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Spectrum of Microorganisms Causing Infections in Post Renal Transplant Patients in a Tertiary Care Hospital, Calicut

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A B S T R A C T

Renal transplant recipients are particularly susceptible to a wide range of infections due to their immunosuppressive therapy, with urinary tract infections (UTIs) being the most prevalent. The microbial spectrum commonly includes Gram-negative bacteria such as *Escherichia coli*, *Klebsiella* spp., and *Pseudomonas sps*, as well as Gram-positive organisms like *Enterococcus* spp. Fungal pathogens, notably *Candida* spp also contribute significantly to the infectious burden in this population. The emergence of multidrug-resistant organisms (MDROs) has further complicated treatment strategies, underscoring the need for vigilant surveillance and tailored antimicrobial therapy. Identification of post renal transplant infections is a key elements of a thorough infection prevention and control strategy in healthcare environments. To determine the microbial infections, to isolate and identify microorganisms causing infections among post renal transplant patients. Also to study the antimicrobial susceptibility pattern and Multidrug resistant organisms (MDRO'S) in post renal transplant patients. Clinical samples, including urine, blood, exudates, and body fluids, are analyzed using standard bacteriological methods to identify causative pathogens. Antimicrobial susceptibility testing is performed via modified Kirby-Bauer disc diffusion, with results interpreted according to CLSI guidelines. Additionally, the VITEK 2 Compact system is used for testing non-fermenting Gram-negative bacteria, anaerobes, and fungi. Blood and body fluids are processed using the BacT/ALERT 3D system. Total 193 Renal transplants took place during this period. Out of which, 39 had post renal transplant infections (20. 2%). Among 39 infected patients 28 (71. 79%) patients had infections in 1st month of transplantation followed by 11 (28. 21%) patients had infection in the 2nd month. A total 48 organisms were isolated from 39 culture positive cases. *Klebsiella spp, Enterococcus spp*., and *E. coli* were the most frequently isolated organisms. The more prevalent microbial infection was UTI. Out of 48 organisms 11 were MDRO'S (21. 91%). This study identifies post renal transplant infections, emphasizing the importance of accurate detection for effective treatment. By acknowledging the diverse range of pathogens and talking a proactive approach health care providers can optimize care for kidney transplant patients and minimize the risk of infections and also this would be helpful for hospital infection control team to reduce the incidence of infections among renal transplant patients.

Introduction

Following kidney transplantation, the possibility of developing an infection is a significant concern, with approximately 70% of transplant recipients likely to encounter an infection within three years post-transplant, leading to potential illness and death (1). Recipients of kidney transplants are more susceptible to a variety of infections due to their weakened immune system from immunosuppressive medication.

These illnesses may be hospital-acquired, community-acquired, or transmitted from the donor, and can also reactivate dormant pathogens. While theoretically, any infectious agent can pose a risk, certain pathogens are of particular concern, including Enterobacteriaceae, which often cause urinary tract infections; Pneumocystis jirovecii, which can lead to pneumonia; Candida species, responsible for invasive fungal infections; herpes viruses; hepatitis viruses; and parasites, all of which can have severe consequences for immunocompromised renal transplant recipients.

While immunosuppressive medications have a vital part in maintaining graft health and function, they also raise the possibility of various post-transplant complications. Notably, renal transplant recipients often experience significant complications, including cardiovascular events, cancer development, and infections. Infections, in particular, are a frequent and serious concern, representing the second leading cause of mortality among patients with well- functioning grafts, highlighting the need for careful management and monitoring.

To mitigate the chance of infection in transplant patients, pre-transplant screening is essential for identifying potential vulnerabilities and enabling preventative measures. While some infections can be avoided by screening, vaccination, and prophylactic antimicrobials, diagnosis can be challenging due to atypical symptoms in transplant recipients.

Furthermore, treatment plans are complicated by pharmacological interactions and the need to balance immunosuppression with the risk of allograft rejection (2, 3). The collective expertise of transplant surgeons and physicians, coupled with refinements in surgical procedures, enhanced organ preservation methods, and the introduction of innovative immunosuppressive medications, have collectively contributed to significant enhancements in both recipient and graft outcomes. This progress has enabled successful transplantation even in challenging cases involving marginal recipients and donor organs, leading to improved survival rates and graft functionality (2, 4).

This research aims to investigate the diverse range of microorganisms responsible for infections in post-renal transplant patients, crucial for accurate diagnosis and effective management. The study provides a thorough summary of common infections occurring after kidney transplantation, offering guidance on prevention, diagnosis, and treatment strategies. Additionally, it provides valuable insights into the care and management of transplant recipients who develop infections, ensuring optimal outcomes.

Materials and Methods

Each kidney transplant patient underwent rigorous daily monitoring for signs of infection. The samples (Urine, Blood, Exudates, Sputum….) of patients suspected with renal transplant infections were send to the lab and processed. Bacterial, fungal isolates were recognized through routine identification methods and its sensitivity pattern to antibiotics and multidrug resistance of isolates were done by using Kirby Bauer disc diffusion method according to CLSI guidelines. Antifungal susceptibility done by using VITEK 2 compact automatic system.

Other methods like BACT /ALERT 3D, VITEK® 2 Compact automatic system were used for the identification of the non fermenting gram negative organisms, anaerobes and fungus.

Results and Discussion

The study was conducted in the Department of Microbiology, Aster MIMS HOSPITAL Calicut during the period from January 2023 to December 2024. Total 193 Renal transplants took place during this period. out of which, 39 had post renal transplant infections (20. 2%).

Sample Wise Distribution

The distribution of organisms was predominantly found in urine samples, accounting for 87. 50%, followed by blood (4. 17%), and exudates (4. 17%), and then body fluids (2. 08%) and sputum (2. 08%).

Age Wise Distribution

Renal transplant patients by age group reveals that those over 40 years old have the highest incidence of post-transplant infections at 35. 79%, followed closely by the 20-30 age group at 33. 3% and the 31-40 age group at 30.8%.

Gender Wise Distribution

This is the data of Gender wise Distribution of Renal Transplant Patients. The data shows that females are more affected (59%) compared to males (41%).

Incidence of infectious rate from 2023-2024

In 2023 infectious rate was 23. 2% which dropped in to 17. 9 % in 2024.

Incidence of infection after kidney transplantation

Among 39 transplant patients, 28 patients (71. 9%) developed infections within the first month of transplantation, and 11 patients (28. 2%) experienced infections in the second month.

Organisms associated with renal transplant patients

Out 48 organisms isolated, the most prevalent organisms was *Klebsiella sps* with a rate of 25. 5 % (n=13), *E. coli, Enterococcus sps* with rate of 21. 6% (n=11), 19. 6 % (n=10) followed by *Pseudomonas sps (n=3), Acinetobacter sps* (n=3), *candida albicans (n=2), Chryseobacterium species (n=2).*

Least isolated were *Staphylococcus epidermidis, Enterobacter sps, CONS, Aeromonas sps*

Organisms causing UTI in renal transplant patients

Klebsiella sps was the common pathogen with rate of 26. 2% (n=11) followed by Enterococcus sps and E. coli with a rate of 23. 8%, 21. 4% (n=10) (n=9).

Least isolated were *Pseudomonas* sps, *Acinetobacter* sps, *Candida albicans*, *Chryseobacterium* sps, Enterobacter sps, *Aeromonas* sps.

Organisms causing SSI in renal transplant patients

In surgical site infections *E. coli* and *Klebsiella sps.* was the common organisms causing SSI with rate of 50%.

Organisms causing respiratory tract infection in renal transplant patients

Klebsiella sps. was the organism causing Respiratory tract infection in renal transplant patients with rate of 100%.

