Implementation of a Blood Culture Algorithm in Emergency Department Patients as a Diagnostic Stewardship Intervention

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Disclosures

- Nothing to disclose

Introduction

- 536,000-628,000 episodes of bloodstream infection occur in the U.S. annually
- In emergency departments blood cultures (BCxs) are collected even if there is a *low probability* of bacteremia.
  - True positive rates: 1.4% to 12.2%
  - BCxs affect treatment decisions in 0.18–2.8%

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Coburn B, Morris AM, Tomlinson G, Detsky AS. Does this adult patient with suspected bacteremia require blood cultures? *JAMA - J Am Med Assoc.* 2012;308:502–511.
Long B, Koyfman A. Best clinical practice: blood culture utility in the emergency department. *J Emerg Med.* 2016;51:529–539.
Howie N, Gerstenmaier JF, Munro PT. Do peripheral blood cultures taken in the emergency department influence clinical management? Emerg Med J. 2007;24:213–214.
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Introduction (continued)

- Consequences of over-culturing
  - Additional resource use (laboratory equipment, personnel)
  - Increased use of antibiotics
  - Avoidable procedures/imaging
  - Unnecessary removal of central venous catheters
  - Prolonged hospital stay
  - Increased in-hospital mortality

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Zwang O, Albert RK. Analysis of strategies to improve cost effectiveness of blood cultures. *J Hosp Med.* 2006;1:272–276.
Bates DW, Goldman L, Lee TH. Contaminant blood cultures and resource utilization: the true consequences of false-positive results. *JAMA J Am Med Assoc.* 1991;265:365–369.
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Introduction

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A Diagnostic Stewardship Intervention To Improve Blood Culture Use among Adult Nonneutropenic Inpatients: the DISTRIBUTE Study

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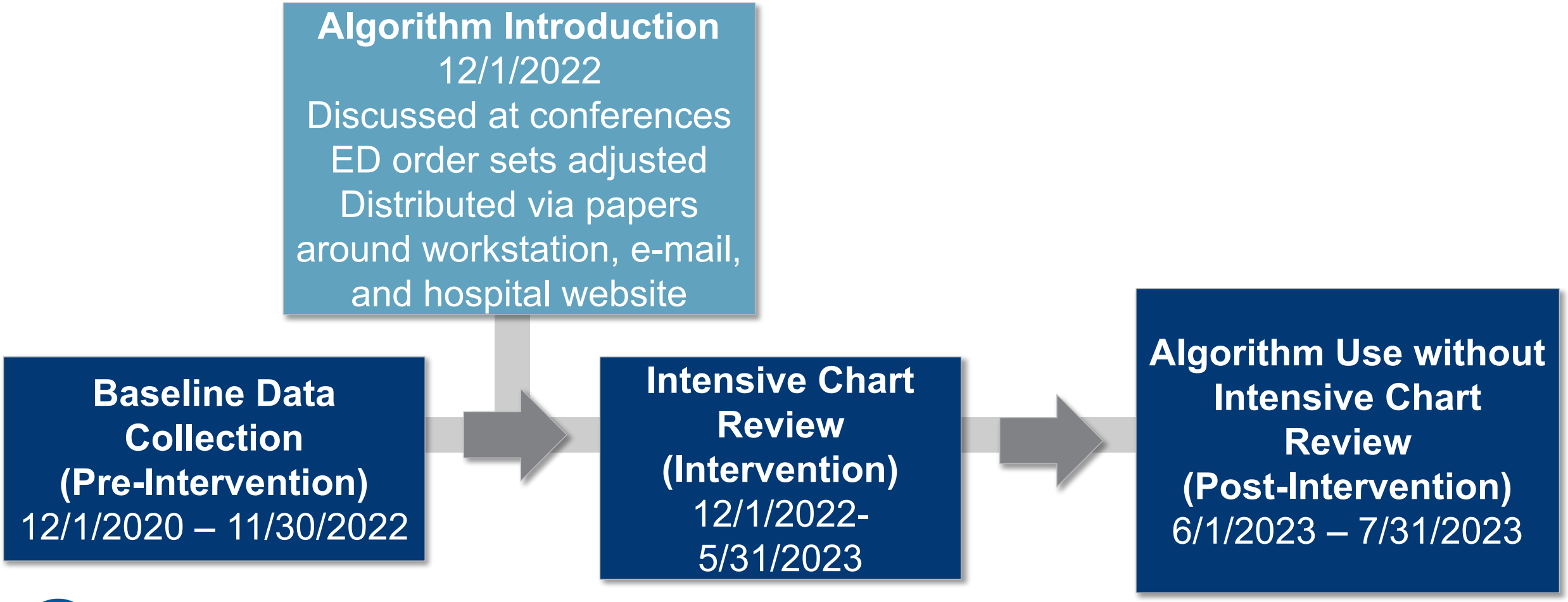
Implementation of the blood culture algorithm with indications for blood cultures in medicine patients resulted in an 18% and 30% reduction in blood cultures in the ICU and medicine units, respectively, at Johns Hopkins Hospital.

Fabre V, Klein E, Salinas AB, Jones G, Carroll KC, Milstone AM, Amoah J, Hsu YJ, Gadala A, Desai S, Goyal A, Furfaro D, Zimmerman J, Lin S, Cosgrove SE. A Diagnostic Stewardship Intervention To Improve Blood Culture Use among Adult Nonneutropenic Inpatients: the DISTRIBUTE Study. J Clin Microbiol. 2020 Sep 22;58(10):e01053-20. doi: 10.1128/JCM.01053-20. PMID: 32759354; PMCID: PMC7512168.

