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## Brief Report

# High rate of Multidrug-Resistant Organisms (MDROs) among COVID-19 patients presenting with bacteremia upon hospital admission

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## Key Words:

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We investigated the clinical implications of bacteremia among hospitalized COVID-19 patients. Higher rates (52.1%) of multidrug resistant organisms (MDRO) were noted on hospital admission compared to nosocomial acquisition (25%). Methicillin resistant *Staphylococcus aureus* was the predominant pathogen. Bacteremia with MDRO should be considered in the differential diagnosis among at risk populations especially those admitted from nursing facilities.

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Since its first detection in 2019, the novel pathogen, severe acute respiratory syndrome coronavirus (SARS-CoV-2) has spread to a pandemic level causing COVID-19. Without a clear treatment strategy in the early months of the pandemic, antibiotics were often used for possible bacterial coinfections.<sup>1–2</sup> Blood culture (BC) was also performed to assess the presence of bacteremia that could complicate the clinical course.<sup>3</sup> We investigated COVID-19 patients with bacteremia to ascertain the clinical implications for patients presenting with dual pathogens.

## METHODS

A retrospective review was performed of the electronic medical records of adult patients admitted to a 776-bed tertiary care center in Detroit, Michigan. COVID-19 cases diagnosed by qualitative reverse-transcriptase polymerase-chain-reaction (RT-PCR) assay between March and June 2020 were included. Data collection consisted of patient demographics, clinical information, and microbiologic results.

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The study was approved by the Ascension St. John Hospital Institutional Review Board.

We defined patients with bloodstream infection (BSI) on admission as a known pathogen in 1 or more BCs or the same commensal organism in 2 or more BCs drawn within 48 hours from time of admission. A nosocomial BSI was diagnosed if 1 or more cultures of blood drawn at least 48 hours after admission yielded a pathogenic organism. BCs were considered contaminated if there was a potential skin contaminant (eg, *Diphtheroids*, *Bacillus* species, or *Coagulase-negative Staphylococci*) in only 1 out of 2 BCs without clinical evidence of a true bacteremia as deemed by the treating infectious disease physician. BSI episodes that represented contamination and relapses were excluded. Multidrug-resistant organisms (MDROs) were defined as resistant to one or more classes of antimicrobial agents including methicillin resistant *Staphylococcus aureus* (MRSA), Vancomycin resistant *Enterococci* (VRE) and certain gram negatives producing extended spectrum beta-lactamases (ESBLs) or Carbapenemase resistant Enterobacteriaceae (CRE)<sup>4</sup>

## RESULTS

We identified 290 hospitalized patients with BC during the study period after exclusion of relapse and BC contaminants. There were 23 of 266 (8.6%) patients with positive BC on admission, all drawn within 26 hours of admission, and the majority were drawn in the emergency unit (Table 1). Nosocomial bacteremia was noted in 16 patients, 14 (87.5%) of them had BC done when they were in Intensive Care Units (ICU).

**Table 1**  
Bloodstream infection among COVID-19 positive cases

Onset of bloodstream infection	On hospital admission (<48 hrs.) N = 23 (%)	Nosocomial (≥48 hrs.) N = 16 (%)
<i>Patient demographics</i>		
Age < 70 y	14 (60.9)	12 (75.0)
Male sex	18 (78.3)	10 (62.5)
African American race	19 (82.6)	12 (75.0)
Admitted from nursing facility	14 (60.9)	6 (37.5)
<i>Patient Comorbidities</i>		
Hypertension	18 (78.3)	9 (56.3)
Diabetes	9 (39.1)	6 (37.5)
Chronic Lung disease	4 (17.4)	5 (31.3)
Congestive Heart failure	5 (21.7)	1 (6.3)
<i>Source of Bloodstream Infection</i>		
Pneumonia	8 (34.8)	11 (68.8)
Hemodialysis catheter related	1 (4.3)	0
Other line related	0	4 (25.0)
Skin & soft tissue	3 (13.0)	0
Urinary tract	3 (13.0)	0
Gastrointestinal	3 (13.0)	0
Endocarditis	3 (13.0)	0
Unknown	2 (8.7)	1 (6.2)
Previous Hospitalization within 90 d	4 (17.4)	2 (12.5)
Previous receipt of antimicrobials within 90 d	4 (17.4)	3 (18.8)
Polymicrobial Bacteremia	0	5 (31.3)
MDRO	12 (52.1)	4 (25.0)
Resistant Gram-positive organisms	9/12 = 75.0%	4/4 = 100%
Methicillin Resistant <i>S. aureus</i>	7	4
Vancomycin Resistant <i>Enterococcus</i>	2	0
Resistant Gram-negative organisms	3/12 = 25.0%	0
ESBL <i>E. coli</i>	2	0
<i>A. baumannii</i>	1	0
<i>Hospital course</i>		
Hospital site where positive	Emergency	Intensive
BC obtained	20 (87.0)	Care 14 (87.5)
Mechanical ventilation	7 (30.4)	16 (100)
Died	12 (52.2)	13 (81.3)