Organisms causing blood stream infection in renal transplant patients

Bloodstream infections in renal transplant patients were caused by *Klebsiella species* and *E. coli*, with each organism accounting for 50% of cases.

Microbial infections among renal transplant patients

UTIs were the most prevalent, accounting for 84. 62% of cases, while bloodstream infections and surgical site infections each occurred at a rate of 5. 13%, and respiratory tract infections at 2. 56%.

Antibiotic susceptibility pattern of *Klebsiella sps.*

Klebsiella species isolated were 100% sensitive to Colistin, Tigecycline, Cholramphenicol, Piperacilllin/Tazobactam and 92. 3% sensitive to Minocycline, Doxycycline. Cefepime + tazobactam, Cefuroxime, Cefixime shows 84. 6% sensitivity. *Klebsiella* species isolated were 61. 5% resistant to Cefepime

Antibiotic susceptibility pattern of *E. coli*

When the susceptibility pattern of *E. coli* to different drugs studied, it showed 100% sensitivity to Colistin, Tigecycline, Cholramphenicol, 90. 9% sensitive to Piperacilllin/Tazobactam, Cefoperazone/sulbactam, Nitrofurantoin, Cefixime, Fosfomyci n. Cefepime + tazobactam, Levofloxacin, Ciprofloxacin shows 81. 8% sensitivity.

Here *E. coli* was 100% resistant to Ampicillin. Followed by Ceftriaxone (81. 8%) and Cotrimaxazole (63. 6%)

Antifungal susceptibility pattern of *Candida albicans*

Here candida albicans was 100% sensitive to Amphotericin B Flucanazole, Voriconazole, Flucytosine, Caspofungin, Micafungin

Distribution of total multidrug resistance organisms

The data highlights the prevalence of Multidrug-Resistant (MDR) organisms. The most common MDR organisms identified are: Carbapenem resistant Enterobacteraels (CRE) -46%. ESBL and CRPA accounts for 36% and 18%.

In this study out of 193 renal transplant individuals, 39 patients had post renal transplant infections. The rate of infections among renal transplant patients was 20. 2%. According to the study conducted by Devaraju, PK *eta l* Bacterial infections were noted in 37. 7% of patients (n=258) during the course of their follow-up (5). Here Post-renal transplant infections are more prevalent in females and individuals over 40 years old. Study conducted by Nursel Çalık Başaran *et al.,* female were susceptible to infection and the mean age of the patients was 43±14 years. (6)

In this study post renal transplant infectious rate was reduced from 23. 2% to 17. 9% (2023- 2024). Juthaporn Cowan *et al.,* study Infectious rate was reduced from 52. 8 % to 36. 2 % (2011- 2012). (7)

Here among 39 infected patients 28 (71. 79%) patients had infections in 1st month of transplantation followed by 11 (28. 21%) patients had infection in 2 nd month. According to the study conducted by Devaraju, PK *et al.,* among the infectious episodes identified, the time of occurrence was <1 month since transplant in 51. 5% (n=133), 1-6 months in 33% (n=86) (5).

A total 48 organisms were isolated from 39 culture positive cases. The most prevalent organisms was *Klebsiella sps, E. coli, Enterococcus sps.* Study by iris schröter *et al., Enterococcus, E. coli* and *Klebsiella sps* was the isolated bacterium (8).

Table.1 Sample Wise Distribution

Samples	Number of isolates	Rate (%)
Urine	42	**87. 50**
Blood	2	**4. 17**
Body fluids	1	**2. 08**
Sputum	1	**2. 08**
Exudates	2	**4. 17**
TOTAL	**48**	

Table. 2 Age Wise Distribution

Age	Number of Cases	Rate (%)
20-30 YR	13	**33. 3**
31-40 YR	12	**30. 8**
>40 YR	**14**	**35. 9**

Table. 3 Gender Wise Distribution

Gender	Number of Cases
Female	**23**
Male	**16**

Table. 4 Incidence of infectious rate from 2023-2024

Year	Total Transplants	Culture Positive Cases	Rate (%)
2023	95	22	**23. 2**
2024	**98**	**17**	**17. 9**

Table. 5 Incidence of infection after kidney transplantation

Month	Number of Transplantation	Rate (%)
1st month of transplantation	28	**71. 9**
2nd month of transplantation	11	**28. 21**
Total	**39**	

Table. 6 Organisms associated with renal transplant patients

Organisms isolated	Number (%)	Rate
Klebsiella species	13	**25. 5**
E. coli	11	**21. 6**
Enterococcus species	10	**19. 6**
Pseudomonas species	3	**5. 9**
Acinetobacter species	3	**5. 9**
Candida albicans	2	**3. 9**
Chryseobacterium species	2	**3. 9**
Staphylococcus epidermidis	1	**2. 0**
Enterobacter species	1	**2. 0**
Cons	1	**2. 0**
Aeromonas species	1	**2. 0**
Total	**48**	

Table. 7 Organisms causing UTI in renal transplant patients

Organisms isolated	Number	Rate (%)
Klebsiella sps	11	**26. 2**
Enterococcus sps	10	**23. 8**
E. Coli	9	**21. 4**
Pseudomonas sps	3	**7. 1**
Acinetobacter sps	3	**7. 1**
Candida albicans	2	**4. 8**
Chryseobacterium sps	2	**4. 8**
Enterobacter sps	1	**2. 4**
Aeromonas sps	**1**	**2. 4**

Table. 8 Organisms causing SSI in renal transplant patients

Organisms isolated	Number	Rate (%)
E. coli	1	**50**
CONS	**1**	**50**

Table. 9 Organisms causing respiratory tract infection in renal transplant patients

Organisms isolated	Number	Rate (%)
Klebsiella species	**1**	**100**

Table. 10 Organisms causing blood stream infection in renal transplant patients

Organism isolated	Number	Rate (%)
E. coli	1	**50**
Klebsiella sps	**1**	**50**

Table. 11 Microbial infections among renal transplant patients

Microbial infection	No. of Cases	Rate (%)
UTI	33	**84. 62**
Blood stream infection	2	**5. 13**
Surgical site infection	2	**5. 13**
RTI	**1**	**2. 56**

Table. 12 Antibiotic susceptibility pattern of *Klebsiella sps.* (n=13)

Antibiotics	Sensitive		Intermediate		Resistant	
	N	%	N	%	N	%
Amikacin	10	76. 92	0	0. 00	3	**23. 08**
Amoxicillin/clavulanic acid	7	53. 85	0	0. 00	6	**46. 15**
Aztreonam	6	46. 15	1	7. 69	6	**46. 15**
Cefepime	5	38. 46	0	0. 00	8	**61. 54**
Cefepime + Tazobactam	11	84. 62	0	0. 00	2	**15. 38**
Cefoperazone + Sulbacta m	10	76. 92	0	0. 00	3	**23. 08**
Ceftriaxone	8	61. 54	0	0. 00	5	**38. 46**
Ciprofloxacin	10	76. 92	0	0. 00	3	**23. 08**
Co-trimoxazole	8	61. 54	0	0. 00	5	**38. 46**
Gentamicin	10	76. 92	0	0. 00	3	**23. 08**
Imipenem	9	69. 23	0	0. 00	4	**30. 77**
Meropenem	9	69. 23	0	0. 00	4	**30. 77**
Levofloxacin	8	61. 54	0	0. 00	5	**38. 46**
Nitrofurantoin	8	61. 54	0	0. 00	3	**23. 08**
Piperacillin + Tazobacta m	13	100. 00	0	0. 00	0	**0. 00**
Doxycycline	12	92. 31	0	0. 00	1	**7. 69**
Minocycline	12	92. 31	0	0. 00	1	**7. 69**
Cefuroxime	11	84. 62	0	0. 00	0	**0. 00**
Cefixime	11	84. 62	0	0. 00	0	**0. 00**
Chloramphenicol	1	100. 00	0	0. 00	0	**0. 00**
Colistin	13	100. 00	0	0. 00	0	**0. 00**
Tigecycline	**13**	**100. 00**	**0**	**0. 00**	**0**	**0. 00**