Objective

- Primary: Compare the blood culture event (BCE) rates before and after introduction of a BCx algorithm ***in an emergency department setting***
- Secondary
  - Compare negative safety signals before and after the introduction of a BCx algorithm

Methods


Algorithm Introduction
12/1/2022
Discussed at conferences
ED order sets adjusted
Distributed via papers around workstation, e-mail, and hospital website
Baseline Data Collection (Pre-Intervention)
12/1/2020 – 11/30/2022
Intensive Chart Review (Intervention)
12/1/2022-5/31/2023
Algorithm Use without Intensive Chart Review (Post-Intervention)
6/1/2023 – 7/31/2023

Indications for Blood Culture Collection in Immunocompetent Adults

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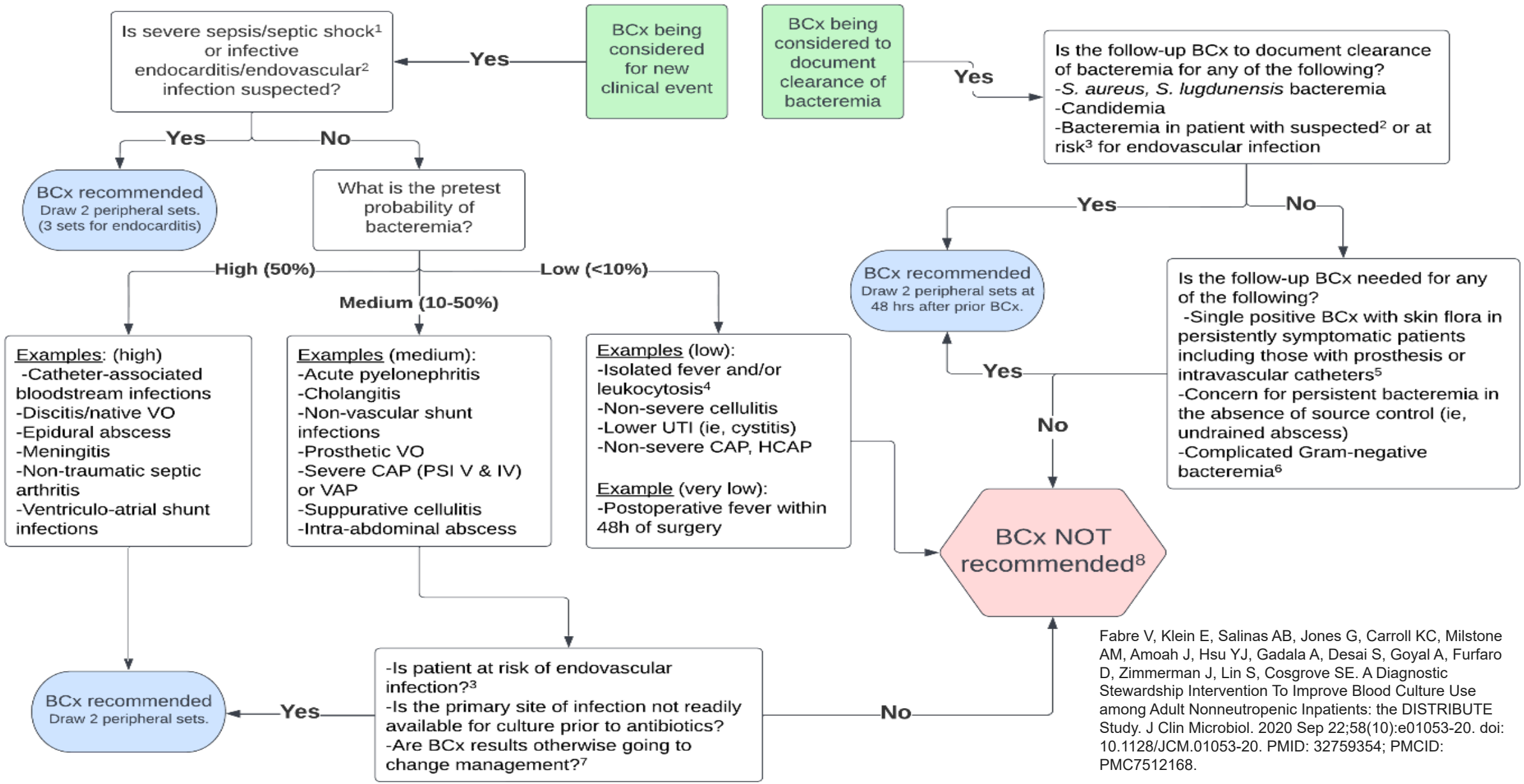
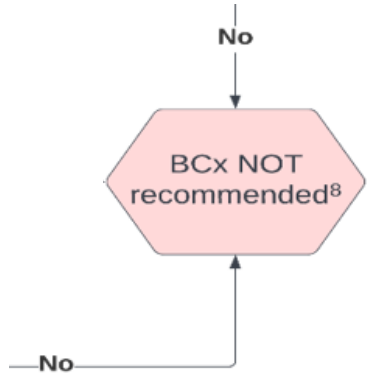


Fabre V, Klein E, Salinas AB, Jones G, Carroll KC, Milstone AM, Amoah J, Hsu YJ, Gadala A, Desai S, Goyal A, Furfaro D, Zimmerman J, Lin S, Cosgrove SE. A Diagnostic Stewardship Intervention To Improve Blood Culture Use among Adult Nonneutropenic Inpatients: the DISTRIBUTE Study. J Clin Microbiol. 2020 Sep 22;58(10):e01053-20. doi: 10.1128/JCM.01053-20. PMID: 32759354; PMCID: PMC7512168.

Definitions

- **Blood Culture Event (BCE)**: 1 or more BCx sets on same calendar day
- **Inappropriate Blood Culture**: BCx set drawn that is documented for a clinical scenario in which "BCx NOT recommended" in the algorithm
- Blood Culture Results
  - **Negative Culture**: no growth recorded in any of the blood cultures sets
  - **Contaminant**: growth recorded in at least one bottle from the blood culture sets taken, but not felt to be clinically significant by the clinical team and NOT treated with antibiotics
  - **True Positive**: growth recorded in at least one bottle from at least one culture set taken and treated with antibiotics



