REVIEW ARTICLE

A DESCRIPTIVE REVIEW OF RELATIONSHIP OF URINARY TRACT INFECTIONS WITH HEALTHCARE-ASSOCIATED AND COMMUNITY-ONSET BLOODSTREAM INFECTIONS

Amina Gul[1],Shevya Awasti[2], Momena Ali[3], Tamjeed Gul[4]

[1]Department of Pathology, Khyber Medical College Peshawar - Pakistan

[2]School of Public Health, University of California, Berkeley - United State of America

[3]Department of Pathology, Khyber Medical College Peshawar - Pakistan

[4]Department of Surgery Bacha Khan Medical College, Mardan - Pakistan

ABSTRACT

Background: Bloodstream Infections (BSIs) that arise secondary to urinary tract infections (UTIs) are frequently encountered in both community and hospital settings and are associated with significant morbidity, mortality, high healthcare costs and prolonged hospital stays

Objective: This descriptive review aims to evaluate available information on the relationship of urinary tract infections with healthcare-associated and community-onset bloodstream infections to get a deeper understanding of improved public health interventions and suggest possibilities for future research.

Material andMethods: A literature search was conducted using PubMed and Embase. Articles published during the last 10 years (2010 and 2020) were imported into covidence for the initial title and abstract screening. All study abstracts were reviewed by two independent reviewers and were eligible for full-text review if they mentioned urinary tract infection as a source of bloodstream infection. The data obtained were analyzed in Microsoft Excel.

Results: Out of 65 articles reviewed for full text, 10 studies were selected. In total 6763 BSI cases were reported. We observed 2075 (30.6%) community-acquired (CA) BSIs compared to 1102 (16.2%) healthcare-associated (HCA) BSIs, and 1484 (21.9%) hospital-acquired (HA) BSIs. UTI was a major source of BSIs in community settings followed by HCA BSIs in most studies. Escherichia. coli was the most common pathogen isolated in patients with CA-BSIs. Hospital Acquired and HCA bacterial infections have the most antimicrobial resistance, compared to CA-infections.

Conclusion: Urinary tract Infections are a major source of developing secondary BSIs. Escherichia. coli is a major pathogen in CA-BSIs. Multidrug-resistant organisms accounted for most of the BSIs, especially in hospital settings and among patients receiving health care.

Keywords: Bloodstream infection, UTI, Hospital Acquired, Community Acquired

This article may be cited as: Gul A, Awasti S, Ali M, Gul T. A descriptive review of relationship of Urinary tract infections with Healthcare-associated and Community-onset Bloodstream infections. J Med Sci 2023 January;31(1):76-81

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections around the world affecting over 150 million people annually.[1] The clinical phenotypes of UTIs are heterogenous and range from mild self-limiting illness to severe life-threatening complications.[2] Bloodstream Infections (BSIs) that arise secondary to urinary tract infections (UTIs) are frequently encountered in both community and hospital settings and are associated with significant morbidity, mortality, high healthcare costs, and prolonged hospital stays.[3-4] Traditionally community-acquired bloodstream infections (CA-BSIs) are BSIs identified in outpatients or in inpatients whose first blood culture tests positive within 48 hours of hospital admission, while hospital-acquired bacteremia (HA-BSIs) is defined as a BSI that occurs in an inpatient whose first blood culture tests positive after 48 hours of admission.[5]

In recent years, dramatic changes in the epidemiology of BSIs have been noted due to a shift in our approach to medical management. Some traditional inpatient procedures are now routinely performed on an outpatient basis. Examples include patients attending day-hospital centers for chemotherapy infusions, hemo-

