90 day mortality, 1 year mortality, need for organ support
  - Results: No mortality differences at 90 days/ 1 year, no differencess in organ support
- Patients do not receive same care in all settings
  - Variables affecting timely antimicrobials- initially a different diagnosis, waiting for cultures to be obtained, younger patients, women, care by non-ID physician (Cullen, Fogg, Delaney, 2013; Madsen & Napoli, 2014)
- Prompt sepsis activation systems currently being developed
Sepsis Management Algorithm

Evaluate

Screen

Identify

Ensure organ perfusion

Seek source and manage

Source

Perfuse

Diagnostic tests

Surviving Sepsis Recommendations:
1st 6 hours

3 hours

• Screen for sepsis at first encounter/ triage or defined intervals
• Obtain blood cultures and lactate if positive screen
• Assessment of organ function
• First antimicrobial dose within 60 min of triage
• Oxygen if O₂ sat < 90%
• Initial fluid bolus at least 30 mL/kg if hypotensive

6 hours

• Assessment of source
• CVP line- goal 8-12 mm Hg unless mechanically ventilated- then 12-15 mm Hg
• MAP ≥ 65 mm Hg
• Central venous oxygen saturation (ScvO2) ≥ 70% [obtained via blood gas from central line]
• Urine output ≥ 0.5 mL/kg/hr

Surviving Sepsis Recommendations:
1st 24 hours

• Indications:
  • Severe sepsis or septic shock OR
  • Persistent hypotension OR
  • Hyperlactemia (≥ 4.0 mmol/L)
  • Low volume ventilation or maintain plateau pressures < 30 mm
  • Glucose goal < 180 mg/dl
  • Gastric Ulcer prophylaxis
  • Venous thromboembolism (VTE) prophylaxis
  • Low dose steroids for patients with hypotension*

* Exact methodology/indications/length of therapy is variable

Source: Dellinger et al, 2013
**Evidence: Antimicrobials within One Hour**

<table>
<thead>
<tr>
<th>Citation</th>
<th>Methods</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gawecki, P., Pera, N., Kurniawan, T., and Al-Kutob, A.</td>
<td>Single-center, retrospective cohort; 161 pts with severe sepsis and septic shock from 2006-2012</td>
<td>Median time to antimicrobials was 119 min. Significant association between antimicrobial delay and increased mortality. Mortality increased 7.6% for every hour delay in antimicrobial administration.</td>
</tr>
<tr>
<td>Fletcher, H., Huggett, J., and Zhang, B.</td>
<td>Single-center, retrospective cohort, 1628 pediatric patients with fever and neutropenia admission (123 pt) from 2001-2009</td>
<td>Delay in antimicrobials associated with adverse outcomes. Overall mortality 5.7%.</td>
</tr>
<tr>
<td>Ali, B., Bajwa, H., Khorshid, A., and Stanford, L.</td>
<td>Single-center, retrospective cohort, 1,117 adult and pediatric cancer pts (mostly home neutropenia pts 64%) with FN in 2006</td>
<td>Delay in antimicrobials associated with adverse outcomes. Two times higher risk adverse outcomes &gt; 60 minutes until first antimicrobial.</td>
</tr>
<tr>
<td>Xu, A., Lee, K., and Lou, Y.</td>
<td>1,003 FN episodes mostly solid tumor pts (68%) from 2006-2014</td>
<td>Mean time to antimicrobials was 119 min. Nine patients longer than 60 min, and included the only three that developed severe sepsis.</td>
</tr>
<tr>
<td>Miskell, F., Safford, J., and Dworkin, C.</td>
<td>Single-center, retrospective cohort, 138 pts admitted to ICU with severe sepsis or septic shock from 2008-2010</td>
<td>Multicenter analysis showed most important predictor for mortality was time to antibiotics greater than 1 hr.</td>
</tr>
</tbody>
</table>

**Sepsis Management of Adult Patients with Cancer**

**Case Example #1 - Mr CH**

Patient data: 80 yo man; refractory CLL post Campath as outpatient, discussions about goals of care 3/1: pt wants to be "full code"
Mr CH Follow-up

- 3/5 2100: Patient condition discussed with family, decided to make comfort care
- 3/5 2200: Resuscitation limits ordered
- 3/6: Streptococcal bacteremia and pneumonia

How did we do?

