

Antibiotic Treatment Guidelines for Intensive Care Units of RMU & Allied Hospital

Evidence Based Recommendations



Antibiotic Treatment Guidelines for Intensive Care Units of RMU & Allied Hospital

These are Evidence based recommendations for empirical antimicrobial usage in intensive care units of Rawalpindi Medical University and Allied Hospitals. Evidence is based on the available data of 2019 of antimicrobial resistance patterns seen in intensive care units.

Treatment should be reviewed clinically at 48-72 hours with the results of clinical findings, imaging results, microbiological cultures and other laboratory findings. Antimicrobials can then be stopped, switched to oral therapy, changed to a narrow spectrum agent or continued with further review.

Antibiotic Usage Policy Committee

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	Mrs. Nabila Shoaib	Pharmacist
	Dr. Kiran Ahmad	Microbiology

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Patron in Chief



Message

Institutional Antimicrobial Usage Protocols is one of the most exciting initiative that Rawalpindi Medical University has taken. The threat brought on by antimicrobial resistance is a key factor driving this project.

Antimicrobial Usage Protocols are produced through series of discussions held between Antimicrobial Usage Policy Committee including members of various disciplines. It involved a structured and intensive discussion process to ensure that content was carefully reviewed and coordinated for consistency.

I also want to express my sincerest congratulations and heartfelt gratitude to all those involved in the preparation of this protocol, led by Professor Naeem Akhtar, for their commitment during the preparation process.

Professor Muhammad Umar Vice Chancellor Rawalpindi Medical University

Chairman



Message

"Practice guideline would only be effective if they are adhered to"

Antimicrobial Usage Protocols emerge as an ever important intervention to support clinical decision-making through a consensual process based on evidence and collective action to tackle disease problem. This Rawalpindi Medical University Antimicrobial Usage Protocols is undoubtedly one of the essential documents which will benefit all Rawalpindi Medical University and Allied hospital employees irrespective of their expertise and workplace as infections can occur to their patients at anytime and anywhere and also for judicious use of antibiotics and reducing antibacterial resistance in hospitals. I am sure many will look forward to having this protocol.

I will like to acknowledge and thank the whole Antimicrobial Usage Policy Committee for their support and patience in this long process.

Professor Naeem Akhtar Chairman Antimicrobial Usage Policy Dean Basic Sciences Rawalpindi Medical University, Rawalpindi.

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SECTION-I

Introduction

This document outlines the antimicrobial recommendations for Intensive Care Units of Rawalpindi Medical University and Allied Hospitals. The recommendations are designed with the specific objective of reducing or minimizing the use of antibiotics. Improper use of antibiotics is major risk factors for the acquisition and infection with multidrug resistant bacteria such as MRSA and ESBL producing E.coli and Klebsiella species etc.

The recommendations are based on National antimicrobial policies of Pakistan from the data collected from Rawalpindi Medical University and Allied Hospitals¹. The recommendations have been developed by Expert Committee of RMU. The recommendations should not be used in isolation but be cross-referenced with relevant specialty protocols.

These recommendations are intended to provide insight for healthcare professionals who prescribe and oversee the provision of antimicrobial therapy in Intensive Care Units. It does not offer recommendations on the treatment of specific infections. The reader is referred to disease-specific guidelines for such support.

The rise of antibiotic-resistant bacterial strains, however, represents a serious threat to public health and the economy. If the effectiveness of antibiotics (drugs that kill or inhibit the growth of bacteria) is lost, we will no longer be able to reliably and rapidly treat bacterial infections, including bacterial pneumonias, ventilator associated and nosocomial infections in intensive care settings.

As more strains of bacteria become resistant to an ever-larger number of antibiotics, our drug choices have become increasingly limited and more expensive and, in some cases, nonexistent.

Bacteremia and surgical site infections due to methicillin-resistant *Staphylococcus aureus* (MRSA) have been associated with a higher mortality rate than similar infections due to methicillin-susceptible *S. aureus*. Similar adverse outcomes have also been reported for infections with resistant gram

negative organisms, including *Pseudomonas, Acinetobacter*, and *Enterobacter* species and extended-spectrum beta-lactamase–producing organisms.

