The Impact of COVID-19 Response on Central Line Associated Bloodstream Infections and Blood Culture Contamination Rates at a Tertiary Care Center in Detroit, Michigan

DMC DETROIT MEDICAL CENTER

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ABSTRACT

Background: Coronavirus Disease (COVID-19) pandemic has presented challenges to every facet of healthcare system. There is limited research evaluating the consequence of diverting resources from patient safety initiatives to COVID-19 crisis efforts. In an attempt to quantify the impact of COVID-19 on the quality of patient care, we compared rates of blood culture contamination and central line associated bloodstream infections (CLABSIs) during COVID-19 to those before the pandemic.

Methods: A comparative retrospective cohort study was conducted to analyze blood culture contamination and CLABSI rate per 1,000 line days in a tertiary care hospital in Detroit within a "pre COVID-19" timeframe, January - May 2019, and "COVID-19" timeframe, January - May 2020. The CLABSI rate data was obtained by Infection Control. Blood culture contamination report was obtained through microbiology Department. Chi-square and t-test were used for statistical analysis.

Results: The blood culture contamination rate increased from 3.2% during pre COVID-19 timeframe to 3.8% during COVID-19 (p <0.01) with the highest rate in March and April 2020, correlating with the peak of COVID-19. The CLABSI rate per 1,000 catheter-days increased from 0.40 pre COVID-19 time period to 1.20 during COVID-19 (p < 0.01). Of the 36 patients that developed a CLABSI, 6 (17%) were in pre-COVID-19 cohort while 30 (83%) were in COVID-19 cohort. Among the 30 patients with CLABSIs identified within COVID-19 cohort, 16 (53.3%) expired compared to 2 of 6 (33.3%) within pre COVID-19 timeframe (p = 0.66) (Table 1).

INTRODUCTION

- CLABSIs have ↑ length of stay (LOS) by 14 days, ↑ morbidity and mortality by 12-25%, and ↑ $46,000 in excess cost per case.[1]
- During the pandemic, hospitals have patient surges, resource shortages and continuously changing recommendations.[2]
- Our study aimed to quantify the impact of COVID-19 on infection control measures, specifically blood culture contamination and CLABSI rates

METHODS

- Blood culture contamination definition: blood culture that grew only *Bacillus* (except *B. anthracis*), *Corynebacterium* (except *C. diphtheria*), *Cutibacterium acnes*, coagulase-negative *Staphylococcus*, or alpha hemolytic *Streptococcus* (except *S. pneumoniae*) without a repeat blood culture positive for the same organism in subsequent 4 days.
- TheraDoc® identified + blood cultures and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) test results.
- The National Healthcare Safety Network's (NHSN) criteria was used to identify CLABSIs.[3]
- Patients were divided into cohorts based on date of infection relative to COVID-19. Fisher's Exact Test and two-tailed Wilcoxon Signed-Rank Test were used for analysis. A p-value < 0.05 was considered statistically significant. SAS Software was used for computations.

RESULTS

Characteristics	Pre COVID- 19 (N = 6)	COVID-19 (N = 30)	p-value
AGE, median (IQR)[1]	60.3 (±17.3)	62.6 (26.1)	0.92
RACE, n (%)			
Black	4 (66.7)	18 (60.0)	1.0
White	1 (16.7)	6 (20.0)	
Other/Unknown	1 (16.7)	6 (20.0)	
FEMALES, n (%)	3 (50.0)	17 (56.7)	1.0
EXPIRED, n (%)	2 (33.3)	16 (53.3)	0.66
SEPSIS AS PRIMARY CAUSE OF DEATH, n (%)	2 (100.0)	6 (37.5)	0.183
CHARLSON COMORBIDITY INDEX, n (%)			
0-1	1 (16.7)	9 (30.0)	0.64
2-3	3 (50.0)	7 (23.3)	
4-5	1 (16.7)	4 (13.3)	
>5	1 (16.7)	10 (33.3)	
TYPE OF CENTRAL VENOUS CATHETER[2], n (%)			
Peripherally Inserted Central Venous Catheter	2 (33.3)	5 (15.6)	0.48
Internal Jugular	4 (66.7)	13 (40.6)	
Mediport	0 (0.0)	1 (3.1)	
Femoral	0 (0.0)	7 (21.9)	
Subclavian	0 (0.0)	6 (18.8)	
CENTRAL VENOUS CATHETER INSERTION LOCATION, n (%)			
Emergency Department	0 (0.0)	4 (13.3)	0.87
Floor (Acute Care or Intensive Care Unit)	4 (66.7)	14 (46.7)	
Interventional Radiology or Operating Room	2 (33.3)	11 (36.7)	
Present on Admission	0 (0.0)	1 (3.3)	
INTENSIVE CARE UNIT, n (%)	3 (50.0)	21 (70.0)	0.38
VASOPRESSORS, n (%)	3 (50.0)	22 (73.3)	0.34
VENTILATOR, n (%)	2 (33.3)	21 (70.0)	0.16
BILEVEL POSITIVE AIRPRESSURE, n (%)	2 (33.3)	4 (13.3)	0.26
LENGTH OF STAY, median (IQR)[1]	19.0 (9.0)	27.0 (33.0)	0.12
CAUSATIVE ORGANISM FROM BLOOD CULTURE ASSOCIATED WITH CLABSI[4], n (%)			0.22
Fungal	4 (66.7)	8 (26.7)	
Gram Negative	0 (0.0)	6 (20.0)	
Gram Positive	2 (33.3)	16 (53.3)	