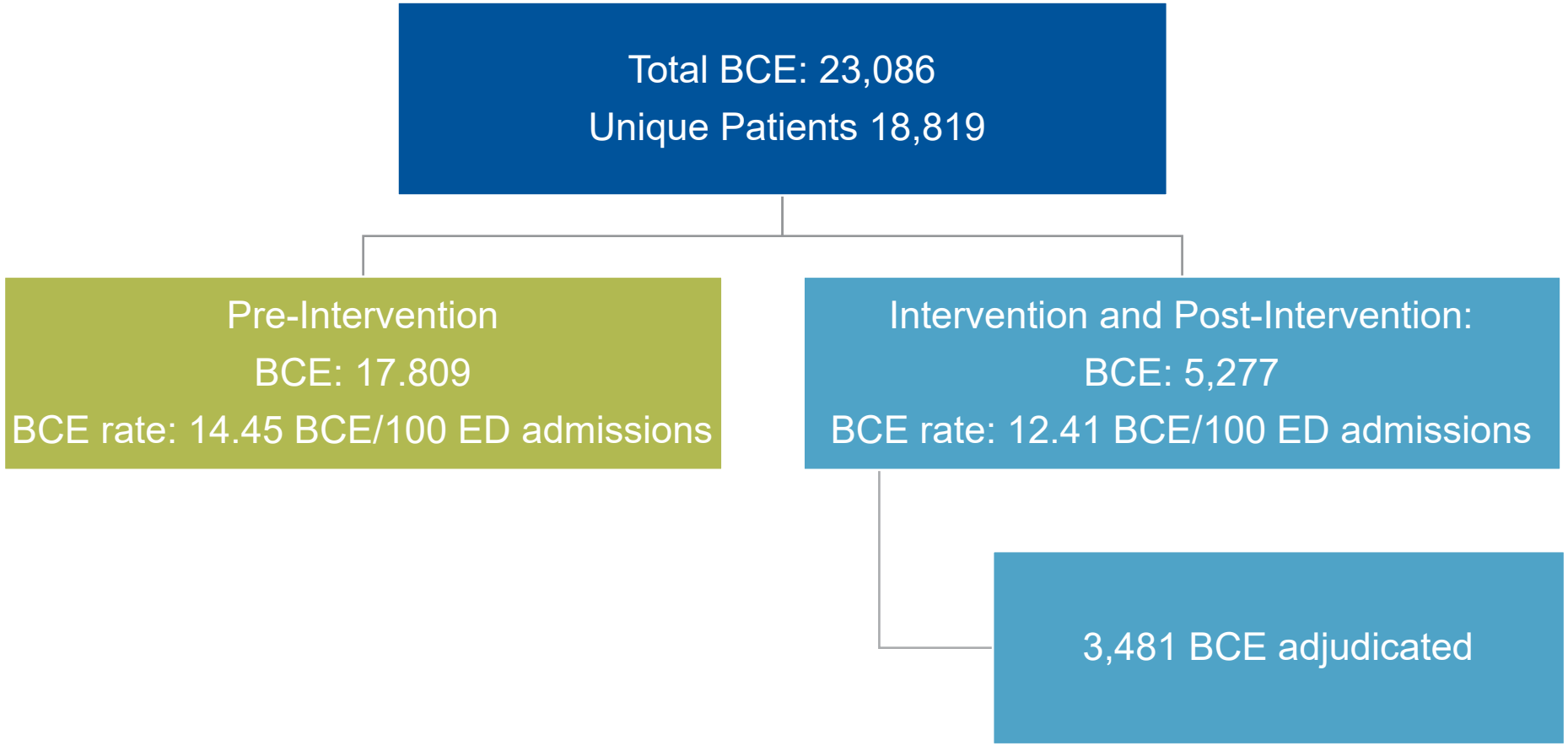
Methods

- Inclusion criteria:
  - At least 18 years of age
  - BCxs ordered while in the ED
- Exclusion criteria
  - Absolute neutrophil count < 500 10^9/L
  - Heart and lung transplant recipients

Methods

- Weekly review of all BCE
  - 7 ED clinicians
  - Weekly feedback on algorithm adherence and blood culture volume

Results


Total BCE: 23,086
Unique Patients 18,819
Pre-Intervention
BCE: 17.809
BCE rate: 14.45 BCE/100 ED admissions
Intervention and Post-Intervention:
BCE: 5,277
BCE rate: 12.41 BCE/100 ED admissions
3,481 BCE adjudicated