The cumulative incidence of adverse events to a variety of antimicrobial classes increases with length of treatment. The emergence of infections with multidrug-resistant gram-negative organisms, combined with a paucity of new drug development, has unfortunately led to the resurgent use of colistin, a polymyxin antimicrobial previously abandoned because of its high rates of nephrotoxicity and neurotoxicity. Monitoring for adverse events while on treatment has been standard of care; the particular tests required depend on the potential adverse event profile of the antimicrobials being administered. Additionally, some anti-infective agents require plasma concentration monitoring to ensure that they are in the desired therapeutic/nontoxic range (e.g. vancomycin, aminoglycosides, and voriconazole). Occurrence of adverse events and non responsiveness of antibiotics is a common reason for a change in antimicrobial agent or a complete discontinuation.

From the institutional perspective, antimicrobials account for upwards of 30% of hospital pharmacy budgets. It has been recognized for several decades that up to 50% of antimicrobial use is inappropriate, adding considerable cost to patient care. In addition to direct pharmacy acquisition costs, numerous reports suggest that inappropriate and unnecessary antimicrobial use leads to increased selection of resistant pathogens. Once antimicrobial resistance emerges, it can have a significant impact on patient morbidity and mortality, as well as increased health care costs.

Study Details

Patterns of Antibiotic Resistance In ICU'S Of Rawalpindi Medical University & Allied Hospitals Rawalpindi

Abstract

2.1 Introduction:

Antibiotic resistance is a global health problem. According to world health organization (WHO), antibiotic resistance could cause 10 million deaths each year by 2050. Antimicrobial resistance (AMR) threatens our progress in healthcare, and ultimately life expectancy. CDC and ECDC

have used terms such as "crisis," "catastrophic consequences" and "nightmare scenario" to highlight the rapid emergence and spread of antibiotic resistance.

The intensive care unit (ICU) is called the epicenter of infections, due to its extremely vulnerable population with increased risk of becoming infected through multiple procedures and use of invasive devices. The early use of antibiotics provides effective control of infections and at the same time, the use of broad-spectrum empiric antibiotics is causing an increasing emergence of antibiotic resistance. A rise in multidrugresistant bacteria is limiting the available therapeutic options for infections in the ICU and is reducing the possibility that empiric treatment selections will offer adequate coverage for common ICU pathogens.

2.2 Objective:

To identify the microbes causing microbial infections in Intensive Care Units of Rawalpindi Medical University and Allied hospitals and analyze the antimicrobial resistance patterns.

2.3 Study Design:

A cross sectional study

2.4 Place of Study:

Rawalpindi Medical University & Allied Hospitals

2.5 Methodology:

Samples received from ICU's of Holy Family Hospital and Benazir Bhutto Hospital during a period of one year (January-December 2019). Samples (blood, urine, endotracheal tips, pus and other samples) were inoculated on suitable culture media. After 24hrs incubation at 37^oC, bacterial isolates were identified according to morphology, gram staining and standard biochemical tests. Susceptibility testing was carried out on Mueller Hinton Agar by modified Kirby Bauer Disk diffusion method.

2.6 Results:

Out of total 1949 samples, bacterial growth was isolated in 774 samples. Gram negative bacteria were prevalent. Most common gram negative bacteria istolated were Acinetobacter spp, Klebsiella spp, Pseudomonas spp and Escherichia coli. Among gram positive bacteria, Staphylococcus aureus, was the common followed by coagulase negative staphylococcus. Gram negative bacteria were resistant to cephalosporins, ciprofloxacin and other major antibiotics available however, tigicycline was the most active drug against gram negative bacteria. High percentage of MRSA (Cefoxitin and moxifloxacin resistant) Gram positive bacteria were observed. Gram positive bacteria were sensitive to teicoplanin, linezolid and vancomycin.

2.7 Conclusion:

Hospital data based study was conducted to ascertain the current scenario of bacterial susceptibility in bacterial infection to optimize empiric therapy among patients admitted in ICU's. The present study concluded that tigecycline is the only drug suitable as an empirical therapy in Intensive Care Units of hospitals for gram negative infections. Other drugs Imipenim, Meropenem, aminoglycosides and flouroquinolones show less than 30% activity therefore these drugs cannot be recommended for empirical therapy.

Results of the Study

Out of total 1949 samples, bacterial growth was isolated in 774 samples.