Table. 13 Antibiotic susceptibility pattern of *E. coli* (n=11)

Antibiotics	Sensitive		Intermediate		Resistant	
	No.	%	No.	%	No.	%
Ampicillin	0	0. 0	0	0. 0	11	**100. 0**
Amikacin	8	72. 7	1	9. 1	2	**18. 2**
Amoxicillin / Clavulanic Acid	6	54. 5	0	0. 0	5	**45. 5**
Aztreonam	4	36. 4	0	0. 0	7	**63. 6**
Cefepime	6	54. 5	0	0. 0	5	**45. 5**
Cefepime + Tazobacta m	9	81. 8	0	0. 0	2	**18. 2**
Cefoperazone + Sulbact am	10	90. 9	0	0. 0	1	**9. 1**
Ceftriaxone	2	18. 2	0	0. 0	9	**81. 8**
Ciprofloxacin	9	81. 8	0	0. 0	2	**18. 2**
Co-trimoxazole	4	36. 4	0	0. 0	7	**63. 6**
Gentamicin	5	45. 5	0	0. 0	6	**54. 5**
Imipenem	7	63. 6	1	9. 1	3	**27. 3**
Meropenem	8	72. 7	0	0. 0	3	**27. 3**
Levofloxacin	9	81. 8	0	0. 0	2	**18. 2**
Nitrofurantoin	10	90. 9	0	0. 0	0	**0. 0**
Piperacillin + Tazobact am	10	90. 9	0	0. 0	1	**9. 1**
Doxycycline	8	72. 7	0	0. 0	3	**27. 3**
Minocycline	11	100. 0	0	0. 0	0	**0. 0**
Cefuroxime	6	54. 5	0	0. 0	4	**36. 4**
Cefixime	10	90. 9	0	0. 0	0	**0. 0**
Chloramphenicol	1	100. 0	0	0. 0	0	**0. 0**
Fosfomycin	10	90. 9	0	0. 0	0	**0. 0**
Tigecycline	11	100. 0	0	0. 0	0	**0. 0**
Colistin	**11**	**100. 0**	**0**	**0. 0**	**0**	**0. 0**

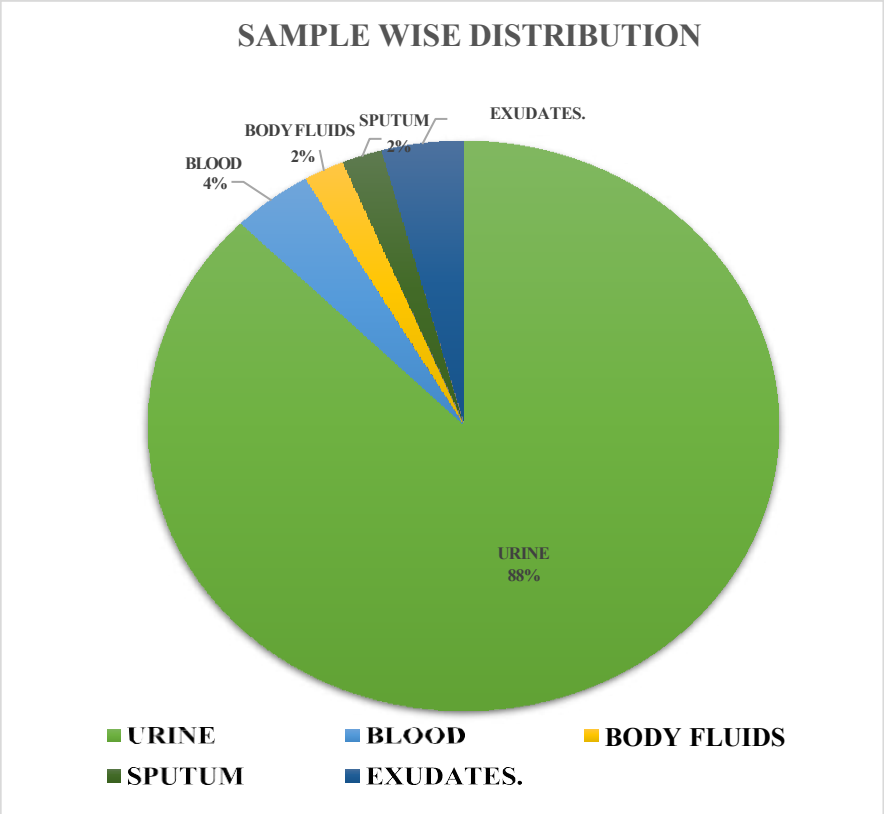
Table. 14 Antifungal susceptibility pattern of *Candida albicans* (n=2)

Antibiotics	Sensitive		Intermediate		Resistant	
	N	%	N	%	N	%
Amphoterici n B	2	100	0	0	0	**0**
Flucanazole	2	100	0	0	0	**0**
Voriconazole	2	100	0	0	0	**0**
Flucytosine	2	100	0	0	0	**0**
Caspofun gin	2	100	0	0	0	**0**
Micafungin	**2**	**100**	**0**	**0**	**0**	**0**

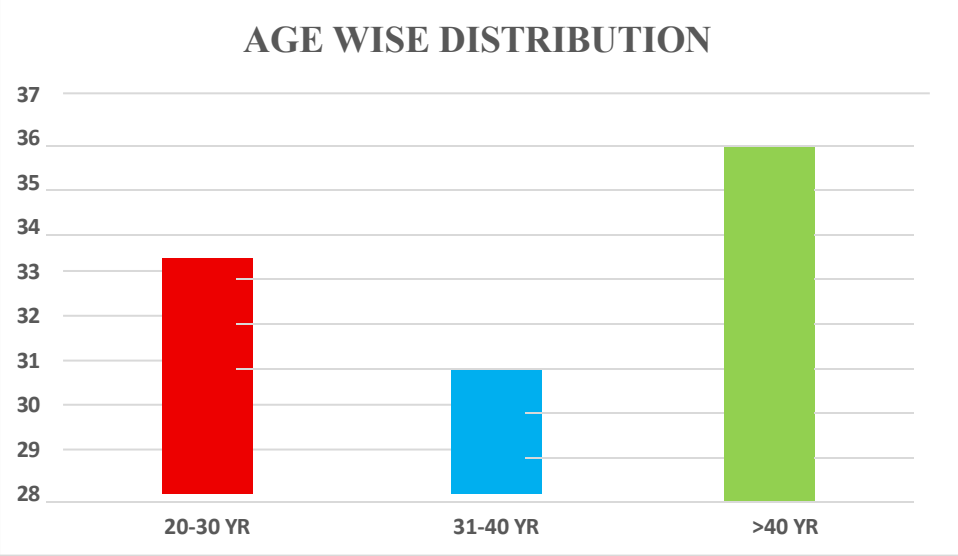
Table. 15 Distribution of total multidrug resistance organisms

MDRO N=11	No. of isolates	Rate (%)
ESBL	4	**8. 3**
CRE	5	**10. 4**
CRPA	**2**	**4. 2**

