MRSA Bloodstream Infection

Starting Point: Hospitalizations during which there is at least one positive blood cultures

"Blood culture positive"   
  
Presence of Staphylococcus aureus in MicroReport such that   
1. SpecimenDateTime of report is between the admission and discharge dates of a hospitalization  
2. specimen is blood  
3. AntibioticResistance to menthicillin is "R" (resistant).

Given our starting point of having positive blood, we can ignore the common skin contaminant subalgorithm.[[1]](#footnote-1)



## Non-blood sterile site culture positive

Temporal constraints on "Non-blood sterile site culture positive": during the current hospitalization (from the date of admission to day +3 after the date of the first positive MRSA blood culture)

## Intravascular catheter

should be (day -3 to day +1 (from draw date of first positive MRSA blood culture) in the current hospitalization

## Inflammatory changes or purulence at catheter site

What are the temporal constraints on inflammatory changes and purulence?

Mike Rubin Answer: Same as above; I'd also check with Rick, but we can use the +/- 24 hour rule as above if that works for everyone. (2/7/2013)

# Appendix: Past versions of the BSI algorithm

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"Blood culture positive"   
  
Presence of Staphylococcus aureus in MicroReport such that   
1. SpecimenDateTime of report is between the admission and discharge dates of a hospitalization  
2. specimen is blood  
3. AntibioticResistance to menthicillin is "R" (resistant).

## "Common skin contaminant"

Presence of any of the 'common skin contaminant' (as defined in box above (and need to be implemented in the MRSA ontology)) organisms in MicroReports that are also positive for MRSA (as defined above).



## >1 blood culture positive for the same isolate

We need more clarification. Are we requiring two MicroReport (that are positive for MRSA and skin contaminants), to have exactly the same list of positive organisms, including skin contaminants, and same antibiotic resistance for each (if data is available)? We also need to operationalize "the same antibiotic susceptibility pattern".

Clarify "positive culture at least XX minutes apart"

Clarify how to determine the site of culture from microReport (i.e., "different blood draw locations")?

## Fever

What is the temporal constraints on fever?

e.g., Query for temperature > 38C and temperature time -?? day of first positive MRSA culture as (defined above) culture and + ?? day of last positive MRSA culture during the same episode of hospitalization.

## Hypotension

Adults (18 years and older) and "Drop in systolic BP of greater than or equal to 30 mmHg" AND Systolic BP less than or equal to 80 mmHg.”

What are the temporal constraints on the BP measurements? Specifically, what are the two time points involved when we compute "drop in systolic BP"?



## Non-blood sterile site culture positive

Temporal constraints on "Non-blood sterile site culture positive": during the current hospitalization (from the date of admission to day +3 after the date of the first positive MRSA blood culture)

## Intravascular catheter

should be (day -3 to day +1 (from draw date of first positive MRSA blood culture) in the current hospitalization

## Inflammatory changes or purulence at catheter site

What are the temporal constraints on inflammatory changes and purulence?

According to CDC/NHSN definition, a primary BSI is defined as follows:

* Patient has a recognized pathogen cultured from 1 or more blood cultures, *and*organism cultured from blood is not related to an infection at another site.

Since we already know, in this project, that we will be addressing only patients with a known positive blood culture for MRSA, the first criterion is met in all cases. Thus, our main task is to operationalize the second criterion (primary *vs.* secondary BSI).

Although there is no established CDC/NHSN category for central line-associated BSI (CLABSI), it is useful to be able to make this distinction. Thus, our secondary task is to operationalize the classification of primary BSI into CLABSI and non-CLABSI.

There are three general approaches we can take to each of these classification processes:

1. Use an explicit algorithmic approach, where each step of the classification is organized into a fully explicit branching algorithm. Both structured and unstructured data can be used in this approach, but all required information and decision points are well defined.
2. Assemble evidence (in the form of structured and/or unstructured data), and allow a human reviewer to make the final classification. Some preliminary classification may be made by the system prior to human review (like exclusion of obvious negatives).
3. Assemble evidence (in the form of structured and/or unstructured data), and apply a machine learning algorithm in order to make the classification.

All three approaches rely on assembling the best evidence for making the classification call, so the first goal is to determine which data (structured and unstructured) are most important for making these classifications. (This document will focus on approach #1, not #2 or #3).

Primary *vs.* Secondary BSI

Key data elements:

* Blood culture positive for MRSA: date of first positive blood culture
* All outpatient cultures from all sources (blood and non-blood): negative and positive cultures drawn within 7 days of the date of current hospital admission
* All inpatient cultures from other (non-blood) sources: negative and positive cultures from all other sources from day -7 to day +3 (from draw date of first positive MRSA blood culture)
* Other data? (ICD-9 codes? Text data from clinical notes indicating presence of an infection other than BSI?)