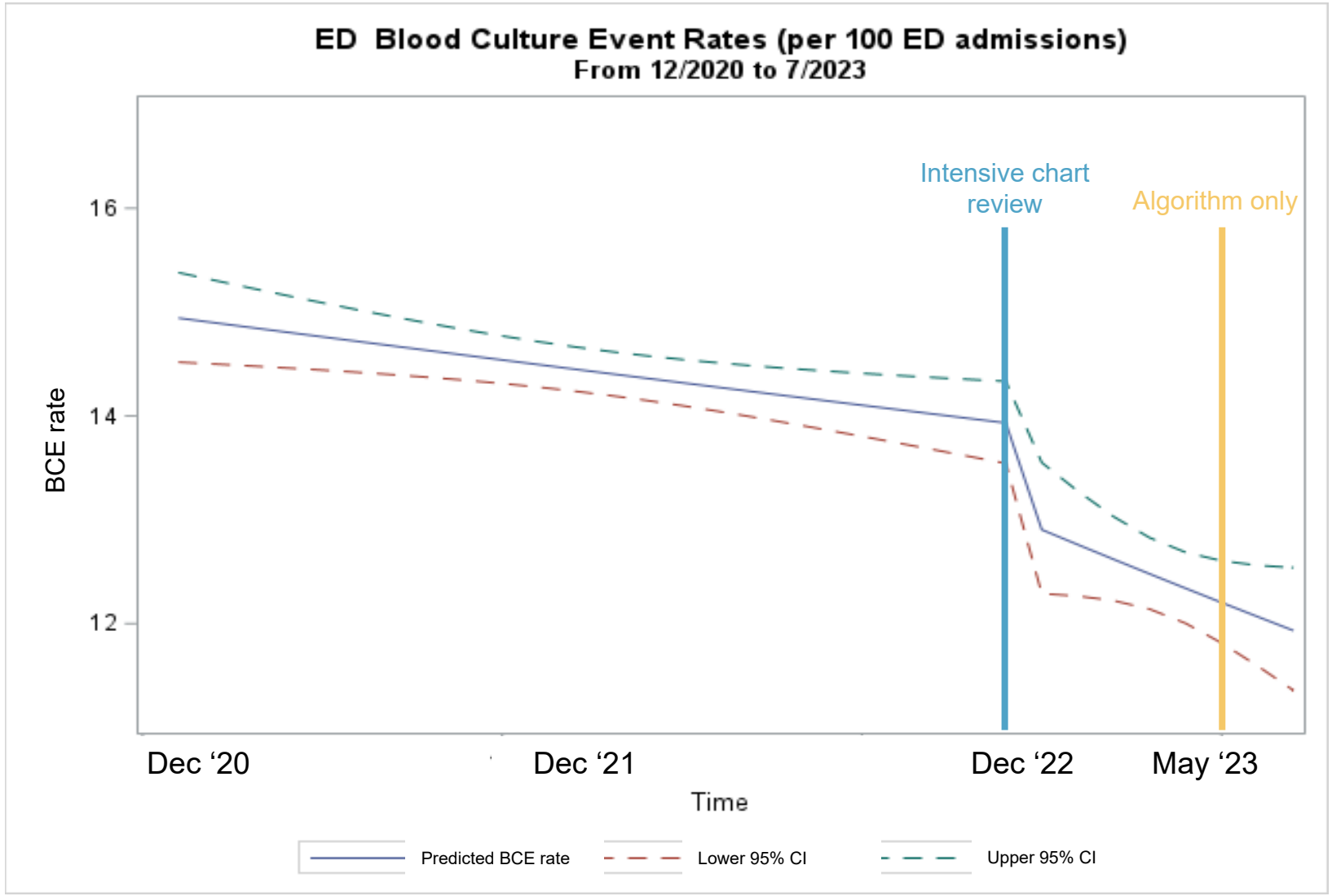
Results

- Prior to the intervention the rate was decreasing by 0.3%. (95% CI -0.5% to -0.1%, p-value 0.01)
- With the intervention the rate decreased by 13%.

(95% CI -21% to -0.1%, p-value 0.04)

- Following the intervention the rate continued to decrease by 0.8%.

(95% CI -2% to 0.4%, p-value 0.09)



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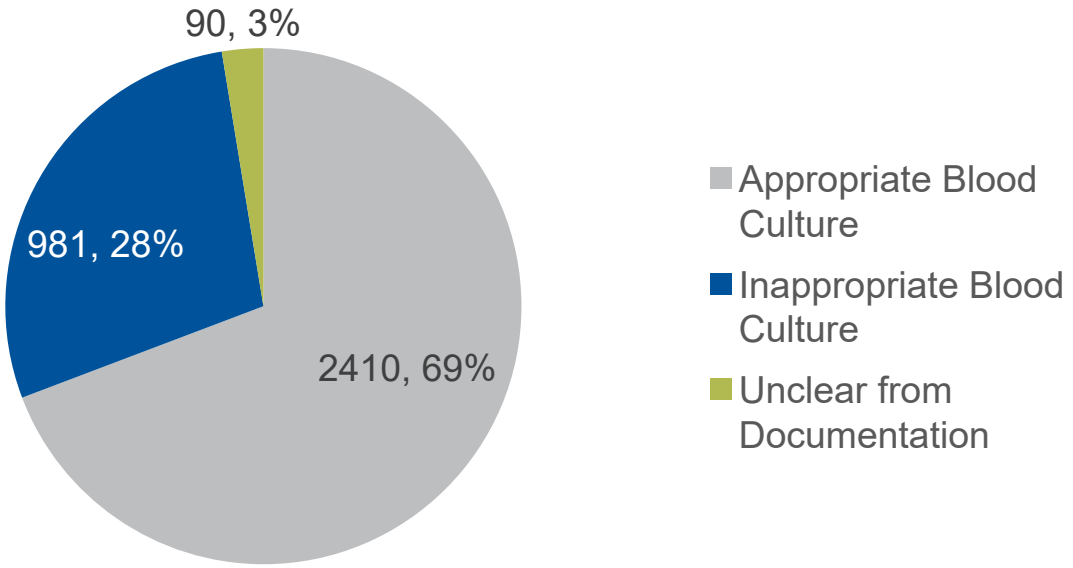
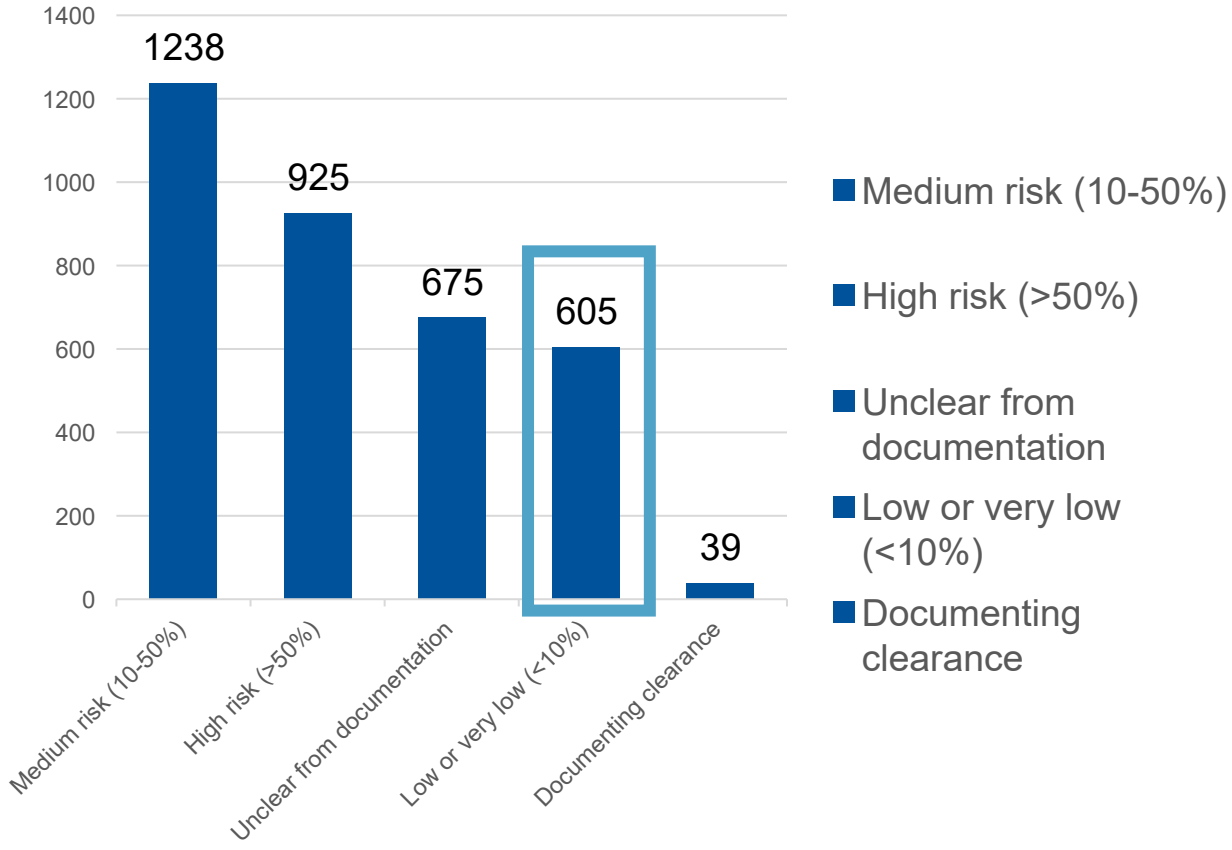
Results