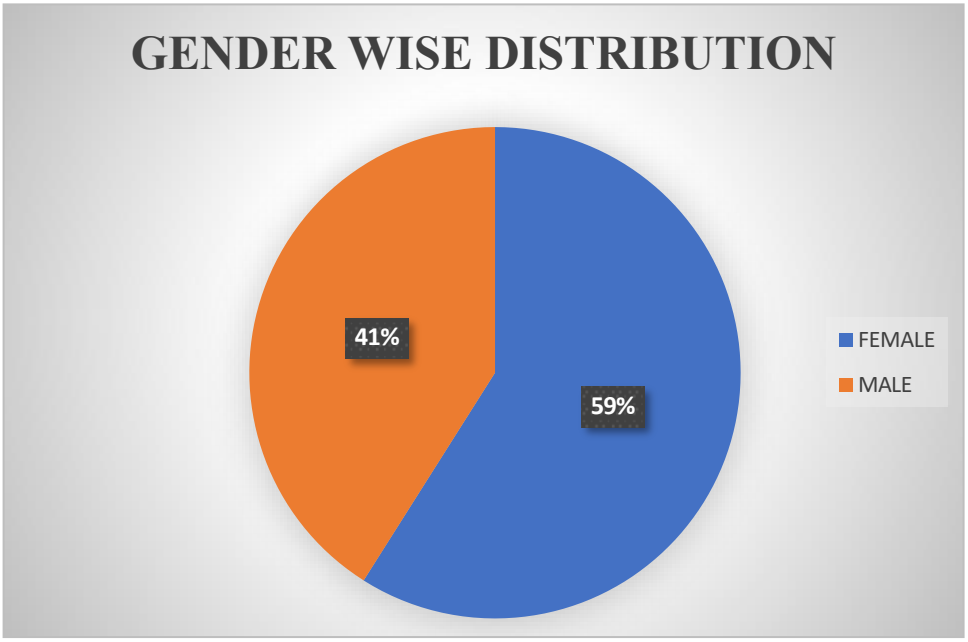
Graph. 1 Sample Wise Distribution



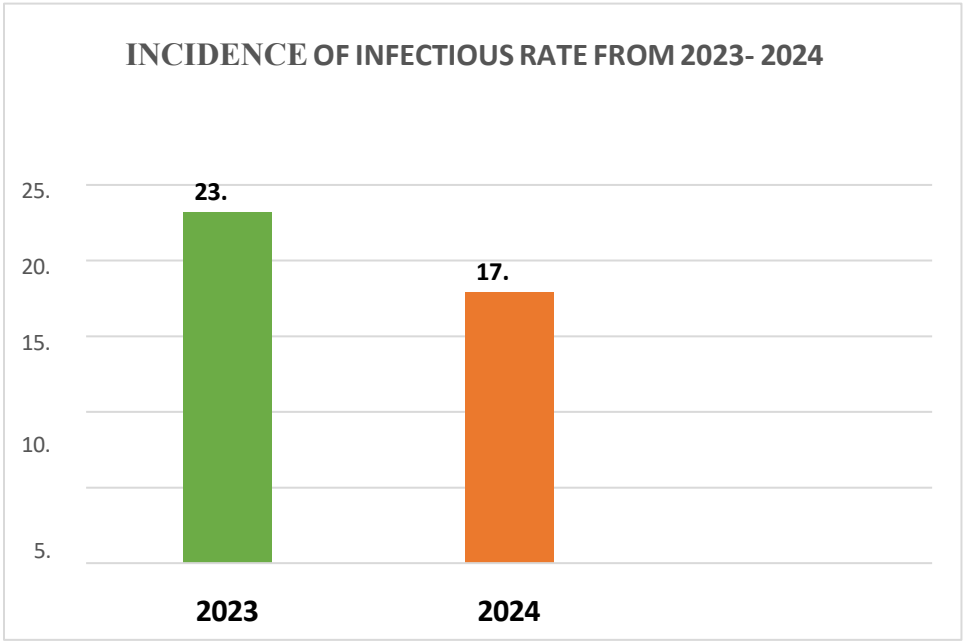
Graph. 2 Age Wise Distribution



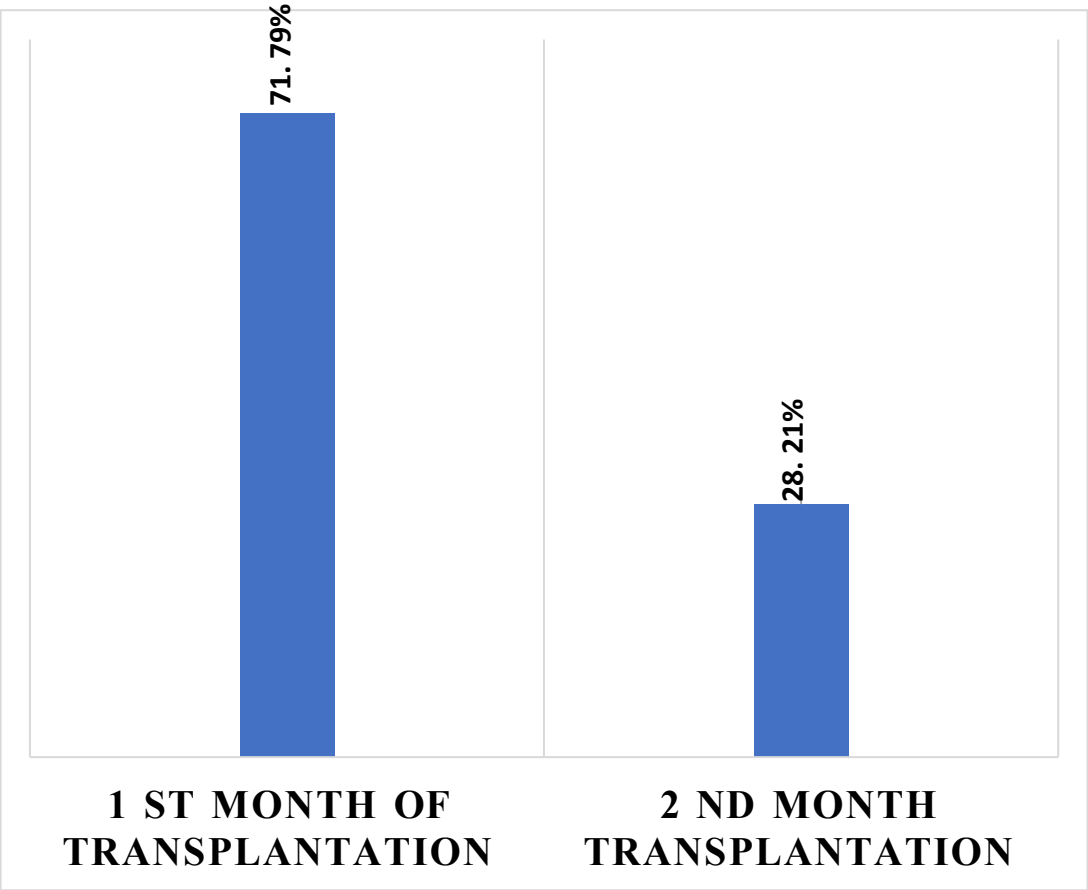
Graph. 3 Gender Wise Distribution



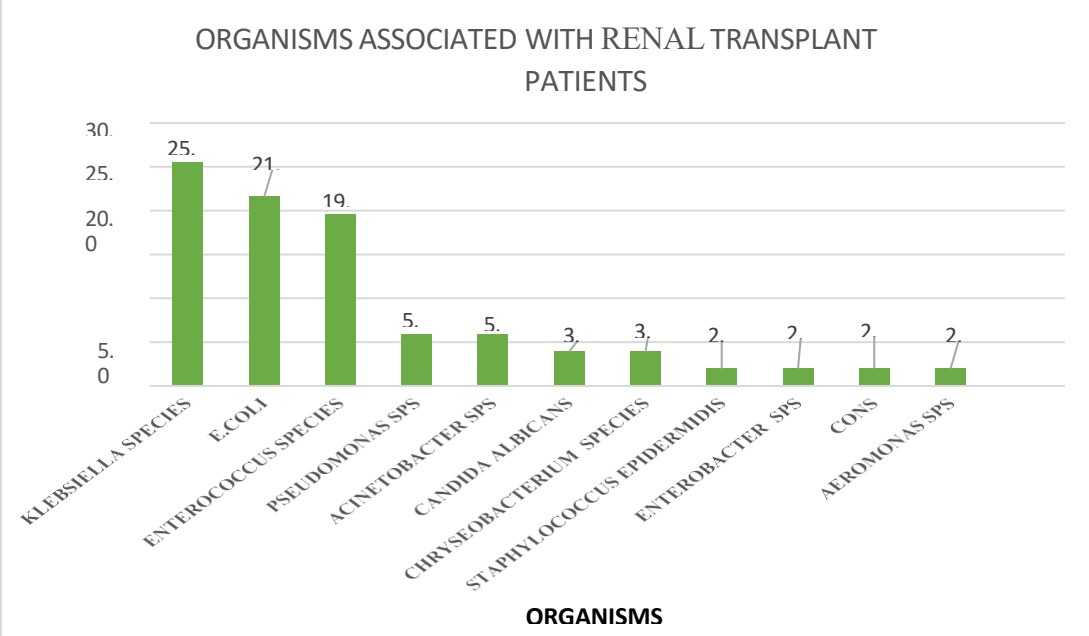