Blood Stream Infections									
Antibiotic Susceptibility Pattern									
Antibiotics									
	Acinetobacter n=57, (28%)	Staph spp /MRSA n=54, (27%)	Pseudomonas spp n=29, (14%)	E.Coli n=28, (14%)	Klebsiellaspp n=23, (12%)				
Amoxicillin +clavulanic acid	<5		<5	<5	<5				
Cefotaxime	<5		<5	<5	<5				
Penicillin		<15							
Ceftriaxone	<5		<15	<15	<15				
Ceftazidime	<5		20	<10	<5				
Cefixime	<5		<20	<10	<20				
Cefoxitin		20.4							
Gentamicin		<30							
Amikacin	<5		20	<40	<30				
Aztreonam	<40		<10						
Ciprofloxacin	<5		<40	<40	<20				
Clindamycin		<50							
Moxifloxacin		<50							
Imipenem	<10		<60	<40	<50				
Cefoperazone+Sulbactam	<5		<60	<30	<20				
Vancomycin		100							
Teicoplanin		100							
Tigecycline	>90		>90	>90	>90				
Linezolid		100							

Respiratory Tract Infections Antibiotic Susceptibility Pattern										
Organisms										
Antibiotics	Acinetobacter n=156, (56%)	Klebsiellaspp n=49, (17%)	Pseudomonas spp n=40, (13.5%)	E.Coli n=31, (10.5%)	Staph spp/MRSA n=10,					
Amoxicillin +clavulanic acid	<5	<5	<5	<5						
Penicillin					<5					
Gentamicin					<5					
Cefotaxime	<5	<5	<5	<5						
Ceftriaxone	<5	<5	<5	<10						
Cefixime	<5	<5	10	<10						
Ceftazidime	<5	<5	<20	10						
Aztreonam			<20							
Cefoxitin					20					
Ciprofloxacin	<5	<10	<20	<30						
Tazocin		<30								
Moxifloxacin					<30					
Amikacin	<5	<40	<20	<40						
Clindamycin					<50					
Erythromycin					50					
Imipenem	<5	<30	10	<50						
Cefoperazone+Sulbactam	<5	<50	20	<30						
Vancomycin					100					
Teicoplanin					100					
Tigecycline	>90	>90	>90	>90						
Linezolid					100					

Urinary Tract Infections Antibiotic Susceptibility Pattern									
	Organisms								
Antibiotics	E.Coli n=19, (38%)	Enterococcus spp n=13, (26%)	Klebsiellaspp n=6, (12%)	Pseudomonas spp n=5, (10%)	Acinetobacter n=4, (8%)	Staph spp/MRSA n=3, (6%)			
Amoxicillin +clavulanic acid	<5		<5	<5	<5				
Clindamycin		<5				<5			
Cefotaxime	<5		<5	<5	<5				
Ceftriaxone	5		<5	<5	<5				
Cefixime	<5		<5	<5	<5				
Ciprofloxacin	5		<5	<5	<5				
Ceftazidime	<5		<5	<5	<5				
Penicillin		<10				<5			
Cefoxitin						33.3			
Amikacin	<40		<40	<40	<5				
Gentamicin		<10				<40			
Moxifloxacin		<10				<40			
Cefoperazone+Sulbactam	<30		50	<20	<5				
Tazocin			50						
Imipenem	<20		<70	<5	<5				
Nitrofurantoin	<90		<90	<90	<90				
Vancomycin		100				100			
Teicoplanin						100			
Tigecycline	>90		>90	>90	>90				
Linezolid		100				100			

Wound infections Antibiotic Susceptibility Pattern									
	Organisms								
Antibiotics	Acinetobacter n=18, 44%	Staph spp/ MRSA n=10,	E.Coli n=9, 22%	Pseudomonas spp n=7, 17%	Klebsiellaspp n=5, 12%				
Amoxicillin +clavulanic acid	5		<5	<5	<5				
Cefotaxime	<5		<5	<5	<5				
Ceftriaxone	<5		<5	<5	<5				
Cefixime	<5		<5	<5	<5				
Ceftazidime	<5		<5	<5	<5				
Aztreonam				<5					
Gentamicin		<5							
Penicillin		<5							
Ciprofloxacin	<5		<20	<5	<5				
Cefoxitin		30							
Imipenem	<5		<40	<5	20				
Cefoperazone+Sulbactam	<5		<40	<30	20				
Clindamycin		50							
Moxifloxacin		50							
Amikacin	<5		<70	<5	20				
Vancomycin		100							
Teicoplanin		100							
Tigecycline	>90		>90	>90	>90				
Linezolid		100							

Methodology For Recommendations

3.1 Panel Composition:

A panel of experts was patronized by Vice Chancellor Rawalpindi Medical University to formulate clinical practice recommendations for Intensive Care Units antimicrobial therapy.

