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A STUDY ON MAR INDEX OF BACTERIAL ISOLATES FROM PATIENTS WITH RESPIRATORY TRACT INFECTION, IN A TERTIARY CARE HOSPITAL

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ABSTRACT
Respiratory tract infections are one of the commonest types of infection affecting both gram positive and negative isolates, an important cause of hospital acquired infections. Antibiotic resistance- a major problem in the ICU, occurs when the bacteria changes it response to the use of medications. An observational cohort study conducted over a period of 6 months in the MICU of a tertiary care hospital in Kerala. Case records were retrospectively reviewed for demographic data, clinical investigations and management. Data analysis was conducted using Microsoft Excel 2010. This study assessed the prevalence of infection, distribution of gender, age, micro-organism based on class and MAR Index patterns. A total of 100 patients were selected based on inclusion and exclusion criteria. The prevalence of infection was found to be 70% and revealed that males (64%) had greater prevalence than females (36%), the age group which showed the highest prevalence was found to be 32% (32) of 71-80 age group, classification based on types, gram negative bacteria (89%) was found to be the most common type of pathogen and gram positive bacteria (11%) were also found. 45% had less than or equal to 0.2 and 55% had greater than 0.2 MAR Index.

KEYWORDS: MAR Index, antibiotics, LRTI, gram positive bacteria, gram negative bacteria.

INTRODUCTION

Antibiotic Sensitivity
Antibiotics are medicines used to prevent and treat bacterial infectons. Antibiotic resistance occurs when bacteria change in response to use of these medicines[1]

ANTIBIOTIC SENSITIVITY TEST
An antibiotic sensitivity (susceptibility) test is done to help choose the most effective antibiotic for treating the particular individual. Mainly done by
a. Broth Dilution Test
b. Anti-Microbial Gradient Method
c. Disc-Diffusion Test (Kirby-Bauer Method)

ANTIBIOTIC RESISTANCE
The ability of a microorganism to resist the effects of an antibiotic is called antibiotic resistance, also known as antimicrobial resistance. Antimicrobial resistant organisms are not killed by drugs that are typically used against them and may continue to multiply. Antibiotic resistance occurs naturally, but misuse is accelerating the process.[2]

IMPACT OF ANTIBIOTIC RESISTANCE ON MORDEN HEALTHCARE SYSTEM
When first-line antibiotics fail to treat infections, more expensive medicines need to be used. A longer duration of illness and treatment, often in hospitals lead to increased healthcare costs as well as the economic burden on patients. Antibiotic resistance declines the achievement of modern medicine at risk. Organ transplantations, chemotherapy and surgeries become much more dangerous without effective antibiotics for the prevention and treatment of infections. In countries without standard treatment guidelines, antibiotic are often over-prescribed by health workers and over- used by public.[3]

In order to prevent and control the spread of antibiotic resistance, individuals should

- Use antibiotics when only prescribed by a certified health professional.
- Always follow the heath workers advice while using antibiotics.
- Never share or use leftover antibiotics.
- Prevent infections by regularly washing hands, preparing food hygienically, avoiding close contact

with sick people, practicing safer sex and keeping vaccinations up to date.
- Choose food that have been produced without the use of antibiotics for growth promotion or disease prevention in healthy animal.

The judicious use of antibiotics are very important for reducing the nosocimal infection rate along with infections caused by bacteria and antimicrobial resistance and can be monitored by regular surveillance of antibiotic susceptibility pattern.[4]

MULTIPLE ANTIBIOTIC RESISTANCE INDICES

Multiple antibiotic resistance (MAR) indexing has been shown to be a cost effective and valid method of bacteria source tracking. Multiple antibiotic resistance index is calculated as the ratio of number of antibiotics to which organism is resistant to total number of antibiotics to which organism is exposed. Multiple antibiotic resistance (MAR) index was determined for each isolate by using the formula MAR = a/b, where 'a' represents the number of antibiotics to which the test isolate depicted resistance and 'b' represents the total number of antibiotics to which the test isolate has been evaluated for susceptibility. MAR is considered as a good tool for risk assessment. This also gives an idea of the number of bacteria showing antibiotic resistance in the risk zone in the study routine susceptibility testing.[1]