Graph. 4 Incidence of infectious rate from 2023-2024



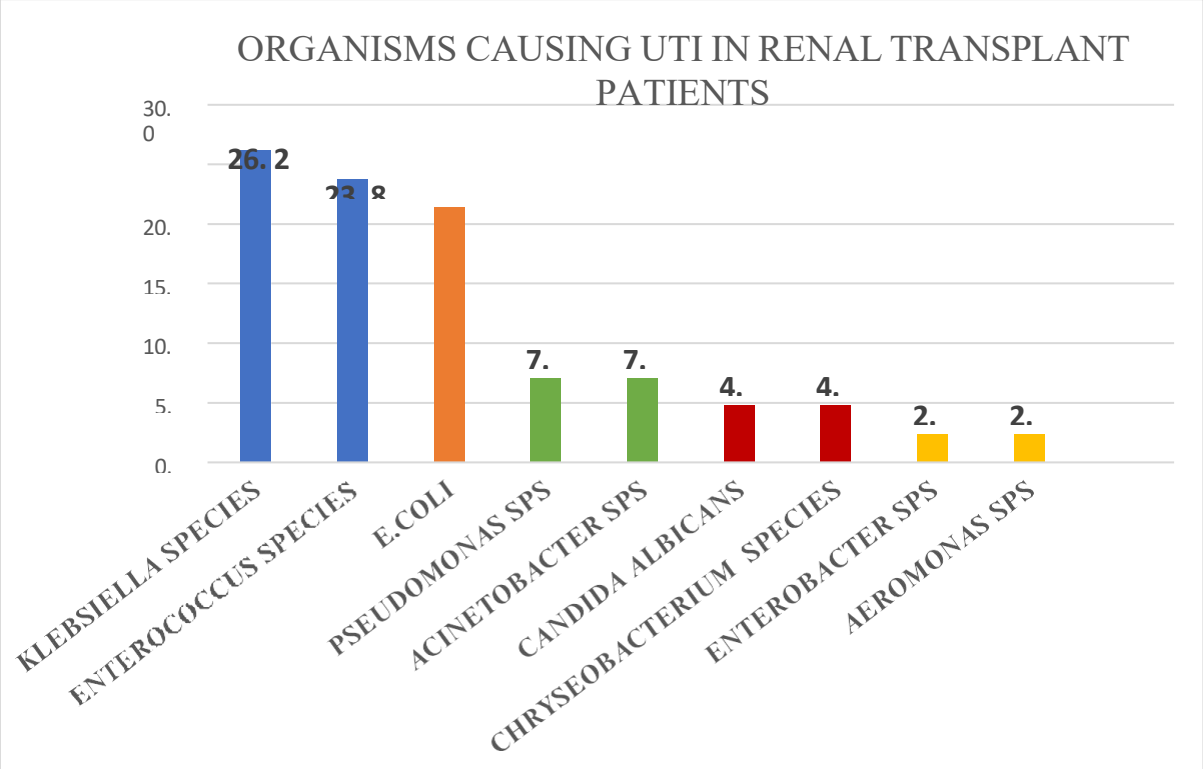
Graph. 5 Incidence of infection after kidney transplantation



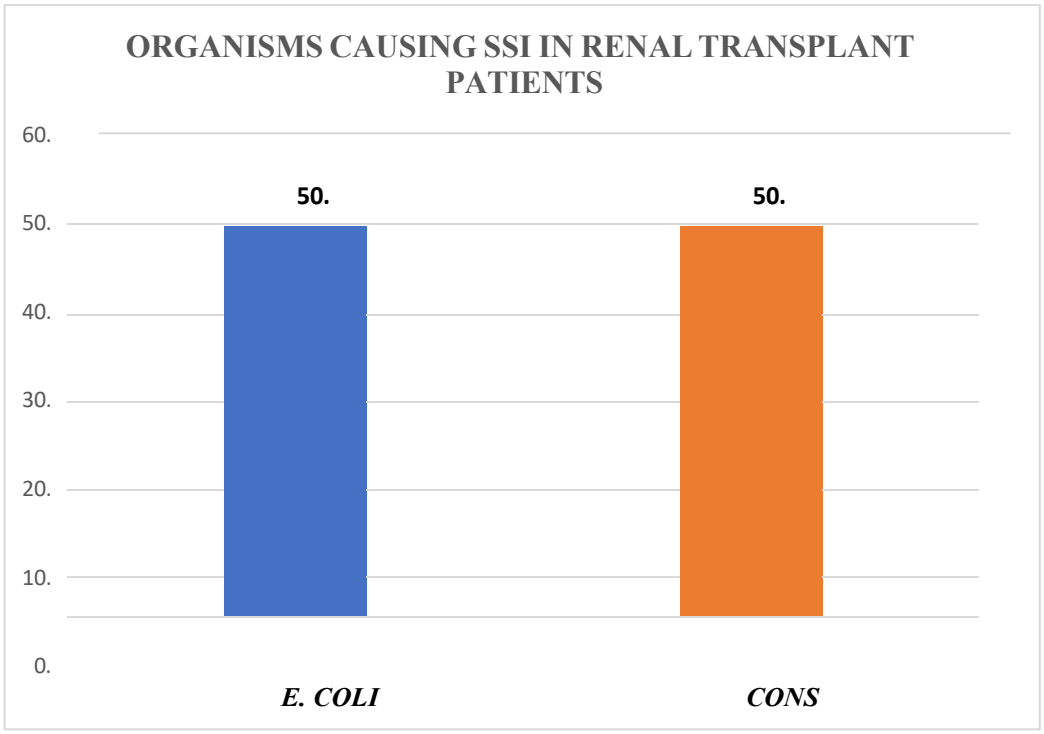
Graph. 6 Organisms associated with renal transplant patients