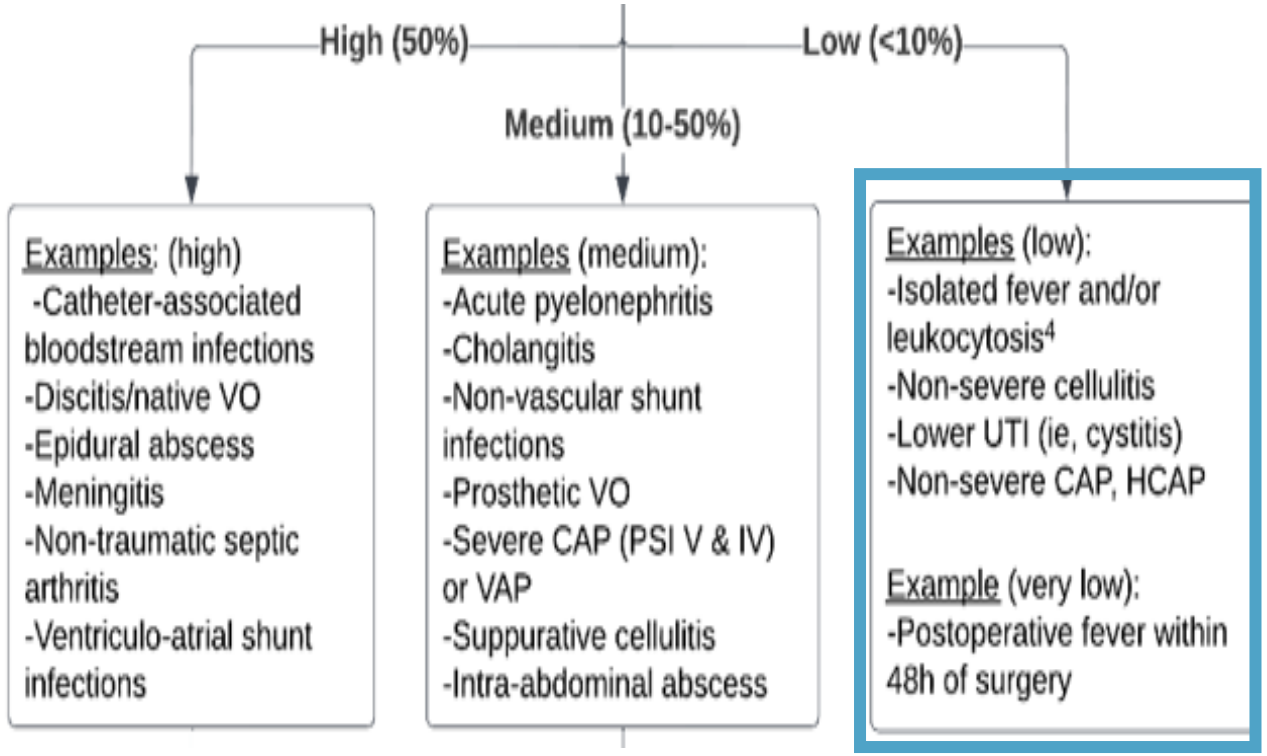
- Reviewed 3,481 BCE during the study period out of 5,277 BCE (66.0%)