MAR INDEX CALCULATION

MAR Index for isolates = [Number of antibiotics to which the isolate is resistant / Number of antibiotics tested]. While MAR index for antibiotics = [Number of antibiotics resistance to the isolates / (Number of antibiotics x Number of isolates)].[5]

MAR INDEX SCORING

MAR index value greater than 0.2 indicate their origin from a high risk source of contamination where antibiotics are often used. The value of MAR index (0.200) differentiates the low and high risk. If the value is between 0.200 and 0.250, it becomes a very risky phase where there are equal chances that MAR fall in the high risk and low risk phases.[5]

MATERIALS AND METHODS

This was an Observational Cohort Study done for a period of 6 months at a tertiary care hospital, Ernakulam, by analyzing the sputum culture reports during the study period. Common pathogens were identified and the MAR Index of the microorganism to understand the nature of the source of microorganism. Data was entered on Microsoft Excel 2010. Data analysis was performed with tables and figures were prepared. The study was approved by the Institutional Ethical Committee. All patients admitted in the MICU Department of age above 18 years, both male and female patients who are diagnosed with respiratory tract infection and on whom sputum culture sensitivity test was performed were enrolled in the study. Patients who are on cancer therapy immune compromised patients, patients who are on long term steroid therapy, pregnant, lactating mothers and paediatric patients were excluded from the study. Case records were retrospectively reviewed for demographic data, clinical presentations, sputum culture reports, management, and outcome. Data analysis was conducted using Microsoft Excel 2010. Statistical analysis was done using descriptive statistics.

RESULTS AND DISCUSSION

This observational cohort study was carried out for a period of 6 months in the MICU department of a tertiary care hospital in Kerala. The study was conducted to evaluate the MAR Index. A total of 150 patients were selected for our study based on inclusion and exclusion criteria. The demographic details of the study subjects includes their age, gender, month of admission, number of hospital days and culture sensitivity done for the subjects. Among the 150 samples evaluated, 100 (66.66%) sputum cultures was found positive for respiratory bacterial infection, 64% of the positive reports were of males. *Klebsiella pneumoniae* was identified to be the most common microorganism. 55% of the positive isolates had MARI greater than or equal to 0.2.

PREVALENCE OF INFECTION

A total of 150 sputum culture and sensitivity reports were analyzed.66.66% (100) of the samples were tested positive for bacterial infection and 33.44% (50) of the samples had either a negative result (no growth) or fungal growth.
(N= 150)

Table 1: Prevalence of bacterial infection.

Result	Percentage (%)
Positive	66.66
Negative/Fungal growth	33.44

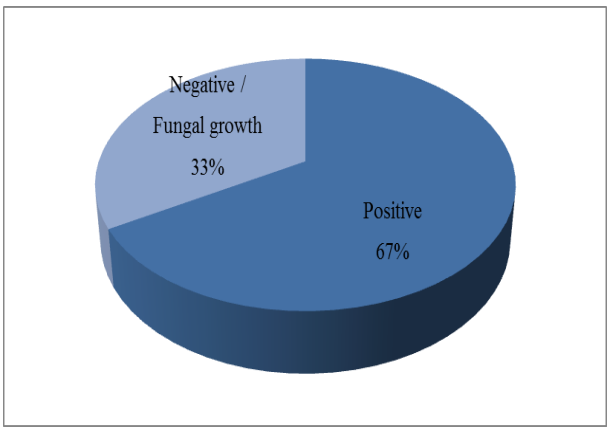

Figure 1: Prevalence of bacterial infection.

Around 70% of the sample reports analysed had a positive respiratory bacterial infection. This could be attributed to a wide variety of factors including gender, lifestyle, medications, hygiene, food habits, etc. (Table -

1, Figure -1). The result was similar to the study conducted by Anand Kalaskar, Sanjeev D Rao, Karri V Ramana (2013) on "Antibiotic susceptibility patterns of LRTI in Rural Tertiary Care Hospital at Karimnagar, South India.[6]

GENDER BASED DISTRIBUTION OF BACTERIAL INFECTION

64% (64) of the positive samples were of males and 36% (36) of the positive samples were females out of the 100 samples.
(N= 100)

Table 2: Sample distribution based on gender.