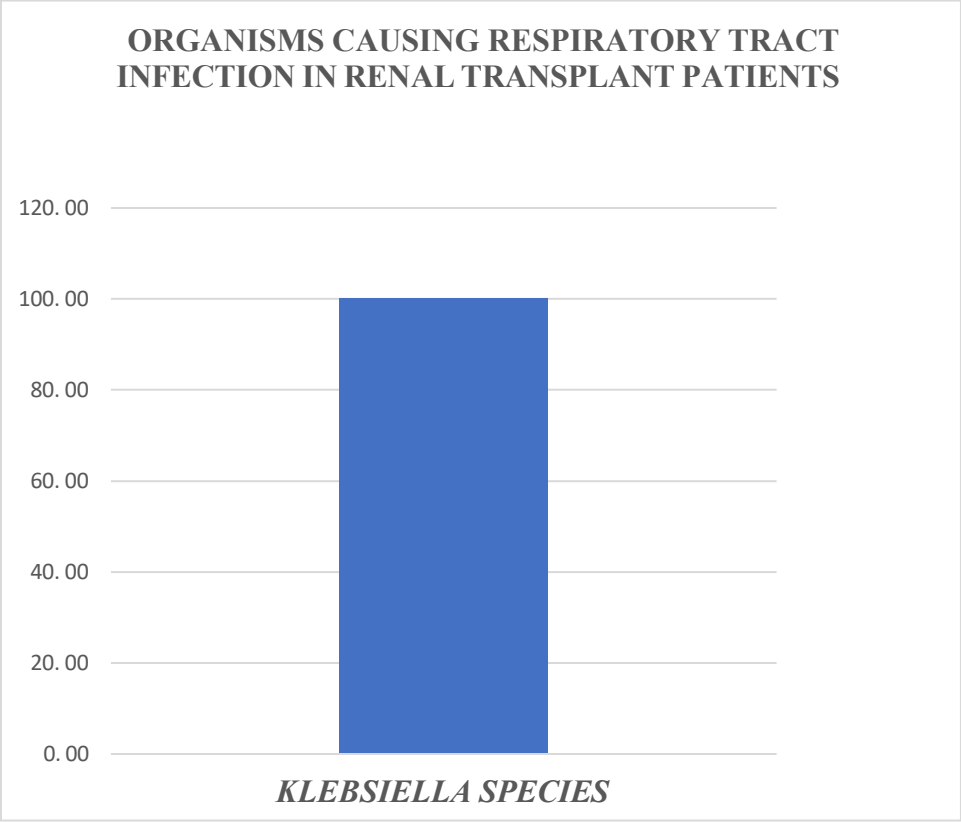
Graph. 7 Organisms causing UTI in renal transplant patients



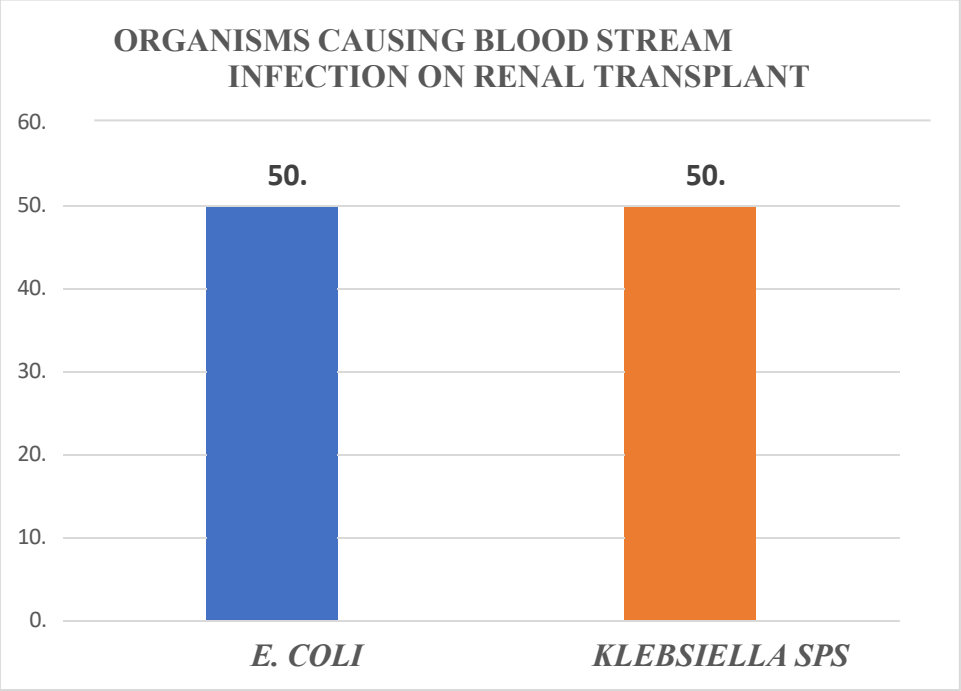
Graph. 8 Organisms causing SSI in renal transplant patients



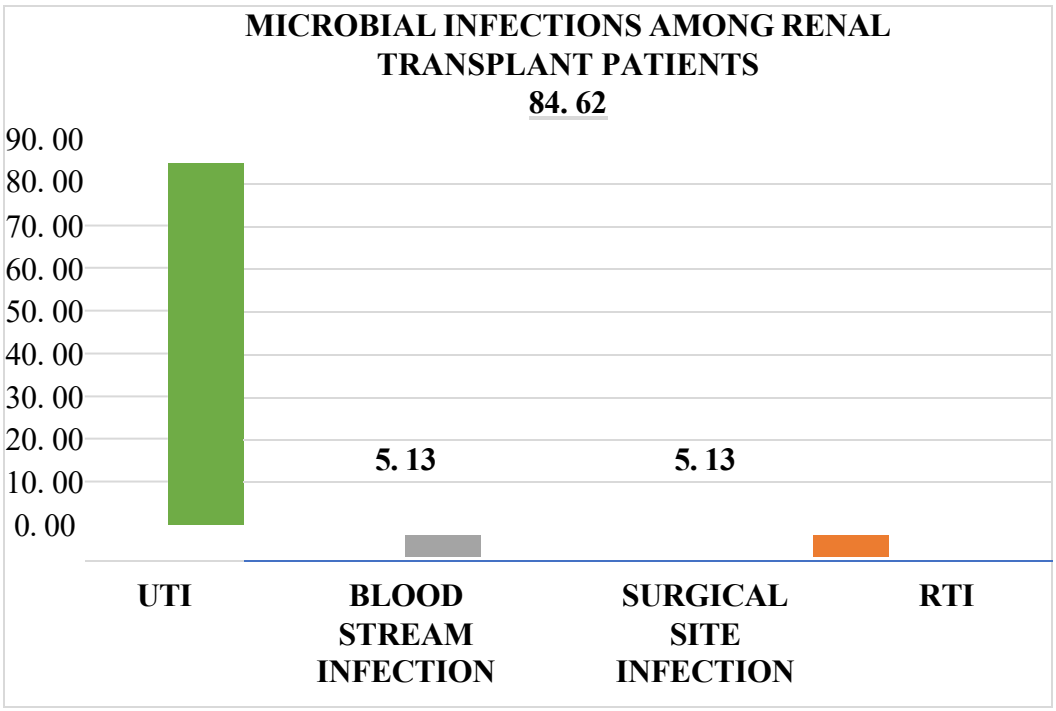
Graph. 9 Organisms causing respiratory tract infection in renal transplant patients



