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Antibiotic susceptibility pattern of bacterial strains isolated from children with upper respiratory tract infection

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Abstract:
Introduction:*Paediatric respiratory tract infections are among the most common reasons for attending hospital and are associated with significant morbidity and mortality. The most infections are limited to the upper respiratory tract and only 5% involve the lower respiratory tract. Definitive bacteriological diagnosis and susceptibility testing would therefore be required for effective management.****Objective:*** *To determine the antimicrobial susceptibility pattern of bacterial pathogens isolated from upper respiratory tract infection of children.* ***Methodology:*** *The study was conducted in the Department of Microbiology, Malda Medical College, Malda. A total of 250 clinically diagnosed cases of upper respiratory tract infections (URTI) in children were included in the present study.Throat swab samples were collected from each patient and processed. Following culture, the isolated organisms were identified and antimicrobial sensitivity was performed by standard method.****Results:*** *Out of 250 throat swab sample, 226 (90.4%) samples were culture positive for potential pathogens. Predominant isolates were Staphylococcus aureus (42.04%), followed by Streptococcus pyogenes (23.45%), Klebsiellapneumoniae (18.58%), Streptococcus pneumoniae (12.83%) and Pseudomonas aeruginosa (3.10%). Antimicrobial susceptibility tests were performed by Kirby Bauer disc diffusion method. The commercially available antibiotic discs were used. Most of the isolates were susceptible to Amikacin, Gentamycin, Ciprofloxacin, Levofloxacin, Ceftriaxone and Meropenem.* ***Conclusion:*** *The antibiogram will help as guideline for the treatment of such infections. Periodic antimicrobial surveillances are needed to regularly update the guidelines on proper empiric and organism specific antibiotic treatment.*

Key words: *Antibiotic susceptibility pattern, Paediatric upper respiratory tract infection, Malda*

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I. Introduction

Respiratory tract infection is one of the most important infectious diseases worldwide and a recurrent problem in childhood.[1, 2]Paediatric respiratory tract infections are among the most common reasons for attending hospital and are associated with significant morbidity and mortality. It has been widely acclaimed that the respiratory tract is the most frequent site of infection as it comes into direct contact with the physical environment and is exposed to airborne microorganisms such as viruses, bacteria, fungi and parasites.[3, 4, 5]Every year acute respiratory tract infection (ARI) in young children is responsible for an estimated 4.1 million deaths worldwide.[6]The most infections are limited to the upper respiratory tract and only 5% involve the lower respiratory tract, respectively.[2, 7, 8]In case of upper respiratory tract infections (URTI) only 25% of cases are due to bacteria, mostly are viral.[9, 10]URTI has been regarded as a nonspecific term that is used to describe acute infections involving the nose, paranasal sinuses, pharynx, larynx, trachea and bronchi.[11, 12]The incubation period of most URTIs last from a few hours to 3 days after exposure while the symptoms may last for 7-10 days or even longer.[13]The disease mainly associated with fever, cough, sore throat and running nose.However, URTI have been suggested to be mild and self limiting, but they have been reported to lead to life threatening complications.[11, 14, 15]There is a need, particularly in developing countries like India, for timely diagnosis of such infection.[2]Mostly acute RTI respond well to antibiotics.It is also understood that antibiotic susceptibility pattern of pathogens vary with time and geographical location.[16]In most cases, there is need to start treatment before the final laboratory results are available. But of recent, empiric treatment and misuse of antibiotic has been complicated by the emergence of antimicrobial resistance among the principal pathogens and a definitive bacteriological diagnosis and susceptibility testing would therefore be required for effective management.[15]

II. Objective

This study was conducted to determine the antimicrobial susceptibility pattern of bacterial pathogens isolated from upper respiratory tract infection of children. The antibiogram will help as guideline for the empirical treatment of such infections.

III. Methodology

Study population: The study was conducted in the department of Microbiology, Malda Medical College, Malda. Paediatric patients up to 12 years of age attended at outpatient department and also admitted in indoor Paediatric department, Malda Medical College and Hospital with symptoms and signs of upper respiratory tract infection (URTI) were included in this study. A total of 250 clinically diagnosed cases of upper respiratory tract infections (URTI) were included in the present study.