Similar patient characteristics revealed that most were black (82.6% vs 75%) males (78.3% vs 62.5%) < age 70 years (60.9% vs 75%) and admitted from nursing facilities (60.9% vs 37.5%) for bloodstream infections on admission and nosocomial bacteremia cases, respectively (Table 1).

All 23 cases of BSI on admission were monomicrobial. Organisms identified were *Staphylococcus aureus* (8), *Escherichia coli* (3), *Staphylococcus epidermidis* (2), *Streptococcus pneumoniae* (2), *Enterococcus faecalis* (2), and one case each of *Enterococcus faecium*, *Acinetobacter baumannii*, *Proteus mirabilis*, *Gemella sanguinis*, *Parvimonas micra* and *Candida glabrata*. MDROs included MRSA (7/8), ESBL *E. coli* (2/3), VRE (2/3) and *A. baumannii* (1/1). No CRE was found. MRSA was implicated in pneumonia (4), endocarditis (2), and genitourinary (1) ESBL producing *E. coli* in gut translocation (1) and urinary tract infection (1), vancomycin resistant *E. faecium* in skin/soft tissue (1) and *E. faecalis* in urinary tract infection (1). The source of *A. baumannii* bacteremia (1) was pneumonia.

16 nosocomial bacteremia cases were noted with eleven monomicrobial and 5 polymicrobial BC. The 23 nosocomial BC isolates included *S. aureus* (8), *Pseudomonas aeruginosa* (3), *E. coli* (2), *S. epidermidis* (2), *Klebsiella pneumoniae* (2), and one each *Klebsiella aerogenes*, *E. faecalis*, *Staphylococcus hominis*, *Streptococcus agalactiae*, *Streptococcus anginosus* and *C. glabrata*. MDROs found were all monomicrobial and only MRSA (4/8). No ESBL, CRE or VRE organisms were found. The source of nosocomial MRSA bacteremia was mainly pneumonia (3), and 1 case without a clear source.

## DISCUSSION

In our study, the rate of positive BC on admission among the hospitalized COVID-19 patients was 8.6% which is higher than 2.5%–2.9% reported in early literature.<sup>1</sup> This is likely due to the higher number of patients (65%) with positive BC on admission from nursing facilities. We previously reported that admission from nursing facilities was an independent risk factor for bacteremia on admission.<sup>5</sup> Similar findings of higher community-onset bacterial infection were reported among the patients admitted from a skilled nursing facility.<sup>1</sup> In our study, in-hospital mortality among patients with dual infection was 64.1%, compared to 53.1% reported in a multicenter study.<sup>6</sup>

In our cohort, gram positive MDRO BSIs were more common either on admission or nosocomially acquired. High rates of resistant BSIs on admission could be explained by those presenting from nursing facilities. A previous study on community onset BSI among non-COVID-19 patients reported that admission from a nursing facility was an independent risk factor for MDRO infections.<sup>7</sup> Indwelling devices, such as urinary catheters and feeding tubes, are frequently used in nursing facilities. Compared with residents from nursing facilities without indwelling devices, residents with indwelling devices have a higher prevalence of MDRO colonization.<sup>8</sup>

Our study limitations are a single center study with a small sample size. Nevertheless, our study strength is inclusion of nursing home patients with severe COVID-19 that had BSIs on admission. Larger studies may further validate our findings.

## CONCLUSION

Higher rates of MDRO BSIs were noted among the hospitalized COVID-19 patients on hospital admission. Gram positive MDRO bloodstream infections were more common either on admission or nosocomially acquired with MRSA being the most common pathogen. Based on our findings in patients presenting from the nursing home with sepsis, MDRO BSI should be considered in the differential diagnosis and efforts should be made to avoid delaying the administration of appropriate antibiotic therapy.

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