Sl. No	Gender	Number of isolates (n)	Percentage (%)
1	Male	64	64
2	Female	36	36

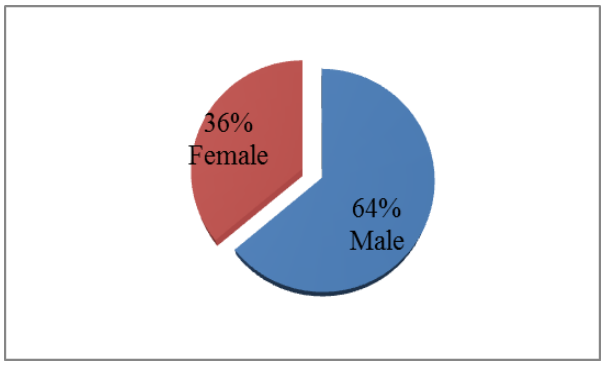

Figure 2: Percentage distribution based on gender.

The study revealed that males (64%) had greater prevalence of LRTI infections than females (36%). (Table- 2, Figure-2). The result was similar to the study conducted by Birasen Behra, Kundan Kumar Sahu, Priyadarshini Bhai, Jatindra Nath Mohantyl (2020) on "Prevalence and antimicrobial susceptibility patterns of bacteria in ICU patients with LRTI, A cross sectional study.[7]

DISTRIBUTION OF SAMPLE BASED ON AGE

4% (4) of the samples were found to be in 21-30 age group, 4% (4) of the samples were found to be in between 31-40 age group, 5% (5) of the samples were found to be in 41-50 age group,12% (12) of the samples were found to be in between 51-60 age group, 29% (29) of the samples were found to be in between 61-70 age group, 32% (32) of the samples were found to be in between 71-80 age group, 10% (10) of the samples were found to be in between 81-90 age group and 4% (4) of the samples were found to be in between 91-100 age group out of the 100 samples.

Table 3: Age wise number of isolates and percentage out of 100 samples.
(N = 100)

Age Group	No of Isolates (n)	Percentage (%)
21-30	4	4
31-40	4	4
41-50	5	5
51-60	12	12
61-70	29	29
71-80	32	32
81-90	10	10
91-100	4	4

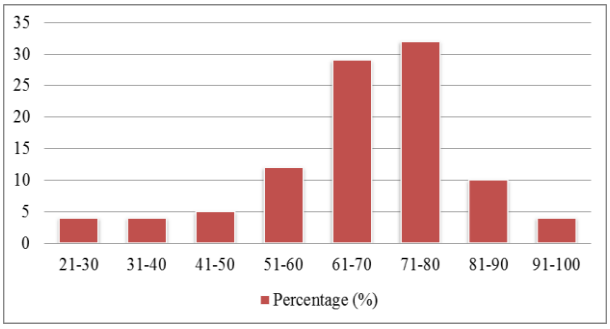

Figure 3- Percentage distribution based on age.

Based on age, the age group which showed the highest prevalence of LRTI was found to be 32% (32) of the samples in 71-80 age group. (Table-3, Figure-3). The result was similar to the study conducted by Tripatji Purti C, Dhote Kiran (2014) on "Lower Respiratory Tract Infections: Current etiological trends and antibiogram".[8]

DISTRIBUTION OF MICROORGANISM BASED ON CLASS

89% (89) of the positive samples were found to be infected by gram negative bacteria and 11% (11) by gram positive bacteria out of 100 samples. (N=100)

Table 4: Percentage distribution of bacteria based on class.

