

Selection of blood culture media matters- BACTEC use in the critically ill facilitates earlier organism detection and antibiotic decision making

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Introduction

Sepsis guidelines recommend prompt and broad spectrum antimicrobial therapy be started within 1 hour of recognition of septic shock, followed by daily reassessment and antibiotic de-escalation (1). De-escalation requires reliable diagnostic data on which to base clinical decisions. Previous studies involving *Staphylococcus aureus* infections have demonstrated that rapid Gram-stain reporting and use of rapid identification molecular testing can affect changes in antimicrobial prescribing (2,3). We have previously shown that differences among contemporary blood culture media can lead to differences in the microbiological recovery of bacteria involved in suspected cases of sepsis. These differences become pronounced when antimicrobial therapy is given prior to obtaining laboratory blood cultures. The BACTEC Plus (Becton Dickinson) blood culture media is more likely to identify blood stream infections if previous antibiotics have been administered. This finding is of particular importance in the critical care setting where over 80% of cultures were exposed to antimicrobials prior to blood culture collection (4). Whether the use of sensitive blood culture media would lead to changes in antibiotic prescribing has not been described.

Methods

All blood cultures obtained from adults within the medical and surgical intensive care units (ICU), burn unit, and emergency department stabilization room between 1/2/2011 and 30/9/2011 were inoculated in paired and random order into a BACTEC Plus (Becton Dickinson) aerobic and BacT/Alert FAN (bioMérieux) aerobic blood culture bottle. Only blood culture sets with collections both in a BACTEC Plus and BacT/Alert FAN bottle were included in the study. Cultures were incubated in their respective instruments and processed within routine 5 day laboratory protocols. Positive cultures and Gram stain results were called to clinical providers. Organism identification and antimicrobial sensitivity results were recorded and reported to providers via electronic medical records.

Classification of microorganisms involved in sepsis can be challenging. Microorganisms were classified as pathogens based on documentation of infection within the chart by provider notes or by independent assessment by an infectious disease professional. Similarly, contaminants were assessed based on documentation of a contaminant in the medical record or decision to avoid antimicrobial therapy for a given case. In situations where the significance of the recorded microorganism could not be readily determined, the microorganism was classified as indeterminate.

Medical charts were reviewed to determine if changes occurred in antibiotic prescribing due to the positive culture result. The two clinical decision points used to track changes in antimicrobial prescribing were: antibiotic changes ≤ 2 hrs after report of the Gram stain, and antibiotic changes ≤ 8 hrs after report of the final organism identification and susceptibility. Possible changes recorded in antimicrobial prescribing were initiation, discontinuation, or switch in therapy.

Results

There were a total of 306 positive cultures. Positive cultures were observed at frequencies of 53% (n=163), 23%, 10% (n=31), and 14% (n=41) within the MICU, SICU, stabilization room, and the burn unit respectively. Antibiotics were administered within 4 hours prior to culture collection for 60% (185/30) of the total blood cultures collected within all critical care units and for 71% of all blood cultures processed from the MICU.