Antibiotic Usage Policy Committee

Patron in Chief	Prof. Dr. Muhammad Umar
Chair	Prof. Dr. NaeemAkhtar
Members	Prof. Dr. Rai Muhammad Asghar
	Prof. Dr. SeemiGul
	Prof. Dr. Muhammad Khurram
	Prof. Dr. Jahangir Sarwar Khan
	Dr. Shireen Rafiq
	Dr. Abrar Akbar
	Dr. Mujeeb Khan
	Dr. Rabia Anjum
	Dr. Fariha Sardar
	Mrs. Nabila Shoaib
	Dr. Kiran Ahmad

3.2 Evidence Review and Formulation of Recommendations

The panel followed a process used in the development of WHO executive guidelines on Essential medicines 2019 and National Antimicrobial policy of Pakistan^{1,2}

The process used in the development of other guidelines that includes a systematic review of the relevant evidence and the formulation of recommendations from that evidence using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was used.

Specific features of the evidence base (such as risk of bias or large effect size) warranted decreasing or increasing the rating of the quality of the evidence. The strength assigned to the recommendation reflected the net benefits and net harms or trade-offs resulting from that recommendation, in addition to level of evidence available.

3.3 Data Synthesis

The evidence was synthesized using antimicrobial data from intensive care units of RMU and Allied Hospitals.

3.4 Formulation of Recommendations

Recommendations were made considering the strength of the evidence available and the net benefits or net harms resulting from those treatments.

3.5 Future Revision Dates

At six monthly basis the Antibiotic Usage Committee will review the antimicrobial patterns and will determine the need for recommendation revisions.

3.6 Culture Negative Yield

Culture negative means no sign of growth/yield.

Common causes of negative cultures were considered to be:

- Previous or current administration of antibiotics can suppress bacterial growth
- Causative micro-organism have no or limited proliferation in cultures
- Fastidious organisms e.g Legionella
- Cell dependent organisms
- Fungi
- Major immune reactions

SECTION-II

Evidence Based Recommendations

Correct treatment begins with the correct diagnosis. Before embarking on a course of treatment, it is essential to identify the infection being treated. This includes gaining an understanding of the primary site of infection, the extent of infection around the primary site, and distant sites seeded secondarily.

The selected antimicrobial agent should have activity against the identified or presumptive causative pathogen(s), known distribution to the site of infection, and proven therapeutic efficacy in the infection being treated. Patient factors that may impact efficacy must be considered, including co-morbidities, concomitant therapies (drug and non-drug), patient age, and organ function.

Suggested treatments are given below. They apply to intensive care patients. When the pathogens isolated, treatment may be changed to a more appropriate antibacterial agent if necessary. If no bacterium is cultured the antibacterial can be continued or stopped on clinical grounds. Record all decisions in the notes. State the duration and indication on the drug chart. IV antibiotics that continue beyond 72 hours must have duration in the notes.

4.1 Principles of Antimicrobial Usage:

- It should be mandatory to send the patient's sample for culture and sensitivity samples before putting the patient on any kind of antibiotics
- This guidance is based on the best available evidence at the time of development. Its application must be modified by professional judgment, based on knowledge about individual patient co-morbidities, potential for drug interactions and involve patients in management decisions.
- It is important to initiate antibiotic as soon as possible in severe infection or in those immune-compromised, particularly if sepsis is suspected.
- This guidance should not be used alone; it should be supported with patient information about safety setting, back-up/delayed antibiotics, self –care, infection severity and usual duration, clinical staff education, and audits.

