Location # 1875

Characterization of Clinical Improvements After Implementation of New Blood Culture Strategy for Severe Sepsis Patients

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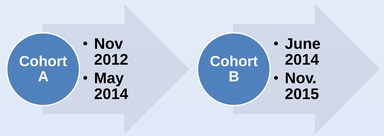
ABSTRACT #60450

Background: Prompt reporting of blood culture Gram stains has been associated with decreased patient mortality, yet original findings have not yet been widely replicated. Our aim was to document the positive impact for patients with severe sepsis after improvements in the time to detection (TTD) of positive blood cultures.

Methods: A retrospective matched comparison group study was performed in a quaternary care medical center between Nov. 2012 – Nov. 2015. Data was extracted from unique cases of severe sepsis, MSDRGs (870, 871, 872). Our historical blood culture system was the comparator (cohort A), while the BD BACTEC Plus Aerobic and Lytic Anaerobic media (Becton, Dickinson and Company, Sparks, MD) was designated as the intervention (cohort B). The downstream impact was determined using the following outcome variables: a) TTD of positive blood cultures, 2) 30 day all-cause raw mortality, substratified by MSDRG, 3) all-cause mortality ratios (observed to expected, O:E, Premier, Inc.), and 4) inpatient length of stay ratios (O:E, Premier, Inc.). Data analysis was performed using JMP, 12.0.1 (Cary, NC); data was analyzed by Wilcoxon Rank Sum or Analysis of Means, alpha = 0.05



Results: Unique positive blood cultures were identified (n=216). Cohort demographics were well matched; no statistical differences were observed for age, gender, clinical service, compliance with sepsis bundles, phlebotomy practices, contamination rates, proportion of MSDRGs, microbial diversity, or sample size. Eleven common bloodstream pathogens represented 87% and 86% of positive results in cohort A and B, respectively. The overall mean TTD was 21.0 ± 15.2 hr for cohort A and 16.8 ± 13.2 hrs for B. Crude all-cause mortality for ICU patients with MSDRG 870 (Septicemia or Severe Sepsis with Mechanical Ventilation for > 96 hrs) was statistically decreased in cohort B (p = 0.04). Among sepsis survivors, statistical improvement in TTD for positive cultures in cohort B was observed (p = 0.003). Finally, the O:E mortality and mean inpatient LOS O:E ratios were significantly improved in cohort B, p=0.02 and p=0.002, respectively.

Conclusion: Decreases in TTD for bloodstream pathogens were associated with significant improvements in crude all-cause mortality for ICU subjects with MSDRG 870 and with improved O:E ratios for mortality and LOS. Further assessment of other clinical, laboratory, and economic variables is warranted. Rev. 10/26/2016

METHODS

Experimental Aim: Assess the downstream impact of newly introduced blood culture system used for patients with sepsis, identified as part of a quality improvement project.

Study Design: A retrospective, observational study was performed with a pre-and post-intervention study design to compare metrics from the intervention period (cohort B) to those from the baseline time period prior to the intervention (cohort A).

The study includes data extracted from in-patient adult and pediatric subjects and follows a quality improvement protocol waived by the Geisinger IRB. The data was assembled by extracting information from the laboratory information system (Sunquest) and the electronic health record (EPIC). JMP ver. 12 and Excel 2013 were used for data validation, statistical analysis, and graphs.

Context: Geisinger Medical Center (GMC) is a 450-bed quaternary care hospital. Typical GMC ED visits reach 42,295/yr and Inpatient Admissions reach 26,966/yr. GMC implemented the BACTEC FX system and BACTEC Plus Aerobic and Lytic Anaerobic media (Becton, Dickinson and Company, Sparks, MD) in June 2014, and patients were monitored until Nov. 2015. Prior to that time, bioMérieux charcoal resin bottles (BacTalert FA and FN) were used. The blood culture conversion was further characterized by reviewing Observed to Expected (O:E) ratios for mortality and length of Stay calculated via Premier Quality Manager System until Nov. 2016.

Usual care during study period, monitored by quality initiatives:

- 2 sets of blood cultures via an electronic orders in a sepsis bundle prior to the administration of antibiotics.
- Overall positive blood culture rates vary between 9 and 11%. For the study set enriched for sepsis MSDRGs 870, 871, and 872, a 28% prevalence was observed.
- Blood culture contamination rate ranges from 0.6-0.8%.
- 16 to 20 mL of blood is commonly obtained from adults.
- Blood collection volume metrics are recorded for cohort B via BD EpiCenter Data Management System: Blood Volume Monitoring software, and manually for cohort A.
- TTD was used to characterize each subject.
- Sepsis coding practices remained uniform and no statistical differences to overall sepsis bundle compliance were observed.
- Of 760 total severe sepsis cases, no differences in age, gender, hospital service, principal diagnosis, or compliance with sepsis bundles were observed.
- The most common services were Hospitalist, Internal Medicine, Critical Care, and Hematology/Oncology, representing 94% of all severe sepsis cases.

Positive Culture Sample Size:
Pre-intervention n = 118, Post-intervention n = 98.
Laboratory Method Intervention: BACTEC FX with LEAN laboratory design for blood culture incubation and Gram stain performance.