Isolation of Organisms by Blood Culture System

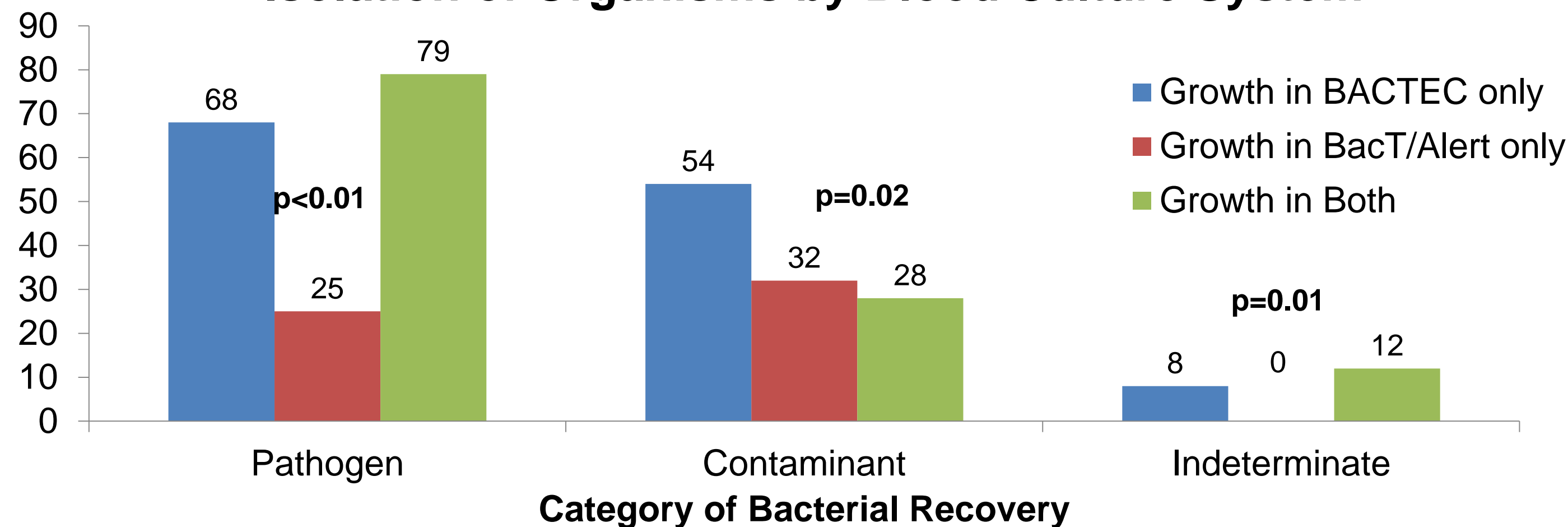


Figure 1. Blood cultures were collected from paired BACTEC and BacT/Alert media as outlined above and as previously described (4). Positive blood cultures were calculated based on the media able to recover microorganisms from patients with suspected sepsis. In 43% (130/306) of the cultures, growth was observed from only the BACTEC media. In 19% (57/306) of the cultures, growth occurred from only BacT/Alert media, and in 39% (199/306) of the cultures, bacterial growth was recovered by both types of media used in the culture collection. ($p < 0.001$)

Table 1. Changes in Antibiotic Prescribing ≤ 2 hrs after initial Gram stain notification by the laboratory

	Total Blood Cultures	Bacterial growth recovered from BACTEC media alone	Bacterial growth recovered from BacT/Alert media alone	Growth in Both media	p-value [†]
Within 2 Hrs of Gram stain notification*					
No	195	41% (n=80)	20% (n=39)	39% (n=76)	0.002
Yes	54	44% (n=24)	19% (n=10)	37% (n=20)	0.0258

*not included in analysis: deceased patients, not available, previously called cultures: n=57

[†]p-value compares BacT/Alert to BACTEC

n= number of blood cultures

No changes in antibiotic prescribing occurred in 195/249 (78%) cultures within 2 hours of Gram stain notification: In 19% of these cases (38/195) patients remained off all antibiotics when a positive Gram stain was called. The remaining 81% of the cases (n=157) remained on previously dosed antibiotics.

Table 2. Changes in Antibiotic Prescribing ≤ 8 hrs after laboratory reporting of bacterial speciation/sensitivity profile

	Total Blood Cultures	Bacterial growth recovered from BACTEC media alone	Bacterial growth recovered from BacT/Alert media alone	Growth in Both media	p-value [†]
Within 8 Hrs of Speciation/Sensitivity notification [^]					
No	160	46% (n=74)	22% (n=35)	32% (n=51)	0.0001
Yes	103	43% (n=44)	13% (n=13)	45% (n=46)	<0.0001

[^]not included in analysis: deceased patients, not available: n=42

[†]p-value compares BacT/Alert to BACTEC

n= number of blood cultures

Changes in antibiotic prescribing within 8 hours after speciation and sensitivity occurred in 39% of the cases (103/263). Of the 103 cases where an antibiotic change was made, 55% (n=55) also remained on an existing antibiotic.