Correspondence
Dr. Tamjeed Gul
Assistant professor of Surgery
Department of Surgery Bacha Khan Medical College, Mardan - Pakistan
Cell: +92-334-9022439
Email: tamjeedgul@hotmail.com
Date Received: 07-11-2021
Date Revised: 27-10-2022
Date Accepted: 11-11-2022

dialysis clinics, patients undergoing ambulatory surgical procedures, and people living in nursing homes with on-site home medical care. These patients acquire infections under circumstances that cannot be classified as HA or CA infections and are referred to as community-onset healthcare-associated infections (HCA-BSIs).[5-6] Numerous studies have attempted to identify potential risk factors associated with the development of secondary- bloodstream infections and reported UTIs as one of the common sources of infection besides pneumonia, abdominal infections, and skin and soft tissue infections. Secondary-BSIs differ in their epidemiological and clinical characteristics and antibiotic resistance profiles and prognosis and are dependent in part on the population studied, study settings, the underlying infection focus, and other associated comorbid conditions. Available data to explain an adequate relationship between UTIs with either CA, HCA or HA-BSIs needs further evaluation. Here, we aimed to conduct a descriptive review of all the available literature published within the last 10 years that focused on risk factors for secondary BSI. In this descriptive review, we aimed to compare the characteristics of the three types of secondary BSIs in the context of UTIs to assess the potential impact of UTIs for each type of BSI and suggest future directions for improved public health and clinical intervention to prevent these serious complications of UTI.

MATERIAL & METHODS

A literature search was conducted using two databases--PubMed and Embase. Embase was searched for articles using the search terms ('bloodstream infection' OR 'bloodstream infection'/exp OR bloodstream infections OR 'bacteremia' OR bacteremia') AND ('urinary tract infection' OR 'urinary tract infection'/exp OR 'urinary tract infections' OR 'UTI' OR 'UTIs') AND ('healthcare associated infection'/exp OR 'healthcare associated infection' OR 'hospital acquired infection') AND 'community-acquired infection'/exp OR 'community-acquired infection*'). For PubMed we used the following search terms, ("Urinary Tract Infections"[Mesh] OR "Urinary Tract Infections" OR "Urinary Tract Infection" OR "UTIs") AND ("Bacteremia"[Mesh] OR "Bacteraemia" OR "Bloodstream infections" OR "Bloodstream infection") AND ("Cross Infection"[Mesh] OR "Hospital Acquired Infection" OR "Healthcare-associated Infection) AND ("Community-Acquired Infections"[Mesh] OR "Community-Acquired infection*".) Both of the searches were performed on 05-01-2020. Articles published in English during the last 10 years (2010 and 2020) were initially downloaded using Endnote software and then imported into COVIDENCE for the initial title and abstract screening. All study abstracts were reviewed by two independent reviewers and were eligible for full-text review if they mentioned UTIs as a source of BSIs. Since this review was descriptive, grey literature in the form of conference proceedings, newspapers, fact sheets, policy documents, and a thesis were not incorporated. Data was finally extracted and imported into an excel sheet for analysis. Characteristics of the studies including author names, year of study, study design (Table 1), and the total number of UTI cases and BSI cases were recorded (Figure 2).

RESULTS

The initial database search query outlined in the methods section yielded 1538 studies that matched our search criteria. About 264 studies were removed as duplicates and 1270 abstracts were reviewed. 1209 studies were found irrelevant and 65 articles were included for a final full-text review. In total 10 studies were selected for this systematic review after resolving any disagreements through consensus. This selection included all the studies where UTI was found in patients with Secondary BSIs, either as CA, HCA, or HA-BSIs. Out of 5 prospective, 3 retrospective, and 1 case-control and surveillance study that fulfilled our inclusion criteria, 8 were conducted in Europe and one each in Taiwan and Spain respectively

Every study that we analyzed, reported blood stream infections as either CA-BSI, HCA-BSI, or HA-BSI. The total number of BSIs and UTIs recorded from each of the 10 studies is shown in Figure 2. Due to variability in the definitions of BSIs, the bar graph shown below depicts some studies in which not all three types of BSIs were reported. Given the data that was presented to us however, we noted that community-acquired BSIs seemed to be the most prevalent infection in patients. 5 out of the 10 studies we analyzed had more community-acquired BSI reports than any of the other types of BSIs and we found the same trend after combining the data from every study. In total 6763 BSI cases were reported in total, and 2075 (30.6%) were community-acquired BSIs compared to 1102 (16.2%) healthcare-acquired BSIs, and 1484 (21.9%) hospital-acquired BSIs.