- Doses need to be adjusted for age, weight and renal function.
- Refer to drug guide for further dosing and interaction information (e.g. interaction between macrolides and statins), ALWAYS check for hypersensitivity/allergy.
- Have a lower threshold for antibiotics in immune-compromised or in those with multiple co- morbidities; send samples for culture and seek advice.
- Selection and use of antibiotics is based on WHO guidelines²:

Drugs in GREEN are first line antibiotics (Access Group)

Drugs in YELLOW are considered second line treatment modality (Watch Group)

Drugs in RED are LAST RESORT (Reserve Group)

- Prescribe an antimicrobial only when there is likely to be a clear clinical benefit, giving alternative, non-antibiotic self –care advice where appropriate.
- Consider a no, or delayed, antibiotic strategy for acute self-limiting upper respiratory tract infections (e.g. acute sore throat, acute cough and acute sinusitis) and mild UTI symptoms
- 'Blind' antibiotic prescribing for unexplained pyrexia usually leads to further difficulty in establishing the diagnosis.
- Avoid broad spectrum antibiotics (e.g. co-amoxiclav, quinolones and cephalosporins) when narrow spectrum antibiotics remain effective, as they increase the risk of all infections eg,*Clostridium difficile*, MRSA and other antibiotic resistant organisims³
- Avoid widespread use of topical antibiotics (especially those agents also available as systemic preparations, in most cases, topical use should be limited).
- Clarithromycin is now recommended over erythromycin, except in pregnancy and breastfeeding. It has fewer side-effects and twice daily rather than four times daily dosing promotes compliance. Statins should be withheld when macrolide antibiotics are prescribed³.

In pregnancy, take specimens to inform treatment. Penicillins, cephalosporins and erythromycin are not associated with increased risk of spontaneous abortion. If possible, avoid tetracyclines, quinolones, aminoglycosides, azithromycin (except in chlamydial infection), clarithromycin and high dose metronidazole (2g stat) unless the benefits outweigh the risks. Short-term use of nitrofurantoin is not expected to cause fetal problems (theoretical risk of neonatal hemolysis). Trimethoprim is also unlikely to cause problems unless poor dietary folate intake, or taking another folate antagonist. If you are unsure about a particular drug's use in pregnancy contact the Pharmacist for further advice³.

4.2 Blood Stream Infections

Antibiotics Must Be Given Within One Hour Of Diagnosis For Severe Sepsis

In all patients transferring to ICU, discussion with an intensivist and medical microbiologist is essential.

Colistin was banned from 2019 and re-allowed by DRAP from 2020 and shows activity of >90% currently in RMU & Allied Hospitals

Sr. #	Organism N=204, 22%	Access Group Antibiotics ²	Sensitivity %	Watch Group Antibiotics ²	Sensitivity %	Reserve Group Antibiotics ²	Sensitivity %	Recommende d Antibiotics	
		Amoxicillin +clavulanic acid	<5	Cefotaxim e	<5	Tigecycline	>90		
		Amikacin	<5	Ceftriaxon e	<5				
	cte 3%	Aztreonam	<40	Cefixime	<5				
1	ietoba 57, 28			Ciprofloxa cin	<5			Tigecycline	
		Acin n=			Cefoperaz one+ Sulbactam	<5			
				Ceftazidim e	<5				
				Imipenem	<10				

Evidence:

 i. shows that commonest organism grown from blood culture is Acinetobacter spp. with 90% sensitivity to Tigecycline (Level of Evidence: High)
 ii. Combination therapy like Aztreonam & Imipenem may be used for empirical therapy for Acinetobacter in blood stream infections (Level of Evidence: Low)

<u>Recommendation:</u>

- Recommendation I: Tigecycline may be used for treatment of suspected Acinetobacter infection in blood stream in ICU patients as first line (Strong Recommendation)
- ii. Recommendation II:

Combination therapy like Aztreonam & Imipenem may be used for treatment of suspected Acinetobacter infection in blood stream in ICU patients as first line (Weak Recommendation)

Sr. #	Organism N=204, 22%	Access Group Antibiotic s ²	Sensitivit y %	Watch Group Antibiotic s ²	Sensitivit y %	Reserve Group Antibiotic s ²	Sensitivity %	Recommend ed Antibiotics
		Amoxicilli n +clavulan ic acid	<5	Cefotaxi me	<5	Tigecyclin e	>90	
2				Ceftazidi me	<5			
	a Spp 12%	Amikacin	<30	Ceftriaxo ne	<15			Tigogyalina
	iell 3,			Cefixime	<20			ngecycline
	Klebsi n=23			Ciproflox acin	<20			
				Cefopera zone+ Sulbacta m	<20			
				Imipene m	<50			