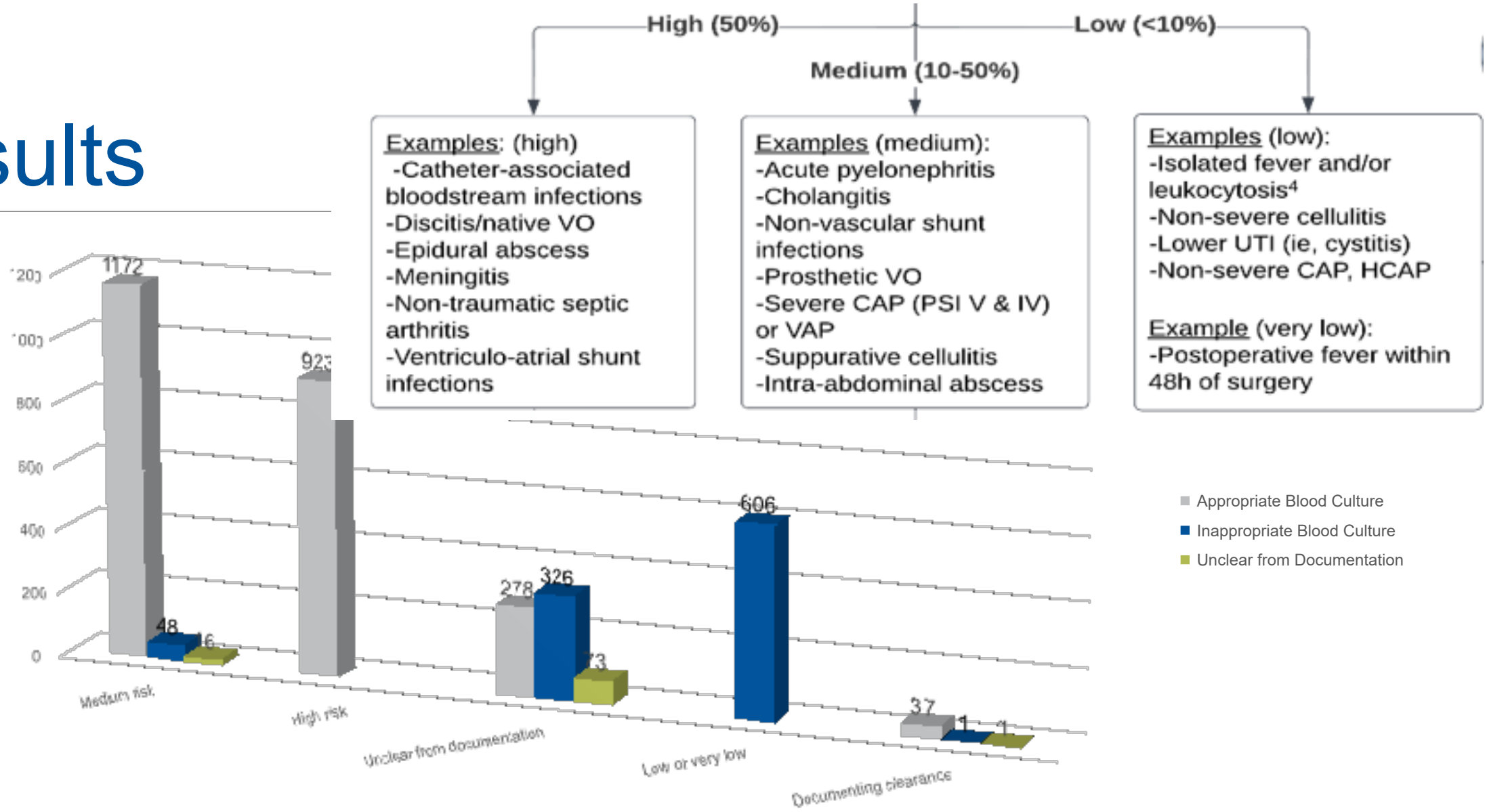
Results



- Medium risk (10-50%)
- High risk (>50%)
- Unclear from documentation
- Low or very low (<10%)
- Documenting clearance

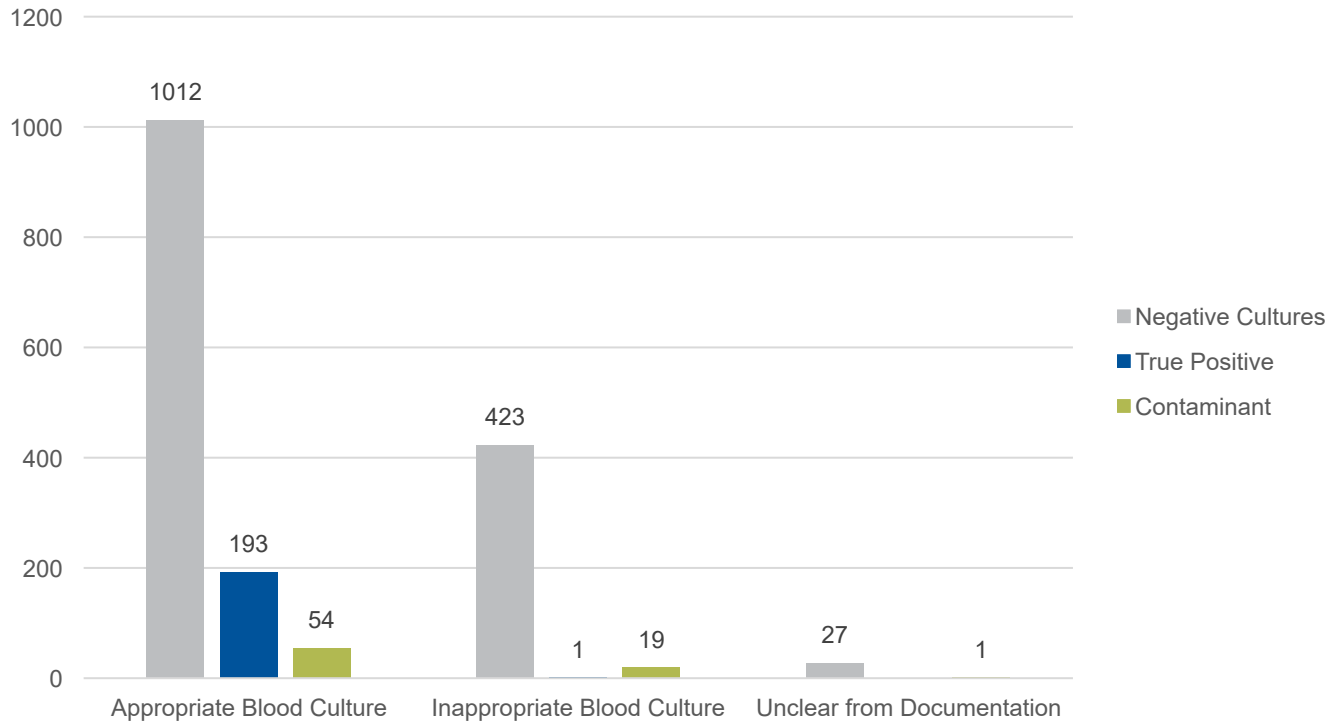


Results


High (50%)
Medium (10-50%)
Low (<10%)
Examples: (high)
-Catheter-associated bloodstream infections
-Discitis/native VO
-Epidural abscess
-Meningitis
-Non-traumatic septic arthritis
-Ventriculo-atrial shunt infections
Examples (medium):
-Acute pyelonephritis
-Cholangitis
-Non-vascular shunt infections
-Prosthetic VO
-Severe CAP (PSI V & IV) or VAP
-Suppurative cellulitis
-Intra-abdominal abscess
Examples (low):
-Isolated fever and/or leukocytosis[4]
-Non-severe cellulitis
-Lower UTI (ie, cystitis)
-Non-severe CAP, HCAP
Example (very low):
-Postoperative fever within 48h of surgery
1172
48
16
923
278
326
606
37
1
1
Medium risk
High risk
Unclear from documentation
Low or very low
Documenting clearance
Appropriate Blood Culture
Inappropriate Blood Culture
Unclear from Documentation

Results

- Of the 3,481 BCE reviewed. We adjudicated 1,730 for negative culture, true positive culture, unclear, or contaminant.
- 448 were inappropriate BCE
  - 1 true positive (0.2%)
  - 19 contaminants (4.0%)