UTI was a major source of BSIs in community settings followed by HCA BSIs in most studies. Since 2018 we found only three studies (data collected between 2006-2013) taking into consideration the three major categories of BSIs and defining UTI as an important underlying source of infection (1-3, Figure 2). In two of the studies by Melzer and Freeman et al (9 and 10 in Figure 2), HCA-BSI was not recorded as a separate group and UTI was reported for CA and HA-BSI groups. For 5 of the above studies (4-8 in Table 1, Figure 2), the total proportion of UTI cases among the three BSI groups was collectively reported and therefore their study observations were limited by documenting UTIs irrespective of whether these infections were acquired in the community or were otherwise healthcare-associated or hospital-acquired.

Pathogen-specific Data and Antimicrobial Resistance. Escherichia. coli was the most common pathogen isolated especially in patients with CA-BSIs. K. pneumonia, P. aeruginosa, and Enterobacter were also reported as

potential pathogens implicated predominantly in HA, and HCA-BSIs. Staphylococcus aureus, streptococcal and enterococcal species were the commonly studied pathogens. Three studies (1, 3, 6) highlighted the importance of ESBL-producing GNB notably E coli and K. Pneumonia in patients with either HA or HCA-BSIs, while no study reported any information on specific Sequence Types of pathogens held responsible for S-BSIs. Many of the papers reported whether their pathogen of interest was resistant to certain antibiotics, without clarifying what kind of infection the pathogen was from. However, between the data of these three studies listed in Table 2, HA and HCA bacterial infections seem to have the most antimicrobial resistance, compared to CA-infections.

Klebsiella pneumoniae is an important human pathogen in the community and in the hospital setting. K. pneumoniae is the second most common cause of Gram-negative bloodstream infections after Escherichia coli. Horcajada et al in 2021 focused specifically on BSI secondary to Urinary focus and observed a high level of resistance for HCA-BSIs when compared to HA and CA-BSIs While comparing enterococcal bacteremia between the two enterococcal species, BSI caused by E. faecium were more resistant than those associated with E. faecalis. The precise role of antibiotic-resistant pathogens in HA-BSIs and HCA-BSIs points towards increased selection pressure in hospital environments and inadequate empirical treatment in these settings.

DISCUSSION

Every study we analyzed reported BSIs as either CA-BSI, HCA-BSI, or HA-blood stream infections. Due to variability in the definitions of BSIs, the bar graph above (Fig 2) depicts some studies in which not all three types of BSIs were reported. Given the available data that was presented to us, however, we noted that community-acquired BSIs seemed to be the most prevalent bloodstream infection in patients. We found 5 out of 10 studies that we analyzed had more community-acquired BSI reports than any of the other types of BSIs. Combining all of the data from every study, 6763 BSI cases were reported in total, we incorporated 2075 community-acquired BSIs, 1102 and healthcare-associated BSIs compared to 1484 hospital-acquired BSIs.

Earlier studies reported differences between HCA-BSIs and HA-BSIs in terms of the underlying diseases, infection focus, causative pathogens, their antibiotic susceptibility patterns, and prognosis, while others found that HCA-BSIs differed from both CA and HA-BSIs in terms of causative pathogens and prognosis.[6-9] Therefore, the

Table 1: Characteristics of the 10 studies included for review.

