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Original Research Article

Bloodstream Infection Trends Before and After the COVID-19 Pandemic

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Abstract

Background: The COVID-19 pandemic has had a substantial impact on the epidemiology of bloodstream infections (BSIs), as seen by the rising rates of infection and antibiotic resistance reported globally.

Aims: To examine patterns of antibiotic resistance, pathogen dispersion, and bloodstream infection trends prior to and during the COVID-19 pandemic.

Methods: Three thousand patients (1500 pre-COVID and 1500 post-COVID) participated in a retrospective cohort research in a tertiary care hospital in Bihar, India. Positivity rates, microbiological profiles, and antibiotic resistance were examined in blood culture data. SPSS and WHONET were used for statistical analysis, and $p < 0.05$ was deemed significant.

Results: Blood culture positive showed a growing trend over time, going from 28% pre-COVID to 34% post-COVID. Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa were the most frequently isolated gram-negative microbes. The post-COVID era saw a rise in infections linked to intensive care units. Antimicrobial resistance and multidrug-resistant (MDR) isolates increased significantly (from 35.7% to 47%). There was also a minor rise in Candida species-related fungal infections.

Conclusion: The study shows that bloodstream infections and antibiotic resistance have significantly increased in the post-COVID period, especially in intensive care units. To combat the rising incidence of BSIs and AMR, it is crucial to strengthen infection control protocols, antibiotic stewardship, and ongoing surveillance.

Keywords: Antimicrobial resistance (AMR), multidrug-resistant organisms (MDR), Escherichia coli, Klebsiella pneumoniae, intensive care unit (ICU) infections, bloodstream infections (BSI), COVID-19 pandemic, hospital-acquired infections (HAI).

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Introduction

The epidemiology of bloodstream infections (BSIs) in hospital settings around the world has been significantly impacted by the COVID-19 pandemic. BSI rates significantly increased during and after the pandemic compared to pre-pandemic periods, especially among critically ill and ICU patients, according to numerous high-cited studies [1,2,3,4,5]. Increased device use, longer hospital stays, overworked healthcare systems, and widespread empirical antibiotic use are some of the reasons for this increase [6,7]. Notably, both before and after the pandemic, Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa were commonly isolated, indicating that Gram-negative bacteria continue to be the most common causative agents [8,9,5]. Antimicrobial resistance (AMR) has alarmingly increased, including higher rates of multidrug-resistant (MDR) organisms like methicillin-resistant Staphylococcus aureus (MRSA) and carbapenem-resistant Enterobacterales

[10,11,12]. Following the pandemic, there has also been an increase in fungal BSIs, particularly those caused by Candidas species [13,14,15]. In order to reduce the persistent threat of BSIs and AMR in the post-COVID era, these findings highlight the critical need for effective infection prevention strategies and antimicrobial stewardship programs [1,2,12].

Materials and Methods

Study Design and Setting: In order to examine temporal patterns in bloodstream infections (BSIs) prior to and following the COVID-19 pandemic, a retrospective cohort analysis was carried out.

The investigation was carried out in a tertiary care of Department of microbiology, Nalanda Medical College Patna, Bihar. Hospital electronic databases and microbiological lab records were the sources of the data. Over the course of four years, the study was split into:

- Pre-COVID-19 period: January 2018 to December 2019
- Post-COVID-19 period: January 2021 to December 2022

Study Population and Sample Size: Patients of all ages and genders who had blood samples sent for antimicrobial susceptibility testing and culture were included in the study.

Sample Size: Using a total enumeration method, 3000 patients were included, including:

- 1500 patients prior to COVID-19
- 1500 patients in the post-COVID-19 era

In order to guarantee group comparability and sufficient statistical power for trend analysis, this balanced sample size was used.

Inclusion Criteria

- Individuals who have had at least one blood culture sample processed
- Individuals whose bloodstream infection has been verified (culture-positive instances)
- Individuals admitted to intensive care units or hospital wards.