Sl. No	Bacteria	No of Organism(n)	Percentage of Organism (%)
1	Gram –ve	89	89
2	Gram +ve	11	11

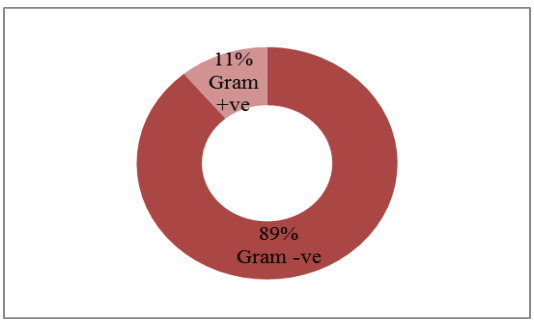

Figure 4- Percentage distribution of bacteria based on class.

Upon classifying the pathogens on the basis of types, gram negative bacteria (89%) was found to be the most common type of pathogen causing respiratory infection. Significant fractions of gram positive bacteria (11%) were also found. (Table-4, Figure-4). The result was similar to the study conducted by Somorjit Sharma et al on "A Study on a bacteriological-profile and antibiotic susceptibility pattern of Lower Respiratory Tract Infection in a tertiary care hospital in North East India".[9]

MAR INDEX

45% of the overall positive samples had MAR Index less than or equal to 0.2 and 55% had MAR Index greater than 0.2 (Figure 5). The highest MAR Index of 1 was found for 1 isolate of *Klebsiella pneumonia* (MDR). 31.46% (28) of gram negative and 54.54% (6) gram positive isolates were from a very high risk MAR Index of 0.5 to 1.25. 84% (23) of gram negative isolates and 45.45% (5) gram positive isolates were from a risky MAR Index of 0.2 to 0.4. 42.69% (38) of gram negative isolates were from a safe MAR Index of 0 to 0.2. 60.71% (17) of *Klebsiella pneumonia* isolates, 33.33% (7) of *Pseudomonas aeruginosa* isolates, 80% (8) of *Acinetobacter baumanii* isolates, 60% (3) *Enterobacter aerogenes* isolates, 100% (7) of *E.coli* isolates, 66.6% (2) of *Proteus mirabilis* isolates, 100% (3) of *Serratia marcescens* isolates, 100% (3) of *Burkholderia cepacia* isolates, 100% (1) of *Enterobacter cloacae* isolates of gram negative isolates and 75% (3) *Methicillin resistant Staphylococcus aureus* isolates, 100% (4) *Methicillin resistant Staphylococcus haemolyticus*,50% (2) *Methicillin resistant Staphylococcus epidermidis*, 25% (1) *Enterococcus faecali* isolates respectively had a high and risky MAR Index of 0.2 to 0.1.(Table 5) (Figure 6). The result was similar to the study conducted by Ayendele et al on "A Study on a Multi-Antibiotic Resistant *Escherichia coli* and *Klebsiella* species obtained from a Tertiary Medical Institution.[10]

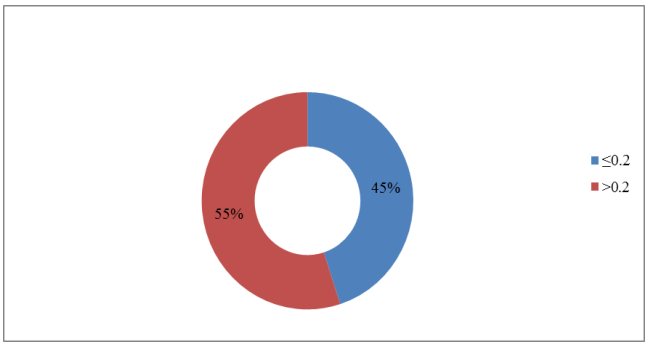

Figure 5: Percentage distribution of bacteria based on MAR Index.

MAR INDEX OF GRAM NEGATIVE BACTERIA.

Table 5- Percentage data of MAR Index of gram negative bacteria.