[1]IQR, interquartile range

[2]Two patients had multiple central venous catheters

Table 1. Baseline Patient Characteristics Between Two Cohorts

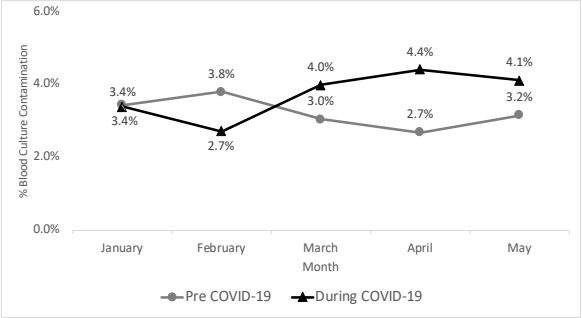

Figure 1. Blood culture contamination rates between January through May in Pre COVID-19 and during COVID-19 cohorts.

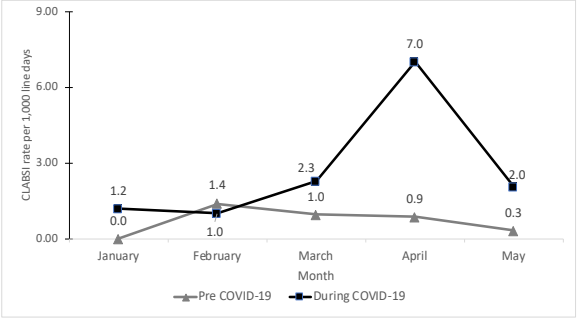

Figure 2. Central Line Associated Bloodstream Infections per 1,000 central-line days between January through May for two cohorts.

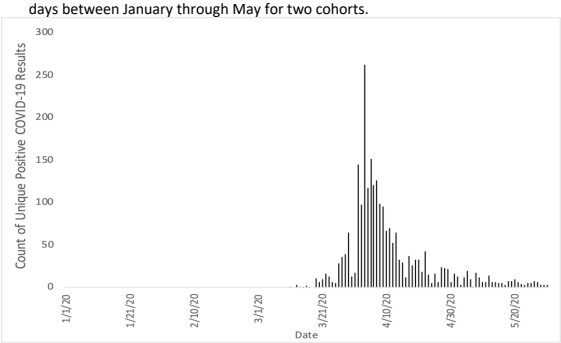

Figure 3. . Number of positive severe acute respiratory syndrome coronavirus 2 reverse transcriptase polymerase chain reaction nasopharyngeal test results. For patients with multiple positive tests, only the first positive culture was included.

DISCUSSION

- Blood culture policies did not change during COVID-19. However, nurses disclosed **common lapses in practice** secondary to staffing shortages:
  1. Using skin disinfectant for less time than manufacturer's recommendations
  2. Collecting serial cultures from same site
  3. Failing to collect multiple blood cultures
  4. Obtaining blood cultures from CVC
- We suspect **CLABSI rates increased** for the following reasons
  1. More CVC placements in the emergency department; less likely to be sterile compared to placement in procedure rooms or intensive care unit
  2. Greater proportion of CVC lines placed in femoral vein, likely as a result of physicians attempting to reduce exposure to COVID-19 patients
- 18 (60%) patients from COVID-19 cohort tested positive for SARS-CoV-2. Studies suggest patients with COVID-19 have increased propensity to develop secondary infections.[4] However, even with excluding these patients, CLABSI rate still increased by 194%.
- Limitations included:
  - Small sample size in the pre COVID-19 cohort
  - No audits on CVC insertion or maintenance during COVID-19; all identified gaps were from interviews with healthcare workers that worked during the pandemic

CONCLUSION

The data demonstrates higher rates of blood culture contamination and CLABSIs during the pandemic. Both rates peaked in April 2020 when the hospital's COVID-19 caseload was greatest. Reasons for such increases are likely attributed to stresses placed on the healthcare system, resource shortages and consistent surges of high acuity patients.[2]

The report justifies **greater investment in infection prevention** to accommodate patient quality care needs during a pandemic.

REFERENCES

1. Haddadin Y, Annamaraju P, Regunath H. Central Line Associated Blood Stream Infections (CLABSI). 2020. https://www.ncbi.nlm.nih.gov/books/NBK430891/. Accessed July 25, 2020, 2020.
2. Adalja AA, Toner E, Inglesby TV. Priorities for the US Health Community Responding to COVID-19. JAMA 2020;323:1343-1344.
3. National Healthcare Safety Network (NHSN): Patient Safety Component Manual. 2020. https://www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf. Accessed September 15, 2020.
4. Langford BJ, So M, Raybardhan S, Leung V. Bacterial co-infection and secondary infection in patients with COVID-19: a living rapid review and meta-analysis. *Clinical microbiology and infection* 2020.