Inclusion criteria: The criteria for inclusion in the study were that the patient must be suffering from upper respiratory tract infections, must not have taken antibiotics of any kind for at least one week before the clinical visit.

Exclusion criteria: We have excluded from this study, critically ill patients and children with anatomical defects of upper respiratory tract mainly cleft lip and cleft palate.

Sample collection and processing: Two throat swab samples were collected from each patient and processed in the department of microbiology. Direct smear will be prepared from one of the specimen for Gram staining. The other specimen will be inoculated in blood agar, chocolate agar and Mac Conkey agar. The inoculated plates were incubated at 37^0 C for 24 to 48 hours aerobically, except for chocolate agar, which were incubated for 24 to 48 hours at 37^0C in an atmosphere of 5-10 % CO_2. After incubation, isolates were identified by their colony morphology, colour, haemolysis on blood agar, microscopic examination and specific biochemical tests.[17]

Antibiotic susceptibility testing: Antimicrobial susceptibility / resistance were performed by Kirby Bauer disc diffusion method. The commercially available antibiotic discs were used for the study were Ampicillin (10 µg.), Amoxycillin (10 µg.), Amoxycillin- Clavulanic acid (Amoxyclav-30 µg.), Cefuroxime (30 µg.), Cefotaxime (30 µg.), Ceftriaxone (30 µg.), Amikacin (30 µg.), Gentamycin (10), Ciprofloxacin (5 µg.), Levofloxacin (5 µg.), Roxithromycin (30 µg.), Azithromycin (15 µg.), Linezolid (30 µg.), Vancomycin (30 µg.), Piperacillin-Tazobactum (100/ 10 µg.), Meropenem (10 µg.). The bacterial strains were identified as either sensitive or resistant to an antibiotic, based on diameter of the zone of inhibition interpretative chart according to Clinical and Laboratory Standard Institute (CLSI) guidelines.[18, 19]

IV. Results

Out of 250 throat swab sample processed in the Department of Microbiology, 226 (90.4%) samples were culture positive for potential pathogens. Rest 24 (9.6%) samples were commensals and were not included in the study. Out of 226 culture positive samples, 53.98% were from males and 46.02% were from females. Chart 1 shows, bacteriological profile of upper respiratory tract infections. Staphylococcus aureus (42.04%) was the commonest pathogen isolated followed by Streptococcus pyogenes (23.45%), Klebsiellapneumoniae (18.58%), Streptococcus pneumoniae (12.83%) and Pseudomonas aeruginosa (3.10%). Gram positive cocci and Gram negative bacilli contribute 78.32% and 21.68% of total isolates respectively (Table 1). Table 2 shows, predominant isolate Staphylococcus aureus showing 92.6% sensitivity to Amikacin, 87.3% to Gentamycin, followed by 86.3% sensitivity to Ciprofloxacin and Levofloxacin, 84.2% sensitivity to Amoxyclav. Streptococcus pyogenes was highly susceptible to Amikacin (90.5%), Gentamycin (84.9%), Ciprofloxacin (84.9%), Levofloxacin (84.9%), Amoxyclav and Ceftriaxone both (81.1%). Streptococcus pneumoniae and Klebsiellapneumoniae were most sensitive to Amikacin and Gentamycin 86.2% and 95.2% respectively. All the isolates of S.aureus, S. pyogenes and S. pneumoniae were susceptible to Linezolid and Vancomycin (100%). Pseudomonas aeruginosa was highly susceptible to Amikacin, Gentamycin and Meropenem (85.7%). All isolates of P. aeruginosa were susceptible to Piperacillin-Tazobactum (100%).

V. Discussion

In our study, Gram positive cocci and Gram negative bacilli contribute 78.32% and 21.68% of total isolates respectively. Staphylococcus aureus (42.04%) was the commonest pathogen isolated from throat swab, followed by Streptococcus pyogenes (23.45%), Klebsiellapneumoniae (18.58%), Streptococcus pneumoniae (12.83%) and Pseudomonas aeruginosa (3.10%). These findings were correlated with studies of Kousalyaet. al. and Joshpat et.al.[1, 13] Some other studies showed S. pyogenes and S. pneumoniae were the predominant isolates.[4, 6, 7, 15, 16, 20] So, Gram positive cocci were the common isolates may be due to the respiratory tract infection is caused by air borne pathogens that survive under dry conditions for long period of time. Gram positive bacteria are more resistant to drying than Gram negative bacteria because of their thicker, more rigid cell wall and also the human pathogens (Staphylococcus, Streptococcus) survive under dry conditions fairly well and remain alive in dust for long time.[21] But some studies showed, Gram negative bacilli were the common

isolates predominantly Klebsiella pneumoniae.[2, 22] Climatic and geographic variation could be the possible reasons for the difference in distribution of bacteria.[6]