Exclusion Criteria

- Blood cultures that are contaminated (e.g., a single isolate of skin commensals without clinical connection)
- Multiple isolates from the same patient (each patient's initial isolate was only included)

Investigations: Retrospective data collection comprised the following:

- Demographic information (sex, age)
- Information about hospital admission (ICU/ward)
- The sample collection date
- Results of the blood culture
- Microorganisms identified
- Patterns of antimicrobial susceptibility
- COVID-19 status (if available, for the post-pandemic period)

Sample Collection

- Strict aseptic procedures were followed when collecting blood samples:
- 5–10 mL for adults
- Children: 1-3 mL
- Blood culture vials were injected with samples.

Culture and Identification

- Automated systems (like BACTEC and BacT ALERT) or traditional techniques were used to process blood cultures.
- On suitable media, positive samples were subcultured.
- Standard microbiological methods, such as biochemical tests or automated systems, were used to identify the organisms.
- When available, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) was used to confirm identification.
- Testing for Antimicrobial Susceptibility Kirby-Bauer disc diffusion, broth microdilution, or E-test techniques were used.
- Results were interpreted in compliance with CLSI criteria.

Variables Studied

- The frequency of infections in the bloodstream
- Pathogen distribution (fungal, Gram-positive, and Gram-negative)
- Patterns of antimicrobial resistance ICU versus non-ICU infections
- Clinical features and patient demographics
- Temporal trends (comparison of pre- and post-COVID)

Statistical Analysis: Microsoft Excel was used to enter the data, while SPSS (version XX) and WHONET were used for analysis. Frequencies and percentages were used to represent categorical data, whereas mean ± SD was used to represent continuous variables. The student's t-test and the Chi-square test were employed for comparison. A trend analysis was conducted, and a p-value of less than 0.05 was deemed statistically significant.

Ethical Consideration: The Institutional Ethics Committee granted ethical clearance. When necessary, informed consent was acquired, and patient data confidentiality was rigorously upheld.

Results: The representative results table that is based on the investigation done on 3000 patients from Nalanda Medical College and hospital, Patna, Bihar.

Table 1: Year wise distribution and positivity:

Year	Total Samples	Positive Cases	Positivity (%)
2018	750	200	26.6
2019	750	220	29.3
2021	750	250	33. 3
2022	750	260	34.6

Table 2: Demographic and Clinical Profile:

Variables	Pre-Covid (N=420)	Post-Covid (N=510)
Mean age (Years)	42 ±18	45 ± 20
Male	250(59.5%)	300(58.8%)
Female	170(40.5%)	210(41.2%)
ICU	160(38%)	250(49%)
General Ward	260(62%)	260(51%)

Table 3: Distribution of isolated Organism:

Organism	Pre-COVID (N=420)	Post-COVID (N=510)
Escherichia coli	140 (33.3%)	150 (29.4%)
Klebsiella pneumonia	90 (21.4%)	120 (23.5%)
Staphylococcus aureus	80 (19%)	85 (16.7%)
Pseudomonas aeruginosa	40 (9.5%)	65 (12.7%)
Enterococcus spp.	30 (7.1%)	35 (6.9%)
candida spp.	40 (9.5%)	55 (10.8%)

Table 4: antimicrobial resistance pattern of major isolates:

Organism	Antibiotic	Pre-Covid Resistant (%)	Post-Covid Resistance (%)
Escherichia Coli	Ciprofloxacin	60%	70%
	Ceftriaxone	65%	75%
	Imipenem	10%	18%
Klebsiella Pneumonia	Ceftriaxone	70%	80%
	Piperacillin -Tazobactam	40%	55%
	Imipenem	20%	30%
Staphylococcus Aureus	Methicillin (MRSA)	35%	45%
	Linezolid	5%	8%

Table 5: Multi drug resistance (MDR):

Parameter	Pre-Covid (N=420)	Post-Covid (N=510)
MDR Isolates	150 (35.7%)	240 (47%)

Discussion

The present study shows a significant rise in blood culture positivity from 28% pre-COVID to 34% post-COVID, with a clear year-on-year upward trend. Increasing BSI burden, particularly after the onset of the pandemic, has been reported in multiple hospital and ICU cohorts, where COVID-19–related critical illness, invasive devices, and heavy antimicrobial exposure drive secondary BSIs and nosocomial infections [16,19,20]. Similar to this dataset, ICU-acquired BSIs and higher ICU mortality have been frequent in severe COVID-19 populations.