- Do the math:
  - Time from fever to evaluation: 19 hr
  - Time from fever evaluation to blood cultures: ? immediate
  - Time from fever evaluation to lactate: 4.5 hours
  - Time from fever evaluation to first antibiotic: 3 hours 5 min
  - Time from fever evaluation to 30 mL/kg fluids: 3 hours, 30 min
  - MAP at 6 hr: 70 mm
  - Serial lactates and central venous oxygen saturation by 6 hr: Yes

- Did our opinions of "most appropriate goals of care" contribute to delay
  - Mr CH MASCC score = 14
  - Delay in recognition
    - Confusing clinical information
    - Competing diagnoses
  - From point of direct observation-6 hour bundle elements completed according to standard

Can Sepsis Guidelines be applied to patients with cancer?

- SIRS + infection risk = excessive false positives
- Unique oncologic risks/interventions
- Not an ED-like workflow
The MD Anderson Experience

• Purpose: Compare baseline and post-protocol (orders, algorithm) for Early Goal-Directed Therapy sepsis management
• Setting: Emergency setting, single center, NCI Designated comprehensive Cancer Center
• Methods:
  • Sample: Baseline 100 pts severe sepsis or septic shock prior to intervention, and 100 randomly selected severe sepsis or septic shock of total 355 post intervention
  • Modified screening criteria:
    • Fever and/or hypotension plus another SIRS
    • Neutropenia NOT included
    • Heart rate modified to 100/min
  • No measurement of central venous pressure related interventions
• Outcome measures:
  • 28 day mortality
  • ICU length of stay, hospital length of stay
  • Goal mean arterial pressure and urine output at 6 hours
  • Time to measurement of lactic acid
  • Appropriateness and timeliness of antimicrobials
• Significant Results:
  • Mortality significantly reduced (20% vs 38%)
  • Patients reaching goal BP (74% vs 90%)
  • Patients reaching goal urine output (79% vs 96%)

Issues with Surviving Sepsis Implementation in Oncology

• Initial studies excluded patients with cancer.
• Patients with cancer often meet screening criteria for SIRS-difficult to identify unique variables to predict sepsis.
• Patients with cancer often present through OPD or as direct admissions, making performance of the ED-oriented, early-goal-directed therapy (EGDT) more challenging.
• Newly identified “time zero” necessitates changing sepsis screening from prescriber to “first encounter/ triage” individual.
• Insertion of central line before 6 hours with severe sepsis and obtainment of central venous oxygen saturation- will need to change culture of practice

Recommendations Incongruent with Current Practices

• Acknowledgement of severe sepsis warrants immediate IMC/ICU care if the patient were to present in ED or other urgent care setting- frequent vital signs, reliable IV access, cardiac monitor
• Obtainment of lactate not universal (but better)
• Obtainment of Central venous oxygen saturation (ScvO2) and procalcitonin
• Use of MAP ≤65 mm as threshold for pressors (often 55-60 mm)
• Immediate Central line insertion
• Follow CVPs for fluid administration
Pilot Project: Implementing First Six hours Bundled Sepsis Interventions

Purpose: Consistent implementation of the Surviving Sepsis Campaign recommended “First Six Hour Bundled Interventions” through:

1) Interprofessional “IPOP Sepsis Management Protocol”.
2) Electronic standing orders for early sepsis interventions.
3) Focused staff education on sepsis management best practices.
4) Practice cue cards and algorithms for sepsis screening, prognostic scoring, and algorithms for patient management.