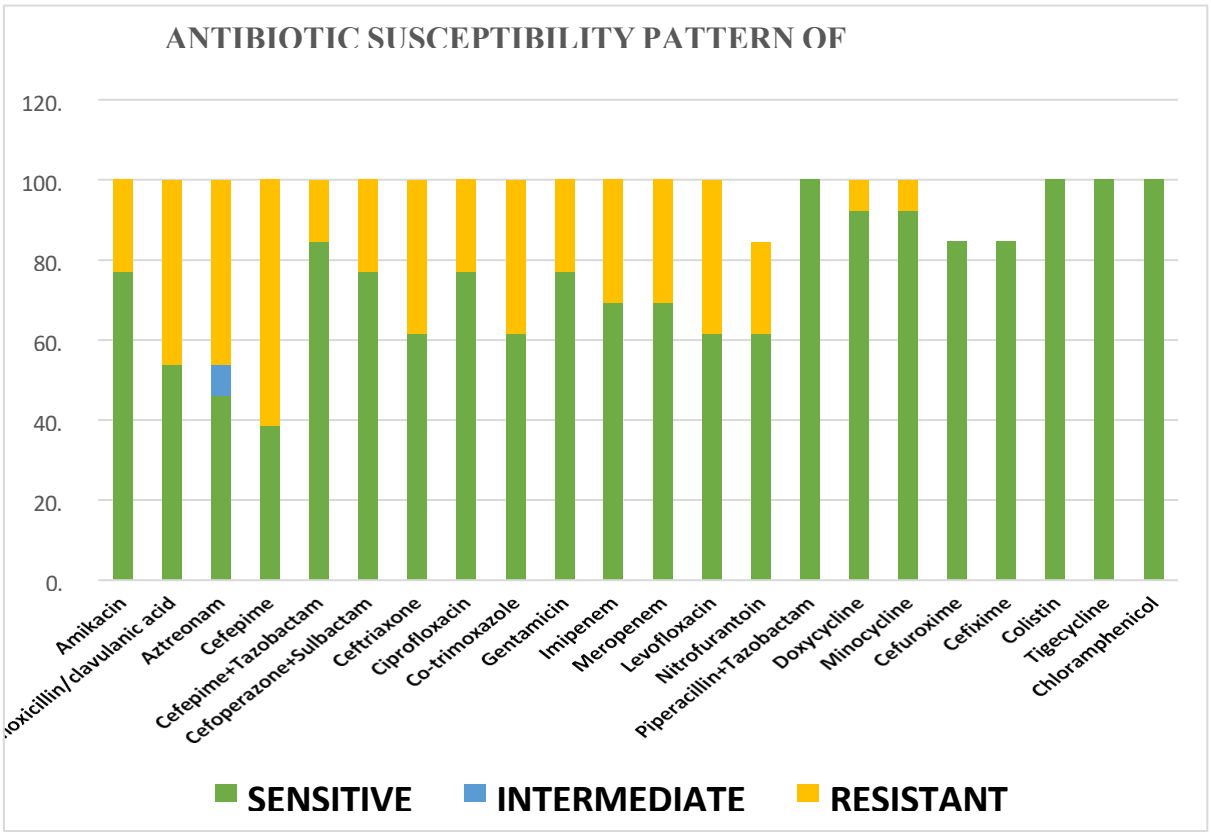
Graph. 10 Organisms causing blood stream infection in renal transplant patients



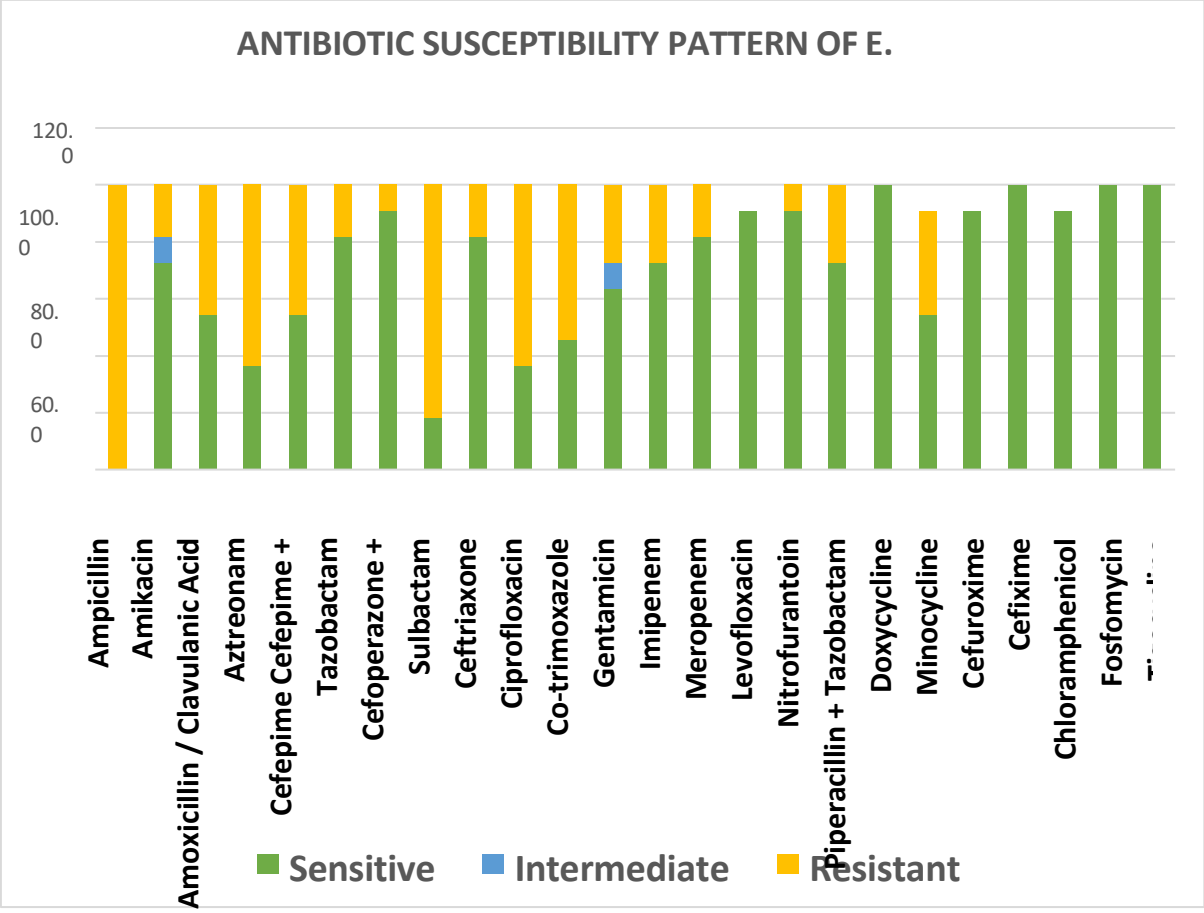
Graph. 11 Microbial infections among renal transplant patients



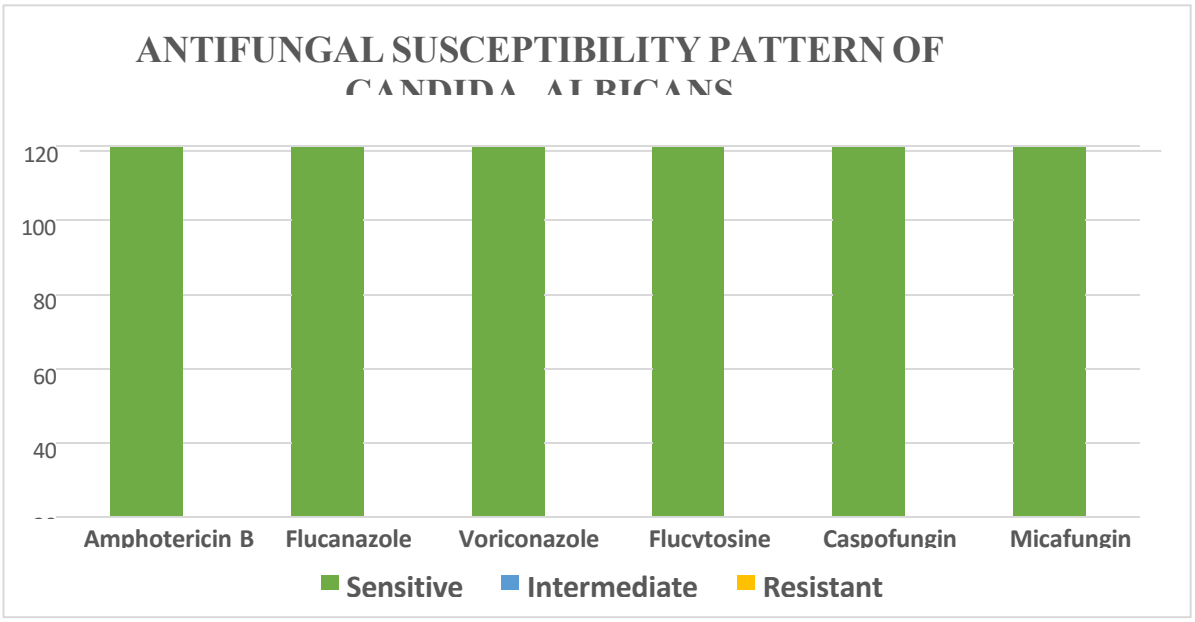
Graph. 12 Antibiotic susceptibility pattern of *Klebsiella sps.*