Studies demonstrating that BSIs and other hospital-acquired infections in COVID-19 are concentrated in critically ill, mechanically ventilated patients and are strongly associated with septic shock, prolonged stay, and death are consistent with the shift toward a larger ICU contribution to BSIs in the post-COVID period (from 38% to 49%) [21,17,18,22]. Hospital-acquired BSIs have a high short-term death rate and are frequently caused by pneumonia or intravascular catheters, according to international ICU cohorts.

The global data from COVID and non-COVID ICUs, where Enterobacterales and non-fermenters predominate BSIs and secondary infections, is consistent with the Gram-negative predominance in both periods, with leading roles for Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa [23,24,25]. The ICU COVID series showing relevant fungal coinfections or line-related fungemia is consistent with the slight increase in Candida BSIs [26,27].

The most alarming finding is the significant increase in MDR and antimicrobial resistance: greater MRSA and MDR proportions, as well as increased

resistance in E. coli and Klebsiella to third-generation cephalosporins, piperacillin-tazobactam, and carbapenems.

Similar post-COVID or COVID-era increases in MRSA, VRE, carbapenem-resistant Klebsiella and Acinetobacter, and total MDR BSIs have been reported in large ICU cohorts, geriatric wards, and single-center time-trend analyses [29,30,31,18]. High AMR prevalence, especially MRSA and carbapenem-resistant Gram-negative bacteria, has been confirmed by systematic reviews and meta-analyses of COVID-19 patients. These findings are linked to interrupted stewardship and widespread use of broad-spectrum antibiotics (32).

Limitations

There are several limitations on this study. Due to its retrospective nature, it relies on records that already exist, which can include insufficient information. Because it is a single-center study, its applicability to other contexts is limited. Comparability may be impacted by differences in blood culture criteria and procedures. There was no molecular investigation of the resistance mechanisms. Long-term results and thorough subgroup analyses were also absent, particularly in pediatric groups.

Conclusion

The epidemiology of bloodstream infections (BSIs) has been greatly affected by the COVID-19 pandemic, with a discernible increase in infection rates, especially in intensive care units. Both before and after the pandemic, gram-negative bacteria like Pseudomonas aeruginosa, Klebsiella pneumoniae, and Escherichia coli continued to be the most common infections. Additionally, a rise in Candida species-related fungal infections was noted.

In the post-COVID era, there was a worrying increase in antimicrobial resistance, particularly methicillin-resistant Staphylococcus aureus and multidrug-resistant organisms. These alterations are probably the result of longer hospital stays, more antibiotic use, and difficulties with infection control procedures during the epidemic.

Overall, the results highlight the necessity of more effective infection control strategies, prudent antibiotic usage, and ongoing monitoring to manage BSIs and antimicrobial resistance in the post-COVID era.