- i. Shows that **Klebsiella spp** grown from blood culture shows 90% sensitivity to Tigecycline (Level of Evidence: High)
- ii. Combination therapy like Imipenem with Amikacin/ Cefixime/ Ciprofloxacin/ Sulzone may be used for empirical treatment for Klebsiella in blood stream infections (Level of Evidence: Low)
- iii. Imipenem shows 50% activity against Klebsiella in blood stream infections (Level of Evidence: Low)

<u>Recommendation</u>:

i. Recommendation I:

Tigecycline may be used for treatment of suspected Klebsiella infection in blood stream in ICU patients as first line (Strong Recommendation)

- Recommendation II: Combination therapy like Imipenem with Amikacin/ Cefixime/ Ciprofloxacin/ Sulzone may be used for treatment of suspected Klebsiella infection in blood stream in ICU patients as first line (Weak Recommendation)
- iii. Recommendation III:
 Imipenem may be used for treatment of suspected Klebsiella infection in blood stream in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=204, 22%	Access Group Antibioti cs ²	Sensitivit y %	Watch Group Antibioti c ² s	Sensitivit y %	Reserve Group Antibioti cs ²	Sensitivity %	Recommend ed Antibiotics
	Q	Amoxicilli n +clavulan ic acid	<5	Cefotaxi me	<5	Tigecyclin e	>90	
		Aztreona m	<10	Ceftriaxo ne	<15			
	s Sp %	Amikacin	20	Cefixime	<20			
3	Pseudomonas n=29, 14%			Ceftazidi me	20			Tigecycline
				Ciproflox acin	<40			
				lmipene m	<60			
				Cefopera zone + Sulbacta m	<60			

- i. shows that **Pseudomonas spp** grown from blood culture shows 90% sensitivity to Tigecycline (Level of Evidence: High)
- ii. Combination therapy like Imipenem, Sulzone with Ciprofloxacin, Amikacin/ Cefixime/ Ceftriaxone / Ceftazidime may be used for treatment of suspected Pseudomonas infection in blood stream (Level of Evidence: High)
- iii. Imipenem or Sulzone separately shows 60% activity against Pseudomonas in blood stream infections (Level of Evidence: Low)

Recommendation:

i. Recommendation I:

Tigecycline may be used for treatment of suspected Pseudomonas infection in blood stream in ICU patients as first line (Strong Recommendation)

- Recommendation II: Combination therapy like Imipenem, Sulzone with Ciprofloxacin, Amikacin/ Cefixime/ Ceftriaxone / Ceftazidime may be used for treatment of suspected Pseudomonas infection in blood stream in ICU patients as first line (Strong Recommendation)
- iii. Recommendation III:

Imipenem or Sulzone may be used for treatment of suspected Pseudomonas infection in blood stream in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=204, 22%	Access Group Antibiotic s ²	Sensitivit y %	Watch Group Antibiotic s ²	Sensitivit y %	Reserve Group Antibiotic s ²	Sensitivity %	Recommend ed Antibiotics
		Amoxicilli n +clavulani c acid	<5	Cefotaxi me	<5	Tigecyclin e	>90	
		Amikacin	<40	Cefixime	<10			
	E.Coli n=28, 14%			Ceftazidi me	<10			
4				Ceftriaxo ne	<15			Tigecycline
•				Cefoperaz one + Sulbacta m	<30			
				Ciproflox acin	<40			
				Imipene m	<40			

- i. shows that **E.Coli spp** grown from blood culture shows 90% sensitivity to Tigecycline (Level of Evidence: High)
- ii. Combination therapy like Amikacin with Imipenem/ Ciprofloxacin/ Sulzone may be used for suspected E.Coli spp infection in blood stream (Level of Evidence: Low)

<u>Recommendation</u>:

i. Recommendation I:

Tigecycline may be used for treatment of suspected E.Coli infection in blood stream in ICU patients as first line (Strong Recommendation)

Sr. #	Organis m N=204, 22%	Access Group Antibioti cs ²	Sensitivit y %	Watch Group Antibioti c ² s	Sensitivit y %	Reserve Group Antibioti cs ²	Sensitivity %	Recommend ed Antibiotics
	Staph spp/MRSA n=54, 27%	Penicillin	<15	Moxiflox acin	<50	Linezolid	100	
_		cefoxitin	20.4	Vancomy cin	100			Vancomycin
5		Gentami cin	<30	Teicopla nin	100			Linezolid
		Clindamy cin	<50					

