Blood cultures in ED

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Why do we care about blood cultures?

- blood cultures are the most direct method for detecting bacteraemia in patients
- a positive blood culture:
  1. can suggest a definitive diagnosis
  2. enable the targeting of therapy against the specific organism in question
  3. provide prognostic value
Why do we care about blood cultures?

- the concerning issues are:
  1. indiscriminate sampling without clear indications
  2. (generally) low yield
  3. contamination rate
  4. increasing use of central venous catheters, & other indwelling vascular access devices

- high contamination rates & low yield significantly lower the positive predictive value of blood cultures
Why do we care about blood cultures?

• faced with a positive blood culture result, clinicians must determine whether the organism represents:
  a. a clinical significant infection associated with great risk of morbidity or mortality, or
  b. a false positive result of no clinical consequence

• when blood cultures drawn from a vascular catheter are positive, the results could indicate one of the 3 possibilities:
  a. true bacteremia,
  b. catheter colonization, or
  c. culture contamination
Blood cultures & sepsis

- 30% to 50% of patients presenting with a clinical syndrome of severe sepsis or shock have positive blood cultures*

* Surviving Sepsis Campaign Guidelines, 2012
Contamination*

- a blood culture was considered to be contaminated if one or more of the following organisms were identified in only one of a series of blood cultures:
  1. coagulase negative staph species (70-80%)
  2. *Corynebacterium* species
  3. viridans group streptococci
  4. *Micrococcus* species
  5. *Bacillus* species other than *Bacillus antracis*
  6. *Propionibacterium* species
  7. enterococci
  8. *Clostridium perfringens*

- definition also includes:
  1. potential pathogen with contaminant
  2. polymicrobial cultures with more than one contaminant species

True positive blood cultures*

- organisms which almost always be thought to represent true bacteremia or fungemia when isolated from a blood culture:
  1. *Staphylococcus aureus*
  2. *Streptococcus pneumoniae*
  3. *Escherichia coli*, & other *Enterobacteriaceae*
  4. *Pseudomonas aeruginosa*
  5. *Candida albicans*

Implications of contaminated blood cultures:

• increase costs associated with:
  • extend length of hospital stay
  • inappropriate treatment with antibiotics

• considerable inconvenience for both of the patient & staff required to follow-up those who may have been discharged - likely readmission is the safest option?
How useful are blood cultures collected in the ED?
Blood cultures ordered in the adult ED are rarely useful

Mountain, D; Bailey, P; O'Brien, DB; Jelinek, GA.

- retrospective Australian study in Perth, WA (2-mth period)
- 4.0% (218/5478) of patients had blood cultures ordered in the ED
- of the 218 cultures, only 30 were positive (13%), with 16 (7.3%) probable contaminants and 14 (6.4%) true positives
- of the 14 true positive blood cultures, the result influenced management in 6 patients, resulting in a useful culture rate of only 2.8% (6/218)
Do peripheral blood cultures taken in the emergency department influence clinical management?

Neil Howie, Jan F Gerstenmaier, Philip T Munro

- retrospective study in Southern General Hospital ED, Glasgow, UK
- **2213** paired peripheral blood cultures were obtained in the ED between 1\textsuperscript{st} Jan 2003 to 31\textsuperscript{st} Dec 2004 (2 years)
- **132 (6%)** yielded growth – 3 cases excluded due to incomplete information
- Of the remaining **129 patients**, **30 (1.4%)** yielded true positive results; **99 (4.5%)** were false positive
- Of **30 patients**, **four (0.18%)** had evidence that their management had been altered as a direct result:
  1. 3 cases had their antibiotics changed because of organisms’ resistance to initial antibiotics
  2. the 4\textsuperscript{th} case, blood culture results prompted urine culture & renal ultrasound, confirming E. coli pyelonephritis
Utility of blood cultures in the management of:

- pneumonia
- cellulitis
- pyelonephritis
Pneumonia
Do Emergency Department Blood Cultures Change Practice In Patients With Pneumonia?