S No	Author/Year of Publication	Country	Study Design	Study Duration	Title of Study
1	Cubero et al., / 2018	Spain	Retrospective	2009-2007	Molecular Epidemiology of Klebsiella pneumoniae Strains Causing Bloodstream Infections in Adults
2	Hsu et al., /2018	UK	Prospective	2013-2012	Strategy to reduce E. coli bacteraemia based on cohort data from a London teaching hospital
3	Pinholt et al., /2014	Denmark	Prospective	2009-2006	Incidence, clinical characteristics and -30day mortality of enterococcal bacteraemia in Denmark: a population-based cohort study
4	Arco et al., /2017	Spain	Prospective	2010-2008	Results of an early intervention programme for patients with bacteraemia: analysis of prognostic factors and mortality
5	Frakking et al., /2013	Netherlands	Retrospective	2010-2008	Appropriateness of Empirical Treatment and Outcome in Bacteremia Caused by Extended-Spectrum--Lactamase-Producing Bacteria
6	Horcajada et al., /2012	Spain	Prospective	2011-2010	Healthcare-associated, community-acquired and hospital-acquired bacteraemic urinary tract infections in hospitalized patients
7	Kang et al., /2011	Korea	Surveillance	2009-2008	Clinical significance of nosocomial acquisition in urinary tract–related bacteremia caused by gram-negative bacilli
8	Kao et al., /2011	Taiwan	Retrospective	2005-2004	Isolated pathogens and clinical outcomes of adult bacteremia in the emergency department: A retrospective study in a tertiary Referral Center
9	Melzer et al., /2013	UK	Prospective	2011-2007	Thirty-day mortality in UK patients with community-onset and hospital-acquired MSSA bacteraemia
10	Freeman et al., /2012	New Zealand	Case control	2007-2003	Bloodstream infection with extended-spectrum beta-lactamase-producing Enterobacteriaceae at a tertiary care hospital in New Zealand: risk factors and outcomes

Table 2: Comparison of Antibiotic susceptibility patterns of pathogens isolated among patients with urinary tract related BSIs in three studies

Study	Pathogen	Type of Infection	AMR Pattern identified in patients with BSIs		
Cubero et al., 2018	K. pneumonia	S-BSI	Amc	Cip	Gent
		HA	223/56	223/72	223/13
		HCA	58/8	58/14	58/1
		CA	67/7	67/12	67/0
Pinholt et al.,2014	E. faecalis	S-BSI	Amp	Van	Gent
		HA	209/5	209/4	209/9
		HCA	104/1	104/2	104/54
		CA	144/0	144/1	144/28
	E. faecium	HA	207/191	207/3	207/145
		HCA	18/15	18/0	18/7
		CA	18/7	18/0	18/2
Horcajada et al.,2012	Enterobacteriaceae	S-BSI	Amc	FQ	Pip/Taz
		HA	142/45	142/51	142/27
		HCA	246/73	246/124	246/37
		CA	279/52	279/69	279/19

Amp: ampicillin; Amc: amoxicillin clavulanate; Cip: ciprofloxacin; Gent: gentamicin; Van: vancomycin; FQ: Fluroquinolone; Pip/Taz: piperacillin-tazobactam

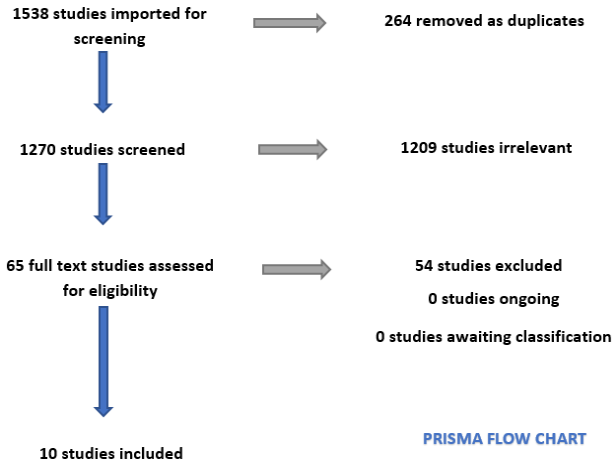

Fig 1: PRISMA Flow Chart showing the stepwise approach towards the inclusion of 10 studies for this descriptive review. The flow diagram depicts the flow of information through the different phases of a systematic review.