From clinical history it was found that majority of the children were from low socioeconomic background, overcrowding, poor hygiene, low immune status, malnutrition could be the possible factors that enhanced the spread of pathogens. Imbalance of oral microbial flora as a result of over use of broad spectrum antibiotics which eliminate the competing bacteria and disrupt the normally balanced ecology of oral microorganisms or medication with corticosteroids may also predispose patients to URTIs.[13]

In this study, predominant isolate Staphylococcus aureus showing 92.6% sensitivity to Amikacin, 87.3% to Gentamycin, followed by 86.3% sensitivity to Ciprofloxacin and Levofloxacin, 84.2% sensitivity to Amoxycav. Streptococcus pyogenes was highly susceptible to Amikacin (90.5%), Gentamycin (84.9%), Ciprofloxacin (84.9%), Levofloxacin (84.9%), Amoxyclav (81.1%) and Ceftriaxone (81.1%). Streptococcus pneumoniae was highly sensitive to Amikacin and Gentamycin both 86.2%, Amoxyclav (82.7%), levofloxacin (82.7%), Ciprofloxacin (79.3%) and Meropenem (79.3%). These findings were correlated with some studies.[1, 7, 13] However a disappointing antibiotic susceptibility pattern of Gram positive organisms were observed for Ampicillin, Amoxycillin, Cefuroxime and Cefotaxime. The major elective force favouring the emergence of antibiotic resistance is their extensive use, which are commonly bought over the counter in drug stores.[23] In the current study Gram positive organisms showed 100% susceptibility to Linezolid and Vancomycin. Similar findings were reported from some other investigators as well.[20, 22] For Gram positive bacterial infections Aminoglycosides and Fluroquinolones are widely recommended as first line drugs and Linezolid and Vancomycin for resistant cases.[22]

Klebsiellapneumoniae showed highest susceptibility to Amikacin and Gentamycin, 95.2% each. More than 60% susceptibility seen in Meropenem (92.8%), Ciprofloxacin and Levofloxacin, 76.1% each, Ceftriaxone (71.4%) and Amoxyclav (66.6%). Less than 60% susceptibility seen in as decreasing order Cefotaxime (33.3%), Cefuroxime (30.9%), Amoxycillin (28.5%), Ampicillin (16.8%), Piperacillin- Tazobactum (14.2%). This study showed, Aminoglycoside, Carbapenem and Fluroquinolone group of drugs were more sensitive against K. pneumoniae. Similar observation noticed in other studies.[2, 22]

Pseudomonas aeruginosa was highly susceptible to Amikacin, Gentamycin and Meropenem (85.7%). All isolates of P. aeruginosa were susceptible to Piperacillin-Tazobactum (100%). Less than 60% susceptibility seen in Ceftriaxone 57.1% and Ciprofloxacin and Levofloxacin, 42.8% each. The lower susceptibility compared very well with other studies conducted in other countries. In our study P. aeruginosa showed resistance against Ampicillin, Amoxycillin, Amoxyclav, Cefuroxime and Cefotaxime.[24] The predominance of P. aeruginosa resistance considerd as a serious problem in many countries.[7]