Setting

• Ambulatory Oncology Clinic for Hematologic Malignancy and Hematopoietic Stem Cell Transplant
• Primary care by four Nurse Practitioners/Physician Assistants and Attending Physician
• Average 60 patients on roster
• Approximately 25-45 daily clinic visits
• RN staffing 6-8/ day; Clin Tech 2-3/day
• Admissions 3-8/ week for inpatient chemotherapy or therapy-related complications
• Most common reason for non-treatment related admission - possible infection

Sepsis Protocol Features

All Hematologic Malignancy Clinic (IPOP/HIPOP) patients will be screened for sepsis every visit.

Oncology Sepsis Protocol will be included in IPOP/HIPOP admission order set.

Sepsis protocol will be activated if patient screens sepsis positive.
**Responsibilities**

**Clin Tech**
- Vital signs
- Screen for sepsis
- Orthostatic vital signs
- Notify RN
- Obtain blood cultures and whole blood lactate after labels printed within 45 minutes of sepsis screen positive
- Alert provider of sepsis screen positive
- Calculate MASCC score
- Initiate sepsis orders available for blood cultures and whole blood lactate
- Administer antimicrobials as ordered and before 60 minutes from sepsis screen positive

**RN**
- Assess patient within 40 minutes
- Determine if patient should be managed as possible sepsis
- Order diagnostic tests for source assessment
- Order antimicrobials within 45 minutes of meeting sepsis screen positive

**Provider**
- Order diagnostic tests for source assessment
- Order antimicrobials within 45 minutes of meeting sepsis screen positive

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**Clinical Technician Rapid Screening Tool**

**Does Your Patient Have Any of the Following?**

- Temperature < 36.0°C
- Temperature ≥ 38.0°C
- Heart rate > 90 beats per minute
- Respiratory rate > 20 breaths/minute
- Oxygen saturation < 90% on room air
- Confusion or change in mental status
- Systolic BP < 90 mmHg or diastolic BP < 60

Patient may be septic. Notify RN for further evaluation.

**SIRS Criteria (any two)**
- Hypothermia temperature < 36.0°C
- Fever temperature ≥38.0°C
- Heart rate > 90/minute
- Respiratory rate > 20/minute
- Hypotension (systolic blood pressure (BP) < 90 mm Hg, or > 40 mm less than baseline; OR a mean arterial pressure [via noninvasive machine or calculated 2 X diastolic BP, plus the systolic BP, divided by three] or < 70 mm Hg)
- Hypoxemia (Oxygen saturation < 90% room air, or partial pressure oxygen [PaO2] < 63 room air by ABG)
- Unexplained coagulopathy/mental status changes
- Weight gain > 20 mL/kg in previous two days
- Capillary refill > 3 seconds or presence of mottling
- Possible/ probably leukopenia (< 4000/mm³)
- Total WBC count > 12,000/mm³
- Glucose > 140 mg/dL in the absence of diabetes

**Risks for Infection (any one)**
- Presence of a central venous catheter
- Presence of mucositis
- Recipient of therapeutic dose corticosteroids
- Recipient of immunosuppressive agents
- Prior fungal infection
- Age > 60 years
- Presence of COPD
- Already receiving therapeutic antibiotics as an outpatient

Two SIRS + One Risk = Sepsis Screen Positive
Aim #1:
Completion of first intervention within 20 minutes

- Goal to Decrease to 20 minutes
- Baseline Group: Mean 291 minutes (SD 535)
- Post-intervention Group: Mean 23 minutes (SD 22)
- Independent samples T-test: p = 0.029*

Observations during protocol implementation demonstrated that current workflow is not conducive to the target. Achievement of blood cultures and lactate by 60 minutes accomplished, but antimicrobial start time still longer than goal much of the time.