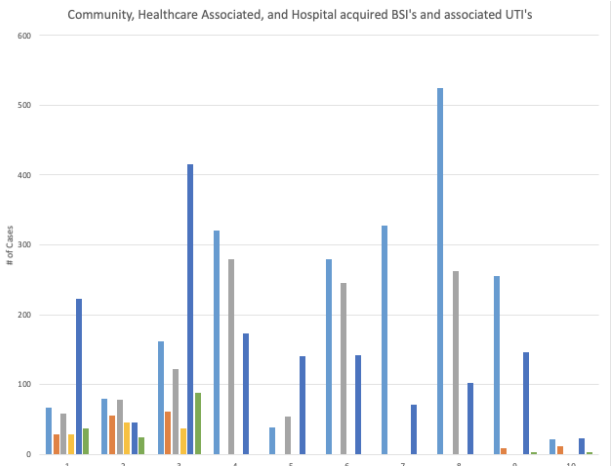

Fig 2: Total number of BSIs (CO, Community Onset; HCA, Healthcare Associated; HA, Hospital Acquired) and UTIs in 10 studies. Numbers from 1 to 10 correspond to studies represented in Table 1.

characteristics of BSI are different depending on the context of infection. A detailed analysis of all the studies included in the present review revealed that UTI was a major source of BSIs in community settings followed by HCA BSIs. Since 2018 we found only three studies (data collected between 2006-2013) taking into consideration the three major categories of BSIs and defining UTI as an important underlying source of infection.[10-12] In two studies by Freeman and Melzer et al, conducted in 2012 and 2013 respectively, found a high proportion of patients that had concurrent UTIs in CA-BSIs as compared to HA BSIs.[13-14] However, they were unable to report HCA-BSIs as separate groups assuming HCA-BSIs as part of CA-BSIs. The remaining 5 studies lack information with respect to UTI cases for each category of BSI and data reported was a total proportion of UTI among the three BSI groups collectively therefore their study observations were limited by documenting UTIs irrespective of whether these infections were acquired in the community or were otherwise healthcare-associated or hospital-acquired.[14-18] Further, it was observed that the standard definitions to meet the criteria for assigning a urinary focus as a definite source of BSI were not clearly stated especially for studies where the primary outcomes were not focused entirely on UTIs.

Most of the studies collected data from either hospital or laboratory records that in some instances was found incomplete in terms of important investigations like urine culture reports and matching organisms. Lack of data as to how many UTI cases were distributed between CA and HA-BSIs requires future studies to differentiate between infections that are truly community-acquired from those that occur as a result of healthcare acquired in the community i-e HCA BSIs. The basic classification of 'pre-day 2 of hospital admission' cases as 'community' may not truly represent infections acquired because of outpatient care that is being offered in the community, or those occurring immediately after discharge from the hospital to continue convalescing at home.[19] That would suggest that a high proportion of 'community' cases observed in some studies may, in part, be the result of this lack of precision as described earlier.[13]