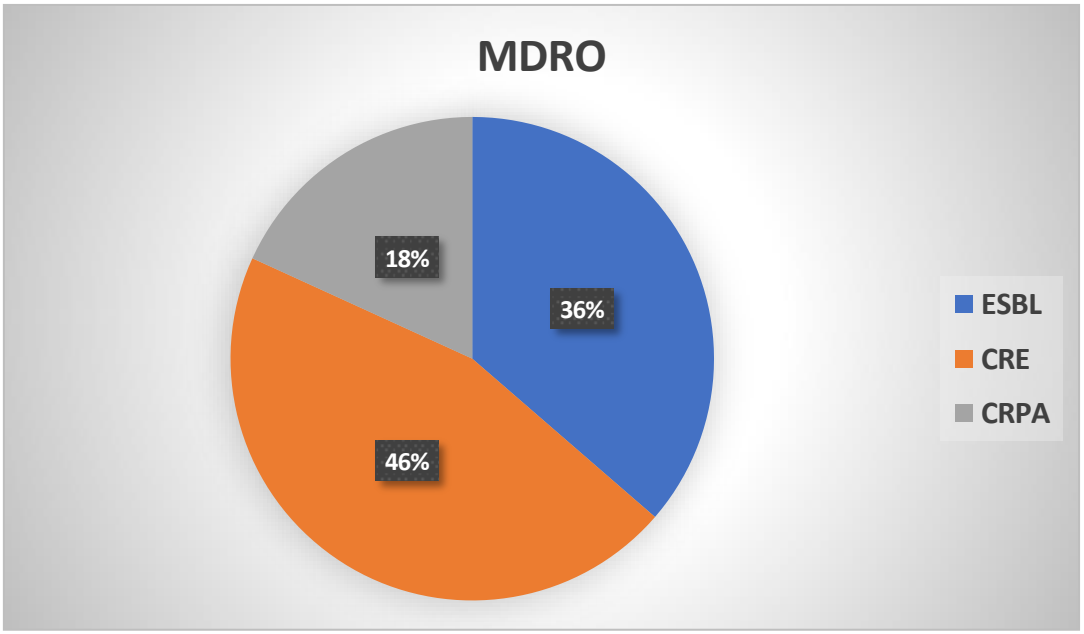
Graph. 13 Antibiotic susceptibility pattern of *E. coli*



Graph. 14 Antifungal susceptibility pattern of *Candida albicans*



Graph. 15 Distribution of total multidrug resistance organisms



Here the *Klebsiella sps* was the common pathogen causing UTI in renal transplant patients followed by *Enterococcus sps* and *E. coli.* Study by J Gozdowska *et al.,* The most common species isolated from urine samples included *Escherichia coli, Klebsiella pneumoniae,* and *Enterococcus faecalis* (9). By this study *E. coli* and *klebsiella sps* was the organisms causing SSI. Study by Peter W. Schreiber *et al., Escherichia coli, Enterococcus spp*, was the common organisms. (10)

By this study *Klebsiella sps* was the organism causing Respiratory tract infection in renal transplant patients. Study by L. Linares *et al., Klebsiella pneumoniae* was the organism causing Respiratory tract infection in renal transplant patients. (11)

In this study *Klebsiella species* and *E. coli* was the organisms causing blood stream infections in renal transplant patients. Study by E Daskalaki *et al., Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa* was the organisms. (12)

Here the most common type of infection was UTI. Study by Lamis Khedr *et al.,* Commonest infection was urinary tract infection (UTI) (13).

This study showed that isolates of enterobacterales like *E. coli* and *Klebsiella sps* were sensitive to Colistin, Tigecycline, Cholramphenicol, Piperacilllin/ Tazobactam, Cefoperazone/ sulbactam, Nitrofurantoin, Cefixime,. According to Borelli Zlatkov *et al.,* enterobacterales sensitivite to carbapenems (Imipenem and Meropenem) also Sensitivite to Amikacin. High sensitivity was also found for Piperacillin/Tazobactam (14). Here gram negative isolates were 100 % resistant to Ampicillin Followed by Ceftriaxone and Cotrimaxazole and Cefepime. According to Borelli Zlatkov *et al.,* Trimetoprim / Sulfametoxasol revealed 45. 6% resistance whereas for Ciprofloxacin resistance was 35. 3%. The increased resistant rate was established for Ampicillin. (14)

Here *Candida albicans* were sensitive to Amphotericin B, Flucanazole, Voriconazole, Flucytosine, Caspofungin, Micafungin. According to Muddana Keerthi *et al., Candida albicans* showed sensitivity to Fluconazole and Ketoconazole in nine cases and sensitivity to Fluconazole, Ketoconazole, and Itraconazole in two cases. (15)

Coming to multidrug resistant organism CRE and ESBL were the predominant MDRO'S here. According to Liying Gong *et al.,* CRE and ESBL were the predominant MDRO'S. (16)

In conclusion, this research was aimed to investigate microbial infections, identify the bacterial and fungal

pathogen, determine the antibiotic and antifungal susceptibility pattern of isolated pathogens and also determine the multidrug resistant organisms among post renal transplant patients. This findings helps in diagnosis ultimately enhancing patient care and outcomes. During the study period hospital performed 193 renal transplant, which resulting in 20. 2% (n=39) of post renal transplant infections.

A total of 48 organisms were isolated from the 39 positive cultures, with *Klebsiella* spp., *Enterococcus* spp., and *Escherichia coli* being the predominant pathogens. UTI was the most frequent type of infections. Among 39 infected patients Majority of the patients had infections in 1st month of transplantation. Furthermore the presence of multidrug resistant organisms (MDRO'S) was a concerning findings.

The chance of infection in kidney transplant patients is influenced by factors like immunosuppression, surgical complications and environmental exposure. Understanding the spectrum of microorganisms causing infections in these patients is crucial for early diagnosis, Effective antimicrobial therapy, Implementing prophylactic measure to reduce infection risk.

By acknowledging the diverse range of pathogens and talking a proactive approach health care providers can optimize care for kidney transplant patients and minimize the chance of infections and also this would be helpful for hospital infection control team to reduce the incidence of infections among renal transplant patients.

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Author Contributions

Anjali M P: Conceived the original idea and designed the model and Analysed, Investigated and wrote the manuscript. Prof. Savitha M: Validation, Formal analysis, Project Adminisration, Supervision, Swathy Viswanath: Manscript review and editing, Dr. Reshmi Goplakrishnan: Review and editing, Athulya M M: Data visulaisation, Gayathri M: Data validation and verification, Irfana: Literature formatting and referencing, Vismaya P P: Literature search and citation management

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.
Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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