Threshold 20 minutes:
Ability to start antibiotics in 60 minutes

Aim #2:
Completion of All Sepsis Interventions

- Goal to Increase 0-40%
- Baseline Group: 65/79 = 82.3%
- Post-intervention Group: 65/79 = 82.3%
- Independent samples T-test: p = 0.00*

Comparison group
Post-intervention group

Clinical Implications

- Screening criteria missed no cases of sepsis.
- Interventions can be performed according to standards
  - First intervention within 20 minutes may be excessively rigid
  - Combined intervention (protocol, electronic orders, algorithms, education) effective to improve adherence
- Education effective in enhancing knowledge of sepsis management best practices
- Recent debate whether all recommendations are equally "essential"
  - Probably most important: prompt diagnostics (blood cultures, lactate) before antibiotics, antibiotics ASAP, adequate fluid resuscitation, source control
  - Use of CVP, central venous oxygen saturation, specific blood pressure support strategies controversial

Rivers et al, 2001

Observational study: four interventions at least 95% of time shown to decrease mortality 7%
Limitations of Pilot Project

- High sensitivity screening criteria
  - Suspect that heart rate threshold 90/minute is low
  - Suspect low temperature threshold 36.0 is high
- Differences in baseline and post-protocol populations
  - Level of acuity (few severe sepsis/shock patients)
  - Diverse confounding variables
- Low volume of some protocol interventions
- Sample size not powered for:
  - Screening sensitivity and specificity calculations
  - Factor analysis of importance of specific SIRS criteria, risks

Lessons Learned….

- Defining extraction rules accurately
- Sepsis screening criteria need refinement for oncology
  - Definitions are not clinical reality
  - Unique cancer physiology (e.g. anemia) and medications (e.g. growth factor)
- Increased attention to vital signs - unintentional consequences
- Additional fluid boluses
- Underestimated impact of workflow
- Translation can not be “ideal fit”
- Variables defining presence of infection lacked rigor
  - 72 hour follow-up
  - Only bacteremia or positive culture

Potential Protocol Changes

<table>
<thead>
<tr>
<th>Protocol Process</th>
<th>Pre</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adherent with current evidence-based recommendations</td>
<td>Adherent with current evidence-based recommendations</td>
<td>Low specificity</td>
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<tr>
<td>High workload with false positives</td>
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<td></td>
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<tr>
<td>Less time, money</td>
<td>Low specificity</td>
<td>Non-standard approach</td>
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<tr>
<td>Time delay until practice changes</td>
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<tr>
<td>High workload until more data is collected</td>
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<tr>
<td>May reduce expense and workload of blood drawing</td>
<td>May reduce expense and workload of blood drawing</td>
<td>Reduced efficiency in assessment/management goals</td>
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<tr>
<td>Will increase early assessment workload for nurses</td>
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<tr>
<td>Reduced efficiency in assessment/management goals</td>
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<tr>
<td>Anticipated reduced false positives</td>
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<tr>
<td>Reduced evidence to support exact threshold changes</td>
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<tr>
<td>Potential for missed cases leading to negative outcomes</td>
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<tr>
<td>No evidence to support exact threshold changes</td>
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<td>Potential for missed cases leading to negative outcomes</td>
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<tr>
<td>Temp 35.4 trigger 11% - 13.5%</td>
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<tr>
<td>HR 95 trigger 86.5% - 89.7%</td>
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<tr>
<td>HR 100 trigger 86.5% - 88%</td>
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<tr>
<td>Potential to increase specificity&quot;</td>
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Future Directions

Discuss Implications with Heme-Onc Faculty and Infectious Disease
- Necessary protocol modifications
- Clinic workflow challenges

Revise IRB Proposal
- Collect data to calculate sensitivity and specificity of screening criteria
- Analysis of pertinence of specific SIRS criteria

Additional Research Questions
- Sensitivity/ specificity of sepsis screening criteria
- MASCC score in blood and marrow transplant
- Oncology-specific indicators of sepsis
- Broaden infection-related data collection

Sepsis Selected References

Questions?

The End