M. Kennedy, D.W. Bates, S.B. Wright, R. Ruiz, R.E. Wolfe & N.I. Shapiro
j.annemergmed.2005.05.025.doi:10.1016

• 1-year prospective, observational, cohort study
• adult patients with pneumonia
• 3762 ED visits with a blood culture obtained
• 414 patients with clinical & radiographic evidence of pneumonia
• 29/414 (7%) culture positive, 26/414 analysed (3 deceased before BC results available
  – 15/414 (3.6%) have therapy altered
  – BC results of 8/11 (1.9%) supported narrowing Rx, but this was not done
• 25/414 (6.0%) contaminants
The contribution of blood cultures to the clinical management of adult patients admitted to the hospital with community-acquired pneumonia: a prospective observational study.

Campbell, SG; Marrie, T; Anstey, R; Ackroyd-Stolarz, S; Dickinson, G. Chest 2003. 123:1142–1150

- Adult patients from 19 different Canadian hospitals from 1/1/1998 to 31/7/1998 (7 months)
- 1022 patients were admitted to hospital for pneumonia
- BCs were drawn in 760 patients (74.4%)
- 43 patients (5.66%) had significantly positive BC results; 15 patients (1.97%) have their therapy changed directed by BC results
Utility of blood cultures in the management of adults with community acquired pneumonia discharged from the emergency department.


- 721 patients discharged; 289/721 had BCs drawn
- 6 positive blood cultures
- 2 resulted in change of treatment ie 0.69% (2 of 289) chance of having a change of treatment directed by the results of the culture
The influence of the severity of community-acquired pneumonia on the usefulness of blood cultures

Waterer GW, Wunderink RG.
Respiratory Medicine January 2001, Volume 95, Issue 1, Pages 78-82

- 209 pts were enrolled
- 38 pts with positive blood cultures
- 9 considered contaminant (4.3%) ; 29 true positive (13.9%)
- yield of pathogens from BCs correlates with PSI grade ($P=0.02$)
- Patients with a PSI class of IV or V are more likely to have a change in management directed by BC results
Conclusion:

• BCs are **not necessary** for those with pneumonia who can be treated as outpatients

• BCs are **necessary** for those requiring admission with moderate to severe pneumonia, esp those in need of ICU admission

• BCs are strongly considered for special group of patients eg. HIV, chemoRx, IVDU, diabetes mellitus, pregnant women
Cellulitis
Are Blood Cultures Necessary in Adults with cellulitis?

A.M. Mills, E.H. Chen

• Evidence review of 5 original research articles:

<table>
<thead>
<tr>
<th>Authors</th>
<th>Positive blood cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perl et al</td>
<td>11/553 (2%)</td>
</tr>
<tr>
<td>Kulthanan et al</td>
<td>20/116 (17.2%)</td>
</tr>
<tr>
<td>Lutomski et al</td>
<td>4/25 (16%)</td>
</tr>
<tr>
<td>Ho et al</td>
<td>1/130 (0.77%)</td>
</tr>
<tr>
<td>Hook et al</td>
<td>2/50 (4%)</td>
</tr>
</tbody>
</table>

• blood cultures do not significantly alter treatment or aid in diagnosing the microbial organism in acute adult cellulitis in normal immunocompetent hosts
Complicated vs uncomplicated cellulitis?