Evidence:

- i. shows that **Staphylococcus spp** grown from blood culture shows 100% sensitivity to Vancomycin, Teicoplanin and Linezolid (Level of Evidence: High)
- ii. Combination therapy like Clindamycin or Moxifloxacin with Gentamicin/ Cefoxitin/ penicillin may be used for suspected Staphylococcus spp in blood stream infections (Level of Evidence: Low)

Recommendation:

i. Recommendation I:

Vancomycin, Teicoplanin or Linezolid may be used for treatment of suspected Staphylococcus infection in blood stream in ICU patients as first line (Strong Recommendation)

 Recommendation II: Combination therapy like Clindamycin or Moxifloxacin with Gentamicin/ Cefoxitin/ penicillin may be used for suspected Staphylococcus spp in blood stream infections (Weak Recommendation)

4.3 **Respiratory Infections**

Upper and lower Respiratory tract infections are very common. 445 samples of respiratory secretions, ETT and others were processed with growth rate of 66%.

Sr. #	Organis m N=204, 22%	Access Group Antibiotics ²	Sensitivity %	Watch Group Antibiotics ²	Sensitivity %	Reserve Group Antibiotics ²	Sensitivity %	Recommende d Antibiotics
		Amoxicillin +clavulani c acid	<5	Cefotaxim e <5 Tigecyclir	Tigecycline	>90		
	L	Amikacin	<5	Ceftriaxon e	<5			Tigecycline
	etobacte .56, 56%			Cefixime	<5			
1				Ciprofloxa cin	<5			
	Acin n=`			Imipenem	<5			
	4			Ceftazidim e	<5			
				Cefoperaz one+Sulba ctam	<5			

i. shows that commonest organism grown from respiratory culture is **Acinetobacter spp**. with 90% sensitivity to **Tigecycline** (Level of Evidence: High)

Recommendation:

 Recommendation I: Tigecycline may be used for treatment of suspected Acinetobacter infection in respiratory tract in ICU patients as first line (Strong Recommendation)

2	%	Antibiotics 2	Sensitivity %	Group Antibiotics 2	Sensitivity %	Recommende d Antibiotics
Amoxicillin +clavulanic acid	<5	Cefotaxim e	<5	<5 Tigecycline >90		
Amikacin	<40	Ceftriaxon e	<5			
		Ceftazidim e	<5			Tinggualing
		Cefixime	<5			ligecycline
		Ciprofloxa cin	<10	.0		
		Tazocin	<30			
		Imipenem	<30			
		Cefoperaz one+Sulba	<50			
	Amiliotics 2 Amoxicillin +clavulanic acid Amikacin	Amoxicillin +clavulanic <5 acid Amikacin <40	Antibiotics 70 Antibiotics 2 2 2 Amoxicillin <5	Amotional A Amotional A 2 2 2 2 Amoxicillin +clavulanic acid <5	Antibiotics Xa Antibiotics Xa Antibiotics Xa Antibiotics Z 2 <t< td=""><td>AntibioticsNoAntibioticsNoAntibioticsNo22222Amoxicillin +clavulanic acid<5</td>Cefotaxim e<5</t<>	AntibioticsNoAntibioticsNoAntibioticsNo22222Amoxicillin +clavulanic acid<5

- i. shows that **Klebsiella spp** grown from respiratory culture shows 90% sensitivity to Tigecycline (Level of Evidence: High)
- ii. Combination therapy like Amikacin with Imipenem/ Sulzone/ Tazocin may be used for suspected Klebsiella infection in respiratory tract (Level of Evidence: Low)

Recommendation:

i. Recommendation I:

Tigecycline may be used for treatment of suspected Klebsiella infection in respiratory tract in ICU patients as first line (Strong Recommendation)

ii. Recommendation II:

Combination therapy like Amikacin with Imipenem/ Sulzone/ Tazocin may be used for treatment of suspected Klebsiella infection in respiratory tract in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=204, 22%	Access Group Antibiotic s ²	Sensitivity %	Watch Group Antibiotic s ²	Sensitivity %	Reserve Group Antibiotic s ²	Sensitivity %	Recommende d Antibiotics
	Amoxicilli n <5 Cefotaxim +clavulani <5 e	<5	Tigecyclin e	>90	T i Iin -			
	٩	Amikacin	<20	Ceftriaxon e	<5			Colistin-
	nas sp 3.5%	Aztreona m	<20	Cefixime	10			2019 and re- allowed by
3	mo , 10			Imipenem	10			
	eudor n=40			Ciprofloxa cin	<20			2020 and
	٩	Ceftazidim <20			of >90%			
				Cefoperaz one +Sulbacta m	20			