Figure 2. Antibiotic Changes Completed with Positive Cultures

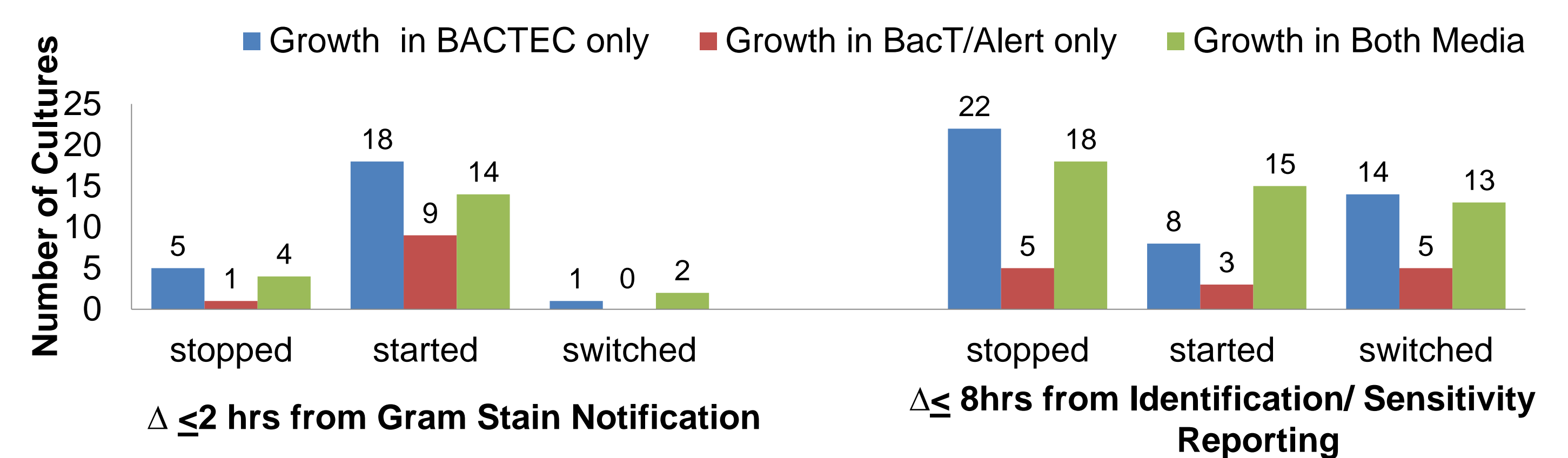
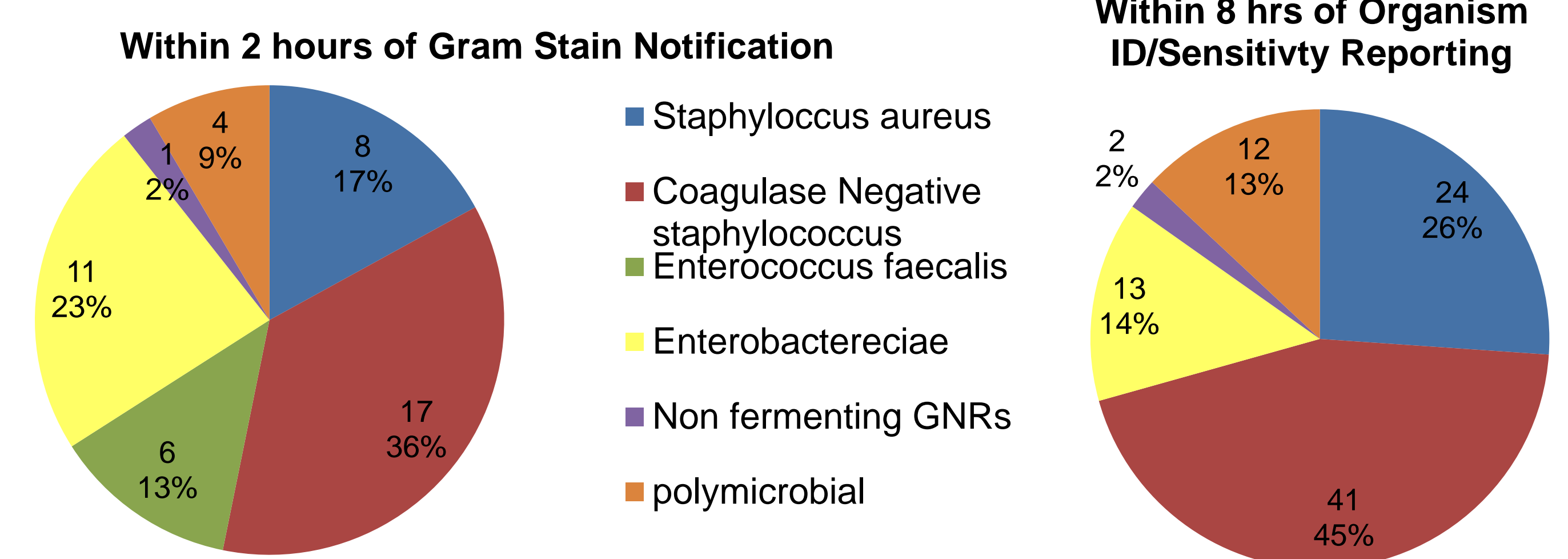


Figure 3. Organisms implicated in Antibiotic Prescribing Changes



Discussion

The relationship between positive blood culture reporting and changes in antibiotic prescribing has not previously been examined and the implications of differences in the yield of bacterial recovery in patients receiving antimicrobials at the time of culture collection has not been fully understood(4). However, this study shows that blood culture reporting affects antibiotic decision making, both on pathogens and contaminants and across bacterial species. Antibiotic changes are more likely to occur after speciation/sensitivity reporting than after Gram stain notification, suggesting empiric antibiotic choice is re-affirmed by Gram staining but long term therapeutic decision making and de-escalation is not made until sensitivity of the organism is reported. The use of BACTEC blood culture media at our facility facilitated changes in antimicrobial prescribing strategies at a rate 2.96 times higher than that observed with the BacT/Alert media when two clinical decision time points were evaluated and allowed for antibiotic re-affirmation and de-escalation decisions to be made more effectively because of the increased yield of recovery in the BACTEC media.

Conclusions

- 60% of all blood cultures drawn in the critical care setting are exposed to antibiotics prior to culture collection.
- The BACTEC blood culture system isolates over 2 times more pathogens than the BacT/Alert system.
- Organism isolation from blood culture media translates into changes in antibiotic prescribing.
- Antibiotic changes occurred within 2 hours of Gram stain notification in 22% of the cultures and within 8 hours of bacterial speciation /sensitivity reporting in 39% of the cultures.
- Gram stain notification facilitates initiation of new antibiotics but organism speciation/susceptibility allows for antibiotic de-escalation.
- Twice as many antibiotic decisions were made after Gram stain notification and 3 times as many after speciation because of isolation exclusively in the BACTEC system. ($p < 0.0001$)

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