VI. Figures and Tables

Chart 1: Bacteriological profile of upper respiratory tract infections

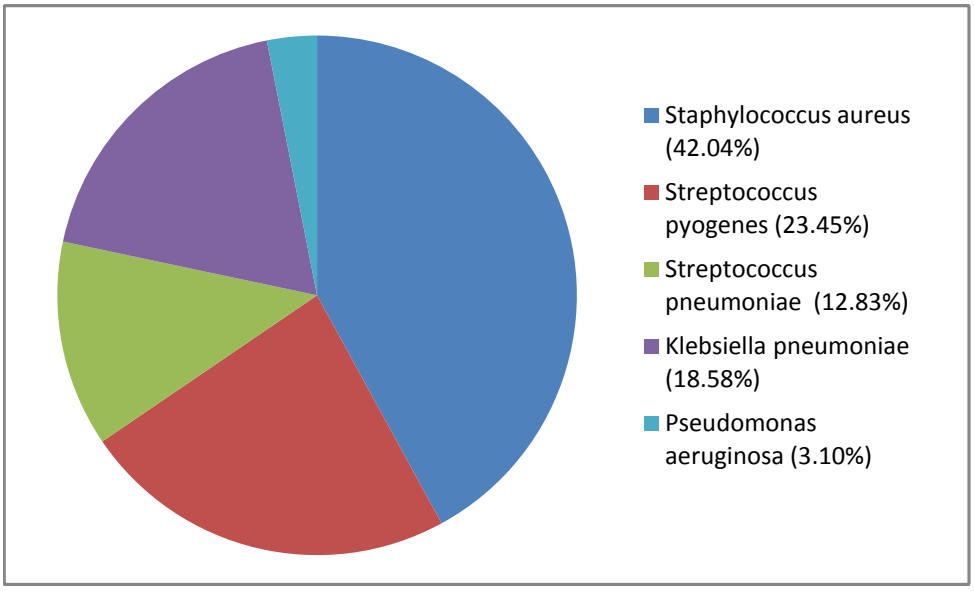


Table1: Percentage of Gram Positive Cocci (GPC) and Gram Negative Bacilli (GNB)

Bacterial Pathogens	% of organisms
Gram Positive Cocci	78.32 %
Gram Negative Bacilli	21.68 %

Table 2: Susceptibility of bacterial strains to antibiotics

Antibiotics	Staphylococcus aureus (n=95)	Streptococcus pyogenes (n=53)	Streptococcus pneumoniae (n=29)	Klebsiellapneumoniae (n=42)	Pseudomonas aeruginosa (n=7)
Ampicillin	12 (12.6%)	6 (11.3%)	2 (6.8%)	7 (16.8%)	0
Amoxycillin	43 (45.2%)	23 (43.3%)	12 (41.3%)	12 (28.5%)	0
Amoxyclav	80 (84.2%)	43 (81.1%)	24 (82.7%)	28 (66.6%)	0
Cefuroxime	50 (52.6%)	29 (54.7%)	14 (48.2%)	13 (30.9%)	0
Cefotaxime	54 (56.8%)	31 (58.4%)	15 (51.7%)	14 (33.3%)	0
Ceftriaxone	74 (77.8%)	43 (81.1%)	23 (79.3%)	30 (71.4%)	4 (57.1%)
Amikacin	88 (92.6%)	48 (90.5%)	25 (86.2%)	40 (95.2%)	6 (85.7%)
Gentamycin	83 (87.3%)	45 (84.9%)	25 (86.2%)	40 (95.2%)	6 (85.7%)
Ciprofloxacin	82 (86.3%)	45 (84.9%)	23 (79.3%)	32 (76.1%)	3 (42.8%)
Levofloxacin	82 (86.3%)	45 (84.9%)	24 (82.7%)	32 (76.1%)	3 (42.8%)
Roxithromycin	61 (64.2%)	33 (62.2%)	15 (51.7%)	-	-
Azithromycin	61 (64.2%)	34 (64.1%)	16 (55.1%)	-	-
Linezolid	95 (100%)	53 (100%)	29 (100%)	-	-
Vancomycin	95 (100%)	53 (100%)	29 (100%)	-	-
Piperacillin-Tazobactum	-	-	-	6 (14.2%)	7 (100%)
Meropenem	74 (77.8%)	42 (79.2%)	23 (79.3%)	39 (92.8%)	6 (85.7%)