Blood culture results do not affect treatment in complicated cellulitis.
Paolo WF, Poreda AR, Grant W, Scoridno D, Wojcik S

- retrospective chart review for 5 years ending 2009

<table>
<thead>
<tr>
<th>Type of cellulitis</th>
<th>Number of cases</th>
<th>Number of cases with positive BCs</th>
<th>Number of cases which change of treatment occurred as a result of positive BCs</th>
<th>Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complicated</td>
<td>314</td>
<td>29/314 (9%)</td>
<td>6/29</td>
<td>13/314 (4%)</td>
</tr>
<tr>
<td>Uncomplicated</td>
<td>325</td>
<td>17/325 (5%)</td>
<td>4/17</td>
<td>10/325 (3%)</td>
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</tbody>
</table>
Conclusion:

• Blood cultures are not necessary for immunocompetent patient with uncomplicated cellulitis

• Increasing evidence that the blood culture result may have little impact upon management of complicated cellulitis
Pyelonephritis
Relevance of blood cultures in acute pyelonephritis in a single-center retrospective study

S. Ledochowski, PS. Abraham, X. Jacob, O. Dumitrescu, G. Lina, A. Lepape, V.Piriou, F. Wallet, A. Friggeri


- retrospective study for 24 months (6/2011-6/2013)
- adult ED patients with pyelonephritis, both managed as outpatients or inpatients
- Both BC and UC were both taken at the ED at the same time, and *before any antibiotic exposure*

- 264/553 patients had both UCs and BCs drawn and *were not exposed to antibiotics*
- 83/264 (31%) were bacteremic; 219/264 (83%) were bacteriuric

- 45 patients had sterile or contaminated UCs; *7 had positive BCs* allowing a definitive bacterial identification
- 76 patients have positive UCs and BCs; only 4 of them had additional information provided by BC
- 11/264 (4.2%) theoretically benefited from BC; however none resulted in change in antibiotic
Conclusion:

• blood cultures add little info compared to urine cultures in the management of pyelonephritis

• blood cultures maybe indicated in:
  - immunosuppressed patients
  - pregnant patients
  - patients with an uncertain diagnosis
  - patients for whom urine culture cannot be obtained eg. oliguria/shock
  - young children, especially younger than 60 days, as part of a septic work-up
CEC Sepsis Kills program

• clinical situations where blood cultures are unlikely to be useful (unless Sepsis Pathway Criteria are met):

  1. cellulitis
  2. mild to moderate community acquired pneumonia
  3. uncomplicated urinary tract infection
  4. septic arthritis
  5. dental & maxillofacial abscesses
  6. cutaneous abscesses
  7. diabetic foot infections
Overview
This guideline outlines evidence-based practice for obtaining blood cultures which should be taken for all patients:

- who meet criteria for commencement on the sepsis pathway
- with severe pneumonia as scored by CORB/SMARTCOP
- with fever or history of fever and suspected or proven neutropenia
- with fever and immunocompromised
- with fever or evidence of infection and a vascular access device or recent surgery
- with fever and recent overseas travel
- with suspected bacterial endocarditis (take 3 sets or 6 sets if the patient has received antibiotics within the last 30 days)
- with delirium.

Selected patients with fever of unknown origin who appear unwell or are at risk of sudden deterioration, such as the elderly (age ≥ 65) or chronically ill, but do not meet criteria for the sepsis pathway may benefit from blood cultures. Discuss these patients with the Staff Specialist or senior doctor in charge of the department/overseeing care of the patient.
Recommendation made by the Australasian College For Emergency Medicine (ACEM):

Avoid blood cultures in patients who are:

- not systemically septic,
- have a clear source of infection and
- in whom a direct specimen for culture (e.g. urine, wound swab, sputum, CSF, joint aspirate etc) is possible
Key messages of CEC Sepsis Kills program – when you decide to take blood cultures:

- aware of the indications
- two (2) sets (4 bottles) of blood cultures, 2 different sites
  - single set (2 bottles) may miss up to 40% of bacteraemias/fungaemias
  - If only one set is taken and it is positive it could be the result of a contaminant (false positive result)
- aseptic technique
  - sterile gloves
  - no touch technique over venepuncture site
  - clean the tops of the blood culture bottles
  - acceptable contamination rate should be no higher than 2-3%
- alcohol 70% or alcohol 70% with chlorhexidine as disinfectant
- 10ml of blood for each bottle
  - if inadequate sample (less than 10ml), fill all in aerobic bottle
Thank you