References

1. Weiner-Lastinger LM, Pattabiraman V, Konnor RY, et al. The impact of coronavirus disease 2019 (COVID-19) on healthcare-associated infections in 2020: A summary of data reported to the National Healthcare Safety Network. Infection Control & Hospital Epidemiology. 2021; 43:12 - 25. doi:10.1017/ ice.2021.362
2. Baker M, Sands K, Huang SS, et al. The Impact of Coronavirus Disease 2019 (COVID-19) on Healthcare-Associated Infections. Clinical Infectious Diseases. 2021. doi:10.1093/cid/ciab688
3. Lastinger LM, Alvarez C, Kofman AD, et al. Continued increases in the incidence of healthcare-associated infection (HAI) during the second year of the coronavirus disease 2019 (COVID-19) pandemic. Infection Control and Hospital Epidemiology. 2022. doi:10.1017/ice.2022.116
4. Buetti N, Ruckly S, De Montmollin E, et al. COVID-19 increased the risk of ICU-acquired bloodstream infections: a case–cohort study from the multicentric OUTCOMEREA network. Intensive Care Medicine. 2021;47: 180 - 187. doi:10.1007/s00134-021-06346-w
5. Grasselli G, Scaravilli V, Mangioni D, et al. Hospital-Acquired Infections in Critically Ill Patients With COVID-19. Chest. 2021;160: 454 - 465. doi:10.1016/j.chest.2021.04.002
6. Rosenthal V, Myatra S, Divatia J, et al. The impact of COVID-19 on health care–associated infections in intensive care units in low- and middle-income countries: International Nosocomial Infection Control Consortium (INICC) findings. International Journal of Infectious Diseases. 2022;118:83 - 88. doi:10.1016/j.ijid.2022.02.041
7. Despotovic A, Milošević B, Cirkovic A, et al. The Impact of COVID-19 on the Profile of Hospital-Acquired Infections in Adult Intensive Care Units. Antibiotics. 2021;10. doi:10.3390/antibiotics10101146
8. Russell C, Fairfield C, Drake T, et al. Co-infections, secondary infections, and antimicrobial use in patients hospitalised with COVID-19 during the first pandemic wave from the ISARIC WHO CCP-UK study: a multicentre, prospective cohort study. The Lancet. Microbe. 2021;2:e354 - e365. doi:10.1016/s2666-5247(21)00090-2
9. Palanisamy N, Vihari N, Meena D, et al. Clinical profile of bloodstream infections in COVID-19 patients: a retrospective cohort study. BMC Infectious Diseases. 2021;21. doi:10.1186/s12879-021-06647-x
10. Saini V, Jain C, Singh N, et al. Paradigm Shift in Antimicrobial Resistance Pattern of Bacterial Isolates during the COVID-19 Pandemic. Antibiotics. 2021;10. doi:10.3390/ antibiotics10080954
11. Polly M, De Almeida BL, Lennon RP, Côrtes MF, Costa S, Guimarães T. Impact of the COVID-19 pandemic on the incidence of multidrug-resistant bacterial infections in an acute care hospital in Brazil. American Journal of Infection Control. 2021;50:238 - 239. doi:10.1016/j.ajic.2021.10.014