Amongst various pathogens implicated in causing UTI-related BSIs, Escherichia coli was the most common pathogen isolated especially in patients with CA-BSIs.[11] klebsiella pneumonia, pseudomonas aeruginosa, and Enterobacter species were also reported as potential pathogens implicated predominantly in HA, and HCA-BSIs. Among the gram-positive bacteria Staphylococcus aureus including methicillin-susceptible Staphylococcus aureus and Methicillin-resistant Staphylococcus aureus, Streptococcus species, and Enterococcus faecalis and faecium were the commonly studied pathogens. Three studies highlighted the importance of ESBL-producing Gram-negative bacteria notably E. coli and K. pneumonia in patients with either HA or HCA-BSIs, while no study reported any information on specific sequence types of pathogens responsible for Urinary tract-related BSIs. Many of the papers reported whether their pathogen of interest was resistant to certain antibiotics, without clarifying what kind of infection the pathogen was from. However, between the data of these three studies, HA and HCA bacterial infections seem to have the most antimicrobial resistance, compared to CA-infections (Table 1). According to the Cubero et. al 2010 study, 141/223 (63.2%) of HA and 23/58 (39.6%) of HCA-K. pneumoniae infections had some form of antimicrobial resistance, compared to 19/67 (28.3%) CA-infections.[10] Similarly, the study by Horcajada et al, reported that 123/143 (86.6%) HA Enterobacteriaceae and 234/246 (95.1%) HCA Enterobacteriaceae had some form of antimicrobial resistance, compared to 140/279 (50.17%) CA infections. [16] Lastly, the study by Pinholt et al, 2014, reported 209 E. faecalis and 207 E. faecium HA infections. Of 209 HA-E. faecalis infections 103 (49%) isolates had some sort of antimicrobial resistance.[12] About 55/104 (52.8%) HCA E. faecalis infections and 22/18 (some infections had resistance to more than one antibiotic) HCA E. faecium-related BSIs were reported. In comparison, only 29/144 (20.1%) of the CA-E. faecalis and 9/18 (50.0%) of the CA E. faecium had some form of antimicrobial resistance. E. faecium did seem to have a higher antimicrobial resistance rate, as it matches the HA and HCA rates previously stated, however, it should be noted that only 18 CA-infections of E. faecium were recorded. Consequently, just 9 antimicrobial-resistant infections bring the rate up to 50%. Due to the stark difference in the number of infections of HA and HCA E. faecium infections versus CA-infections, the resistance rates should be compared with caution. The precise role of antibiotic-resistant pathogens in HA-BSIs and HCA-BSIs noted reflects the increased selection pressure in hospital environments in conjunction with inadequate empirical treatment in these settings. As the estimated burden of antibiotic-resistant HCA-BSIs is proportionately high, a separate classification of CA and HCA-BSIs is important as the problem of drug resistance in CA infections will be overestimated using the traditional classification.[18] The finding of this review is limited by a small data set and lack of data on other potential sources of HA-BSIs.

CONCLUSIONS

Urinary tract Infections are a major source for developing secondary BSIs. Escherichia. coli is a major pathogen in CA-BSIs. Hospital Acquired and HCA bacterial infections have the most antimicrobial resistance, compared to CA-infections. As UTIs are a potential risk factor for developing life-threatening BSIs further investigation into the true relationship of UTIs with S-BSIs is required to improve the clinical management and outcomes of patients. CDC/NHSN recommendations for establishing a definite association between BSI and UTI must be met to assess the actual burden of urinary tract-related BSI. Assuming that HCA-BSIs and HA-BSIs share characteristics based on their mode of acquisition, underlying infection focus, microbiological profile, antibiotic resistance patterns, and prognosis, collecting surveillance data on HCA and HA-BSIs secondary to UTI would have obvious implications for professionals involved in the care of sick patients in community settings.

REFERENCES

1. Magruder M, Sholi AN, Gong C, Zhang L, Edusei E, Huang J, et al. Gut uropathogen abundance is a risk factor for development of bacteriuria and urinary tract infection. Nature communications. 2019;10(1):5521.

2. Gharbi M, Drysdale JH, Lishman H, Goudie R, Molokhia M, Johnson AP, et al. Antibiotic management of urinary tract infection in elderly patients in primary care and its association with bloodstream infections and all cause mortality: population based cohort study. Bmj. 2019;364:l525.

3. Baier C, Linke L, Eder M, Schwab F, Chaberny IF, Vonberg RP, et al. Incidence, risk factors and healthcare costs of central line-associated nosocomial bloodstream infections in hematologic and oncologic patients. PloS one. 2020;15(1):e0227772.

4. Sabih A, Leslie SW. Complicated Urinary Tract Infections. StatPearls. Treasure Island (FL)2020.

5. Laupland KB, Pasquill K, Parfitt EC, Naidu P, Steele L. Burden of community-onset bloodstream infections, Western Interior, British Columbia, Canada. Epidemiology and infection. 2016;144(11):2440-6

6. Aguilar-Duran S, Horcajada JP, Sorli L, Montero M, Salvado M, Grau S, et al. Community-onset healthcare-related urinary tract infections: comparison with community and hospital-acquired urinary tract infections. The Journal of infection. 2012;64(5):478-83.

7. Courjon J, Demonchy E, Degand N, Risso K, Ruimy R, Roger PM. Patients with community-acquired bacteremia of unknown origin: clinical characteristics and usefulness of microbiological results for therapeutic issues: a single-center cohort study. Annals of clinical microbiology and antimicrobials. 2017;16(1):40.