CLABSI *vs.* non-CLABSI

Key data elements:

* Information from first blood culture positive for MRSA: evidence of line draw (source)
* Any negative blood cultures from day -3 to day +1 (from draw date of first positive MRSA blood culture) that indicate evidence of line draw (source)
* Text data from nursing notes from day -3 to day +1 (from draw date of first positive MRSA blood culture) that indicate presence of a central line (PICC, IJ/subclavian/femoral line, dialysis catheter)
* Data from available chest X-ray text reports from day -3 to day +1 (from draw date of first positive MRSA blood culture) that indicate the presence of a central line
* Data from efforts to extract presence of central line (Brian Sauer) from day -3 to day +1 (from draw date of first positive MRSA blood culture) that indicate the presence of a central line

Explicit algorithm approach

Primary *vs.* Secondary BSI:

* "Simple" approach:
  + The BSI is considered SECONDARY if:
    - there are any other (non-blood) cultures positive for MRSA during the current hospitalization (from the date of admission to day +3 after the date of the first positive MRSA blood culture)

(DL reasoning to determine non-BS positive culture; Rule to determine time frame)

* + - there are any other (non-blood) cultures positive for MRSA as an outpatient in the 7 days prior to admission *if* the date of the first positive MRSA blood culture is day 14 of hospitalization or less

(DL reasoning to determine non-BS positive culture; Rule to determine time frame)

* + The BSI is considered PRIMARY if:
    - no other (non-blood) cultures meet the above criteria, *or*
    - all other (non-blood) cultures during the current hospitalization from day -7 to day +3 (from draw date of first positive MRSA blood culture) are either negative, or positive for pathogens other than MRSA, *and*
    - all other (non-blood) cultures as an outpatient in the 7 days prior to admission are either negative, or positive for pathogens other than MRSA, *if* the date of the first positive MRSA blood culture is day 14 of hospitalization
* "Advanced" approach:
  + The above criteria, *plus* additional information (ICD-9 codes? Text data from clinical notes indicating infections other than BSI?)

CLABSI *vs.* non-CLABSI:

* "Simple" approach:
  + The BSI is considered CLABSI if:
    - Any blood culture from day -3 to day +1 (from draw date of first positive MRSA blood culture) indicates a culture source from a line (include text here that indicates a line draw, such as LINE, PICC, R IJ, SUBCLAVIAN, *etc.*)
  + The BSI is considered non-CLABSI if:
    - no blood cultures from day -3 to day +1 (from draw date of first positive MRSA blood culture) meet the above criterion
* "Advanced" approach:
  + The BSI is considered CLABSI if:
    - The "simple" criterion is met, *or*
    - Any nursing note from day -3 to day +1 (from draw date of first positive MRSA blood culture) indicates the presence of a central line, *or*
    - Any chest X-ray report from day -3 to day +1 (from draw date of first positive MRSA blood culture) indicates the presence of a central line, *or*
    - Any data from other efforts to extract presence of central line from day -3 to day +1 (from draw date of first positive MRSA blood culture) indicates the presence of a central line
  + The BSI is considered non-CLABSI if:
    - no blood cultures from day -3 to day +1 (from draw date of first positive MRSA blood culture) meet the above criteria, *and*
    - no text data from nursing notes, chest X-ray reports, or other extraction efforts from day -3 to day +1 (from draw date of first positive MRSA blood culture) indicates the presence of a central line

1. Rick Martinello (2/27/2013 email): [S]ince MRSA is not a "common skin contaminant" the decision point directs to "no" and the CSC subroutine is irrelevant. The flow chart process needs to be "re-run" for each positive culture, so that if a patient had both MRSA and one or more cultures postive for a CSC, the process (including the CSC sub-routine) could determine the relevance of the culture positive for the CSC. Essentially always, the identification of MRSA in the blood is assumed to be a true positive (though we question whether the source is a primary or secondary bloodstream infection). As CSC in blood cultures can often be false positives (that is, mistakenly picked up from the skin during specimen acquisition rather than truly in the patient's blood) the CDC/NHSN case definition requires the specific CSC to be found in blood cultures more than once within a 48 hour window from "separate" cultures (separate defined as being specimens obtained at least "XX" minutes apart or from different sites) and the patient has signs consistent with a blood stream infection (fever or hypotension). [↑](#footnote-ref-1)