GRAM NEGATIVE ORGANISM	≤0.2	>0.2
K.pneumoniae	46.42%	53.58%
P.aeruginosa	66.66%	33.34%
A.baumanii	30%	70%
E.aerogenes	40%	60%
E. coli	0%	100%
P.mirabilis	33.33%	66.67%
S.marcescens	0%	100%
B. cepacia	66.66%	33.34%
R.ornithinolytica	100%	0%
R.pickettie	100%	0%
S.mattophilia	100%	0%
E.cloacae	100%	0%
A. dentrificians	100%	0%
S. paucimobilis	100%	0%

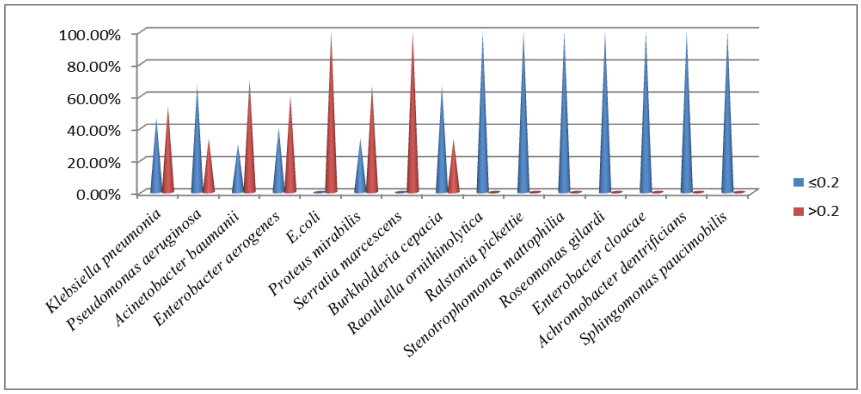

Figure 6: Percentage distribution of MAR Index of gram negative bacteria.

MAR INDEX OF GRAM POSITIVE BACTERIA

Table 6: Percentage data of MAR Index of gram positive bacteria.

GRAM POSITIVE ORGANISM	≤0.2	>0.2
MRSA	33.34%	66.66%
MRSH	0%	100%
MRSE	0%	100%
Enterococcus faecalis	0%	100%

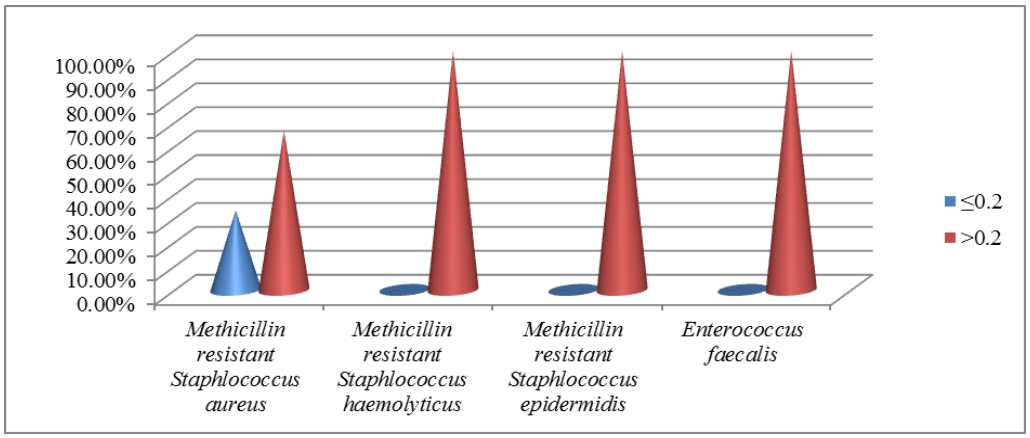

Figure 7: Percentage distribution of MAR Index of gram positive bacteria.

CONCLUSION

The overuse and frequent misuse of antibiotics have resulted in changing antibiotic resistance profiles in microorganisms among bacterial populations. Various factors like increase in the use of antibiotics on livestock, self-medications, irrational use of antibiotics, lifestyle, food habits, etc, attributes to the decreased sensitivity or increased resistance towards the antibiotics. Since antimicrobial resistance is a growing menace worldwide, the development of guidelines promoting the use of conventional antibiotics and combination of antibiotics might arrest the development of resistance to an extent. Interpretation of test results in order to streamline antibiotic therapy can enhance the safety and care of patients leading to expansion of stewardship programmes.

LIMITATIONS OF THE STUDY

The study was conducted in a limited time frame and on a very few number of samples. The study may be followed up later for detailed assessment with detailed patient demographics and history.

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