RESULTS

DATA DISTRIBUTIONS

Table 1: Comparison of "time to detection" (TTD) among top 11 pathogens identified in cohort A and B respectively.

	Cohort A			Cohort B*		
Bloodstream Pathogen	**Mean**	**SEM**	**N**	**Mean**	**SEM**	**N**
E. coli	14.6	1.7	27	13.2	1.5	31
***S. aureus* (MRSA)**	25.2	2.9	15	12.0	2.8	4
K. pneumoniae	19.4	3.8	13	29.7	13.8	7
Beta-hemolytic streptococci	23.6	7.1	12	9.8	0.8	8
Coagulase negative staphylococci	24.5	2.5	11	24.0	2.4	11
***S. aureus* (MSSA)**	31.2	8.3	11	14.8	1.6	7
P. aeruginosa	20.1	0.5	3	16.8	1.6	6
E. faecalis	12.6	0.3	2	11.0	1.7	4
E. cloacae	9.2	2.8	2	12.7	1.1	2
Mixed Gram Negative Bacilli	13.4	6.1	4	NA	NA	0
C. albicans	31.6	14.9	3	NA	NA	0
***S. bovis* Group**	NA	NA	0	9.2	1.3	2
B. fragilis	NA	NA	0	23.6	1.4	2
Subtotal (n)	NA	NA	118	NA	NA	98
% of Pathogens Represented**	NA	NA	87%	NA	NA	86%

* 7 of 9 common pathogens were identified faster in cohort B than in cohort A.
** The top 11 pathogens comprise 87% of cohort A and 86% of cohort B.

Note:

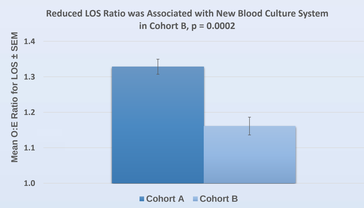
The most common microbes in fatal cases were associated with E.coli, MSSA, MRSA, and Beta-hemolytic streptococci. After implementation of BACTEC media.

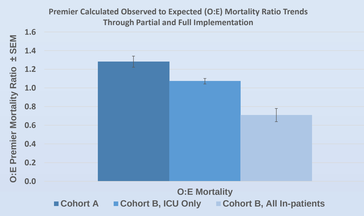
Use of BACTEC media reduced the mean TTP for MSSA and MRSA by 62% (12.0 hrs) and 28% (14.8 hr), respectively.

COMPARATIVE DATA

Figure 1. Association with Reductions in Premier O:E Mortality and Length of Stay (LOS(Ratios

- **FIG. 1A) O:E mortality ratio decreased sharply (p=0.02); with mean O:E ratio dropping from 1.17 (± 0.28) for cohort A to 0.89 (± 0.25) for cohort B.**
- **FIG. 1B) As further evidence of associated reduction in O:E mortality ratios, a trend is observed during an "ICU only" phase of implementation, which was further reduced when BACTEC bottles were collected for all inpatients (p =0.02 for All In-patients). A similar trend was observed intervention period for LOS (data not shown).**
- **FIG. 1C) The inpatient mean O:E LOS ratio dropped from 1.33 (± 0.09) for cohort A to 1.15 (± 0.11) for cohort B. (p=0.002).**





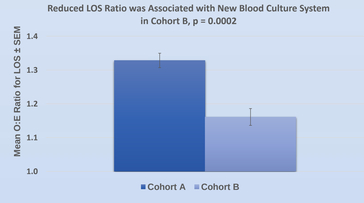


Figure 2. Overall distribution of clinical service was not significantly different between cohorts

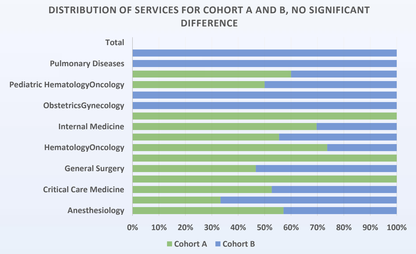
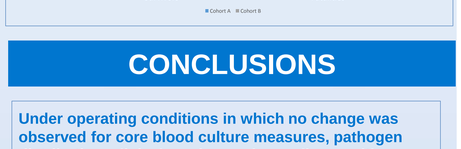


Figure 3. For MSDRG 870, unadjusted percent mortality was statistically improved for Cohort B.



CONCLUSIONS

Under operating conditions in which no change was observed for core blood culture measures, pathogen distribution, clinical service, and compliance with sepsis bundles:

1. **Decreases in "time to detection" for common bloodstream pathogens were associated with significant improvements in crude all-cause mortality for ICU subjects coded with MSDRG 870.**
2. **The introduction of BACTEC FX in cohort B was associated with significant reductions in Premier Mortality and LOS observed to expected (O:E) ratios.**

LIMITATIONS: While this data represents a promising association, further assessment of expanded clinical, laboratory, and economic variables is warranted. Expanded assessment of clinical conditions, costs, reporting time, and post-test time to therapy in the two cohort periods is ongoing.

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