8. Lenz R, Leal JR, Church DL, Gregson DB, Ross T, Laupland KB. The distinct category of healthcare associated bloodstream infections. BMC infectious diseases. 2012;12:85.

9. Takeshita N, Kawamura I, Kurai H, Araoka H, Yoneyama A, Fujita T, et al. Unique characteristics of community-onset healthcare- associated bloodstream infections: a multi-centre prospective surveillance study of bloodstream infections in Japan. The Journal of hospital infection. 2017;96(1):29-34.

10. Cubero M, Grau I, Tubau F, Pallarés R, Domínguez MA, Linãres J, et al. Molecular epidemiology of klebsiella pneumoniae strains causing bloodstream infections in adults. Microbial Drug Resistance. 2018;24(7):949-57.

11. Hsu DD, Melzer M. Strategy to reduce E. coli bacteraemia based on cohort data from a London teaching hospital. Postgraduate medical journal. 2018;94(1110):212-5.

12. Pinholt M, Ostergaard C, Arpi M, Bruun NE, Schonheyder HC, Gradel KO, et al. Incidence, clinical characteristics and 30-day mortality of enterococcal bacteraemia in Denmark 2006-2009: a population-based cohort study. Clinical microbiology and infection : the official publication of the European Society of Clinical Microbiology and Infectious Diseases. 2014;20(2):145-51.

13. Freeman JT, McBride SJ, Nisbet MS, Gamble GD, Williamson DA, Taylor SL, et al. Bloodstream infection with extended-spectrum beta-lactamase-producing Enterobacteriaceae at a tertiary care hospital in New Zealand: risk factors and outcomes. International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases. 2012;16(5):e371-4.

14. Melzer M, Welch C. Thirty-day mortality in UK patients with community-onset and hospital-acquired meticillin-susceptible Staphylococcus aureus bacteraemia. The Journal of hospital infection. 2013;84(2):143-50.

15. Del Arco A, Olalla J, de la Torre J, Blazquez A, Montiel-Quezel N, Prada JL, et al. Results of an early intervention programme for patients with bacteraemia: analysis of prognostic factors and mortality. BMC infectious diseases. 2017;17(1):360.

16. Horcajada JP, Shaw E, Padilla B, Pintado V, Calbo E, Benito N, et al. Healthcare-associated, community-acquired and hospital-acquired bacteraemic urinary tract infections in hospitalized patients: a prospective multicentre cohort study in the era of antimicrobial resistance. Clinical microbiology and infection : the official publication of the European Society of Clinical Microbiology and Infectious Diseases. 2013;19(10):962-8.

17. Kang CI, Chung DR, Son JS, Ko KS, Peck KR, Song JH. Clinical significance of nosocomial acquisition in urinary tract-related bacteremia caused by gram-negative bacilli. American journal of infection control. 2011;39(2):135-40.

18. Kao CH, Kuo YC, Chen CC, Chang YT, Chen YS, Wann SR, et al. Isolated pathogens and clinical outcomes of adult bacteremia in the emergency department: a retrospective study in a tertiary Referral Center. Journal of microbiology, immunology, and infection = Wei mian yu gan ran za zhi. 2011;44(3):215-21.

19. Bou-Antoun S, Davies J, Guy R, Johnson AP, Sheridan EA, Hope RJ. Descriptive epidemiology of Escherichia coli bacteraemia in England, April 2012 to March 2014. Euro surveillance : bulletin Europeen sur les maladies transmissibles = European communicable disease bulletin. 2016;21(35).

CONFLICT OF INTEREST: Authors declare no conflict of interest

GRANT SUPPORT AND FINANCIAL DISCLOSURE: NIL

AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Gul A:	Study conception, Literature search, Data Entry, Writing, Critical review
Awasti S:	Study conception, Literature search, Data analysis, Critical review
Ali M:	Literature search, data entry
Gul T:	Literature search, Writing, critical review

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.