Days of Antibiotic Therapy

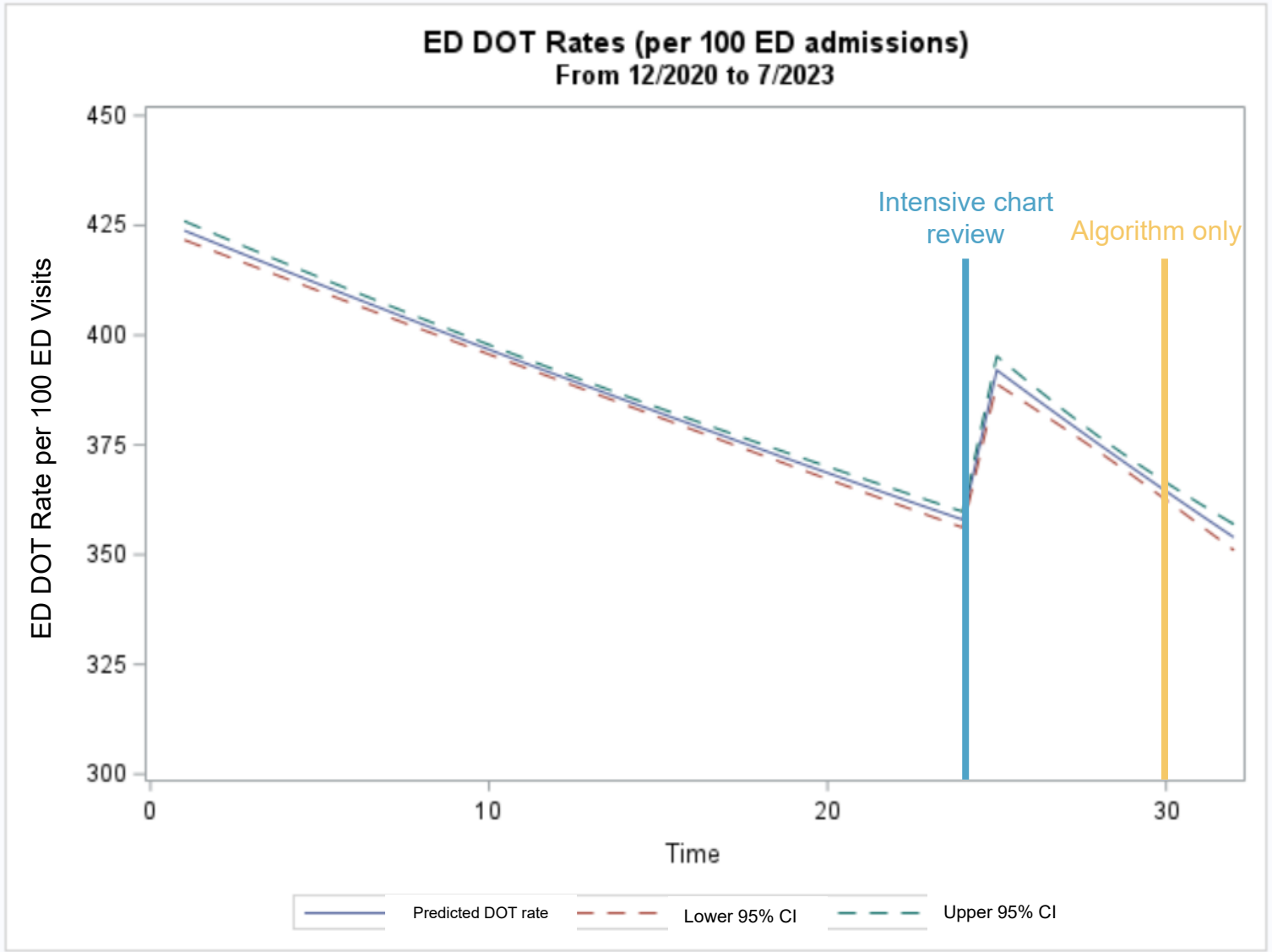
Pre-intervention monthly mean: 23,727

- Rate decreasing by 0.7% (95% CI -0.6% to -0.8%, p-value < 0.01)

Intervention: Rate increased by 17% (95% CI 12% to 23%, p-value < 0.01)

Post-intervention monthly mean: 23,697

- Rate decreasing by 0.7% (95% CI -0.6% to -0.8%, p- value < 0.01)



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30 Day ED Re-admissions

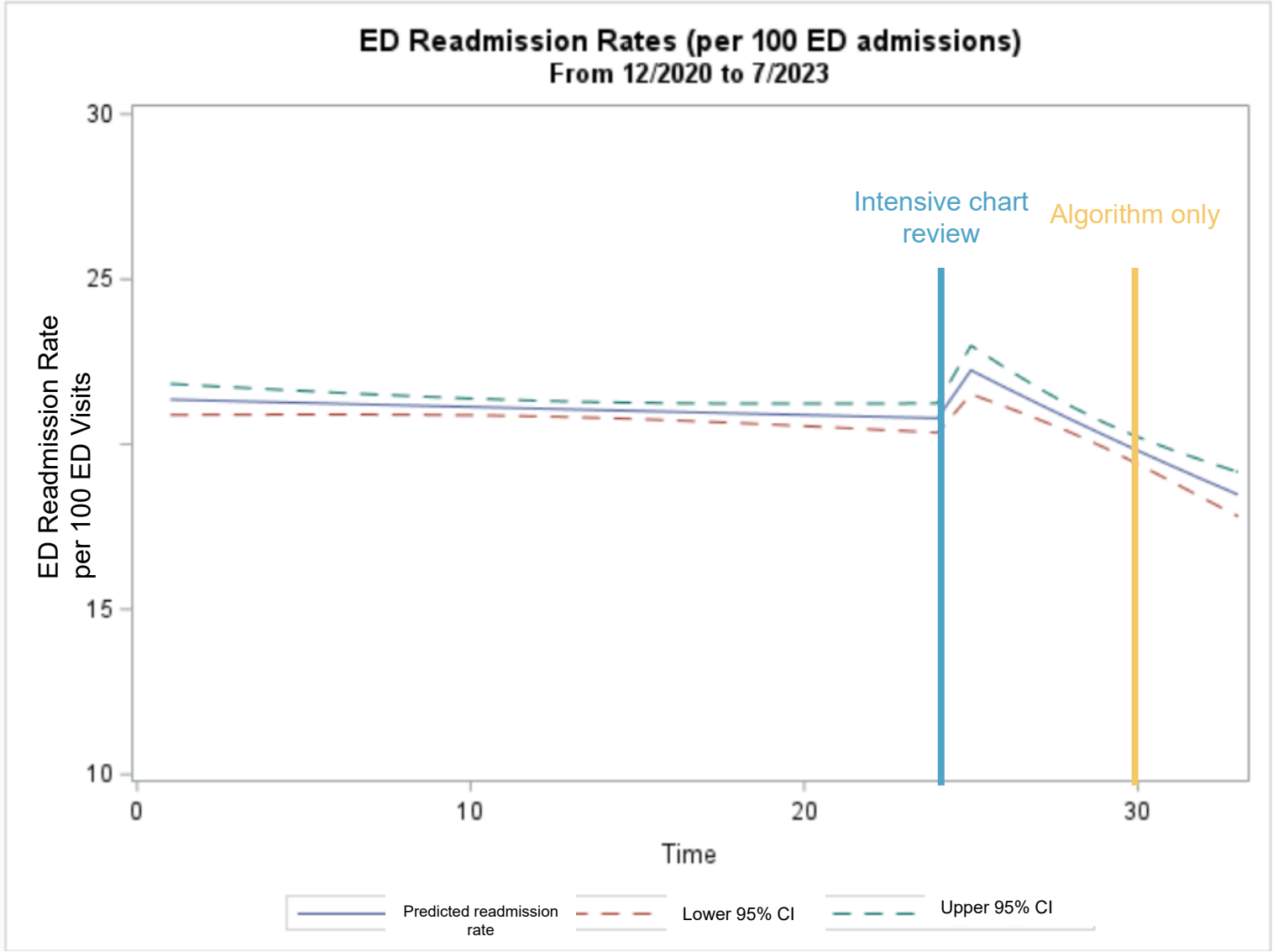
Pre-intervention: 21.06 readmissions per 100 ED visits