Figure 1: Susceptibility patterns of S. aureus

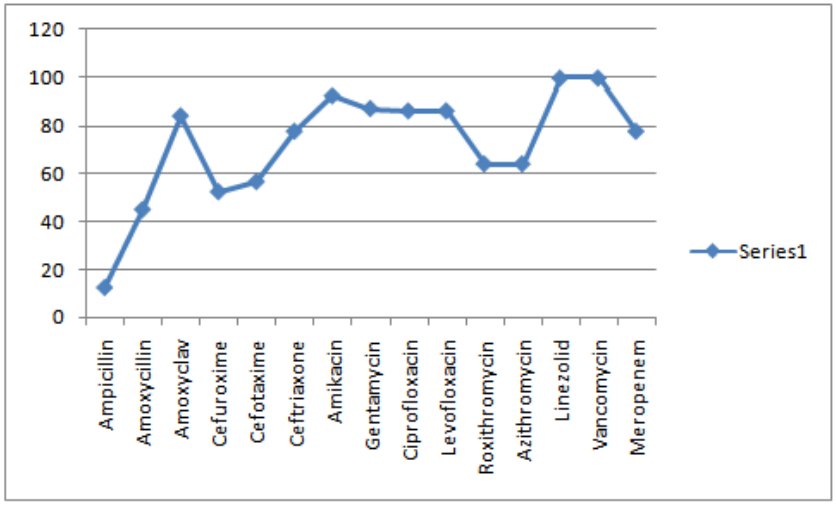


Figure 2: Susceptibility patterns of S. pyogenes

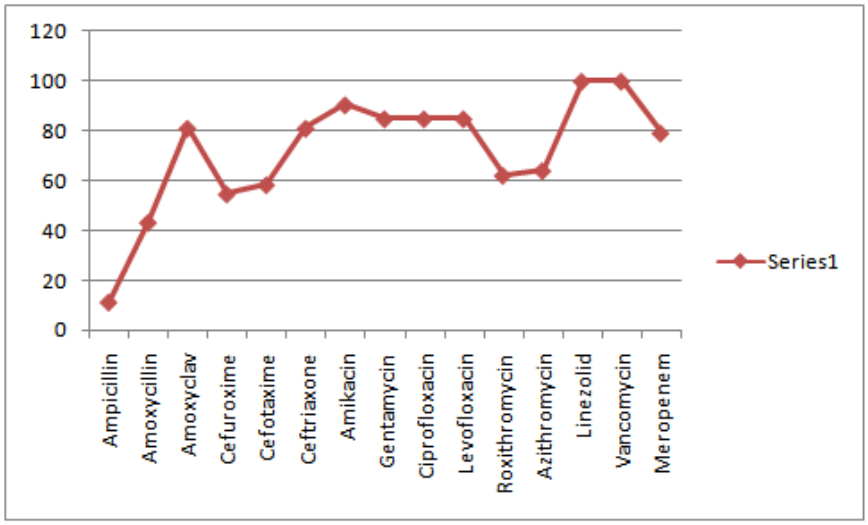


Figure 3: Susceptibility patterns of S. pneumoniae

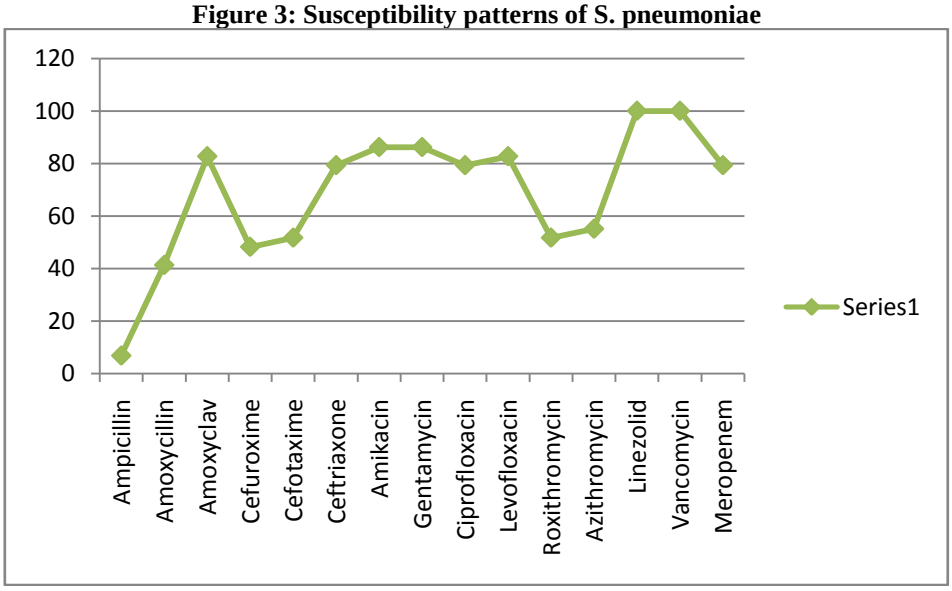


Figure 4: Susceptibility patterns of K. pneumoniae

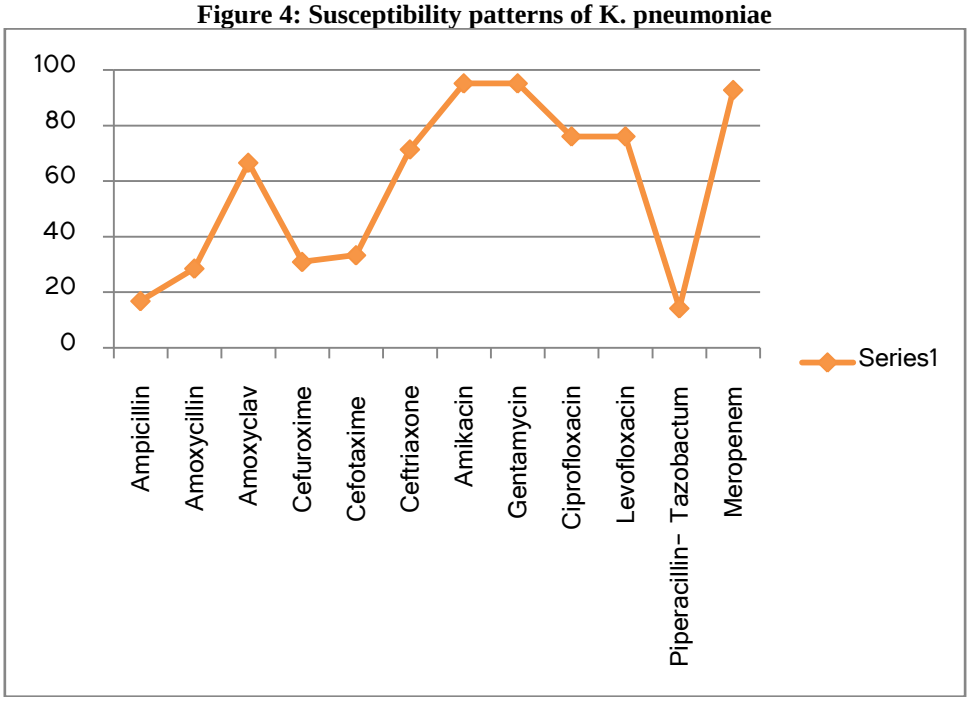
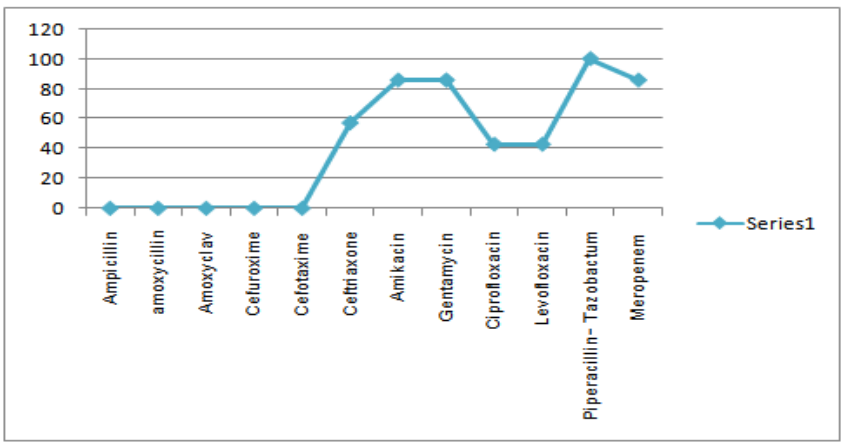


Figure 5: Susceptibility patterns of P. aeruginosa



VII. Conclusion

This study was conducted to ascertain the current scenario of bacterial susceptibility in upper respiratory tract infection. Accurate information is essential to select a clinically effective antibiotic therapy for the infections. In this study, some of the antibiotics show very low susceptibility may be due to indiscriminate and inappropriate use, abuse of drugs, adulteration of drugs and mutation of microorganisms and lack of appropriate infection control strategies. Periodic antimicrobial surveillances are needed to update the guidelinesregularly on proper empiric and organism specific antibiotic treatment.

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