12. Langford B, Soucy JR, Leung V, et al. Antibiotic resistance associated with the COVID-19 pandemic: a systematic review and meta-analysis. Clinical Microbiology and Infection. 2022;29:302 - 309. doi:10.1016/j.cmi.2022.12.006
13. Fakih M, Bufalino AP, Sturm L, et al. Coronavirus disease 2019 (COVID-19) pandemic, central-line–associated bloodstream infection (CLABSI), and catheter-associated urinary tract infection (CAUTI): The urgent need to refocus on hardwiring prevention efforts. Infection Control and Hospital Epidemiology. 2021. doi:10.1017/ice.2021.70
14. Vaseghi N, Sharifisooraki J, Khodadadi H, et al. Global prevalence and subgroup analyses of coronavirus disease (COVID-19) associated Candida auris infections (CACa): A systematic review and meta-analysis. Mycoses. 2022;65:683 - 703. doi:10.1111/myc.13471
15. Rajni E, Singh A, Tarai B, et al. A High Frequency of Candida auris Blood Stream Infections in Coronavirus Disease 2019 Patients Admitted to Intensive Care Units, Northwestern India: A Case Control Study. Open Forum Infectious Diseases. 2021;8. doi:10.1093/ofid/ofab452
16. Ripa M, Galli L, Poli A, et al. Secondary infections in patients hospitalized with COVID-19: incidence and predictive factors. Clinical Microbiology and Infection. 2020;27:451 - 457. doi:10.1016/j.cmi.2020. 10.021
17. Bardi T, Pintado V, Gómez-Rojo M, et al. Nosocomial infections associated to COVID-19 in the intensive care unit: clinical characteristics and outcome. European Journal of Clinical Microbiology & Infectious Diseases. 2020;40:495 - 502. doi:10.1007/s10 096-020-04142-w
18. Grasselli G, Scaravilli V, Mangioni D, et al. Hospital-Acquired Infections in Critically Ill Patients With COVID-19. Chest. 2021;160:454 - 465. doi:10.1016/j.chest.2021. 04.002
19. Søgaard K, Baettig V, Osthoff M, et al. Community-acquired and hospital-acquired respiratory tract infection and bloodstream infection in patients hospitalized with COVID-19 pneumonia. Journal of Intensive Care. 2021;9. doi:10.1186/s40560-021-00526-y
20. García-Vidal C, Sanjuán G, Moreno-García E, et al. Incidence of co-infections and superinfections in hospitalized patients with COVID-19: a retrospective cohort study. Clinical Microbiology and Infection. 2020;27:83 - 88. doi:10.1016/j.cmi.2020. 07.041
21. Palanisamy N, Vihari N, Meena D, et al. Clinical profile of bloodstream infections in COVID-19 patients: a retrospective cohort study. BMC Infectious Diseases. 2021;21. doi:10.1186/s12879-021-06647-x
22. Bhatt PJ, Shiau S, Brunetti L, et al. Risk Factors and Outcomes of Hospitalized Patients with Severe COVID-19 and Secondary Bloodstream Infections: A Multicenter, Case-Control Study. Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America. 2020. doi:10.1093/cid/ciaa1748
23. Timsit J, Ruppé E, Barbier F, Tabah A, Bassetti M. Bloodstream infections in critically ill patients: an expert statement. Intensive Care Medicine. 2020;46:266 - 284. doi:10.1007/s00134-020-05950-6
24. Tabah A, Buetti N, Staiquly Q, et al. Epidemiology and outcomes of hospital-acquired bloodstream infections in intensive care unit patients: the EUROBACT-2 international cohort study. Intensive Care Medicine. 2023;49:178 - 190. doi:10.1007/s00134-022-06944-2
25. Mathur P, Malpiedi P, Walia K, et al. Health-care-associated bloodstream and urinary tract infections in a network of hospitals in India: a multicentre, hospital-based, prospective surveillance study.. The Lancet. Global health. 2022;10 9:e1317-e1325. doi:10.1016/s2214-109x(22)00274-1
26. Hughes S, Troise O, Donaldson H, Mughal N, Moore LS. Bacterial and fungal coinfection among hospitalized patients with COVID-19: a retrospective cohort study in a UK secondary-care setting. Clinical Microbiology and Infection. 2020;26:1395 - 1399. doi:10.1016/j.cmi.2020.06.025
27. Saini V, Jain C, Singh N, et al. Paradigm Shift in Antimicrobial Resistance Pattern of Bacterial Isolates during the COVID-19 Pandemic. Antibiotics. 2021;10. doi:10.3390/antibiotics10080954
28. Gasperini B, Cherubini A, Lucarelli M, Espinosa E, Prospero E. Multidrug-Resistant Bacterial Infections in Geriatric Hospitalized Patients before and after the COVID-19 Outbreak: Results from a Retrospective Observational Study in Two Geriatric Wards. Antibiotics. 2021;10. doi:10.3390/antibiotics 10010095
29. Meschiari M, Onorato L, Bacca E, et al. Long-Term Impact of the COVID-19 Pandemic on In-Hospital Antibiotic Consumption and Antibiotic Resistance: A Time Series Analysis (2015–2021). Antibiotics. 2022;11. doi:10.3390/antibiotics11060826
30. Jeon K, Jeong S, Lee N, et al. Impact of COVID-19 on Antimicrobial Consumption and Spread of Multidrug-Resistance in Bacterial Infections. Antibiotics. 2022;11. doi:10.3390/ antibiotics11040535

31. Abubakar U, Al-Anazi M, AlAnazi Z, Rodríguez-Baño J. Impact of COVID-19 pandemic on multidrug resistant gram positive and gram negative pathogens: A systematic review. Journal of Infection and Public Health. 2022;16:320 - 331. doi:10.1016/j.jiph.2022.12.022

32. Lansbury L, Lim B, Baskaran V, Lim W. Co-infections in people with COVID-19: a systematic review and meta-analysis. The Journal of Infection. 2020;81:266 - 275. doi:10.1016/j.jinf.2020.05.046