- Rate decreasing by 0.1% (95% CI -0.3% to 0.5%, p-value 0.16)

Intervention: rate increased by 16% (95% CI 14% to 18%p-value < 0.01)

Post-intervention: 21.19 readmissions per 100 ED visits

- Rate decreased by 2.2% (95% CI -0.30% to -0.15%, p-value < 0.01)



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Limitations

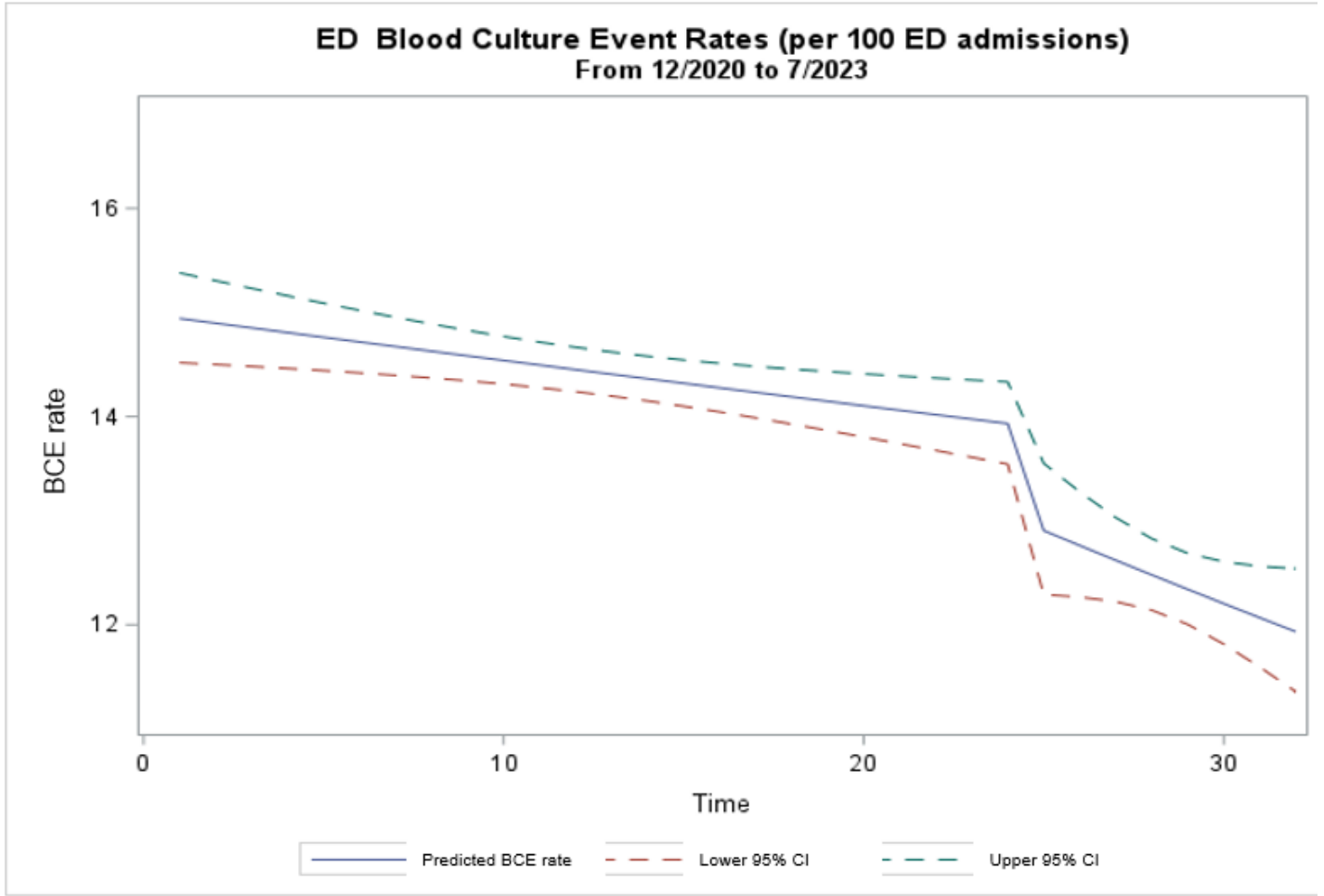
- Limitations
  - Only reviewed a subset of BCE
  - Adjudication for “true positive” vs. “contaminant” started later in analysis
  - High-resource intervention
    - Intensive chart review stopped at 6 months

Conclusions

- Decreased rate of BCE
  - Sustained response following cessation of intensive chart review
- No negative outcome measures *among ALL ED patients*
  - Antibiotic DOT
  - 30-day readmission to the ED
- Next steps:
  - Evaluate algorithm implementation in community hospital ED without intensive chart review and compare outcomes

Take Away Points

- Introduction of a BCx algorithm in an academic tertiary care ED, resulted in a decrease in BCE rate and no increase in DOT or readmission was observed.
- Guideline only. Clinical acumen should always take precedence



Thank you!

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Extra Slides

1 True Positives

- Elderly patient with CAP and extensive lower extremity wounds with staph epidermidis bacteremia (2/2 sets)