Evidence:

i. shows that **Pseudomonas spp** grown from respiratory culture shows 90% sensitivity to Tigecycline (Level of Evidence: High)

Recommendation:

i. Recommendation I:

Tigecycline may be used for treatment of suspected Pseudomonas infection in respiratory tract in ICU patients as first line (Strong Recommendation)

Sr. #	Organis m N=204, 22%	Access Group Antibiotic s ²	Sensitivity %	Watch Group Antibiotic s ²	Sensitivity %	Reserve Group Antibiotic s ²	Sensitivity %	Recommende d Antibiotics
	E.Coli :31, 10.5%	Amoxicilli n +clavulani c acid	<5	Cefotaxim e	<5	Tigecyclin e	>90	Tigecycline Colistin- banned from 2019 and re-
		Amikacin	<40	Ceftriaxon e	<10			
				Cefixime	<10			
4				Ceftazidi me	10			DRAP from
	Ë			Ciprofloxa cin	<30			shows activity
				Cefoperaz one+Sulba ctam	<30			01 290%
				Imipenem	<50			

Evidence:

- i. shows that **E.Coli spp** grown from respiratory culture shows 90% sensitivity to Tigecycline (Level of Evidence: High)
- ii. Combination therapy like Amikacin with Imipenem/ Ciprofloxacin/ Sulzone may be used for suspected E.Coli spp infection in respiratory tract (Level of Evidence: Low)
- iii. Imipenem shows 50% activity against E.Coli spp in respiratory tract infections (Level of Evidence: Low)

Recommendation:

- Recommendation I: Tigecycline may be used for treatment of suspected E.Coli infection in respiratory tract in ICU patients as first line (Strong Recommendation)
- Recommendation II: Combination therapy like Amikacin with Imipenem/ Ciprofloxacin/ Sulzone may be used for treatment of suspected E.Coli infection In respiratory tract in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=204, 22%	Access Group Antibiotic s ²	Sensitivit y %	Watch Group Antibiotics ²	Sensitivit y %	Reserve Group Antibiotic s ²	Sensitivity %	Recommende d Antibiotics
	/MRSA	Gentamici n	<5	Moxifloxaci n	<30	Linezolid	100	
		Penicillin	<5	Vancomyci n	100			Vancomycin
5	5pp, =10	cefoxitin	20	Teicoplanin	100			Teicoplanin
	Staph s n	Clindamyc in	<50					Linezolid
		Erythromy cin	50					

- shows that Staphylococcus spp grown from respiratory culture shows 100% sensitivity to Vancomycin, Teicoplanin and Linezolid (Level of Evidence: High)
- ii. Combination therapy like Clindamycin or Erythromycin with Moxifloxacin/ Cefoxitin may be used for suspected Staphylococcus spp in respiratory tract infections (Level of Evidence: Low)
- iii. Clindamycin or Erythromycin shows 50% activity against Staphylococcus spp in respiratory tract infections (Level of Evidence: Low)

<u>Recommendation</u>:

- Recommendation I: Vancomycin, Teicoplanin or Linezolid may be used for treatment of suspected Staphylococcus infection in respiratory tract in ICU patients as first line (Strong Recommendation)
- ii. Recommendation II:

Combination therapy like Clindamycin or Erythromycin with Moxifloxacin/ Cefoxitin may be used for treatment of suspected Staphylococcus infection in respiratory tract in ICU patients as first line (Weak Recommendation)

4.4 Urinary Infections

It is advised that patients should be reviewed at 24-48hrs with culture results and susceptibility tests and aim to switch to an oral agent. IV antibiotics can be de-escalated once IV/oral switch criteria are met. Stop antibiotics if infection has been ruled out. Record all decisions in the

notes. State duration and indication on the drug chart. If possible delay starting therapy until urine cultures are reported.

People > 65 years: do not treat asymptomatic bacteriuria; it is common but is not associated with increased morbidity

Sr. #	Organism N=50	Access Group Antibiotics ²	Sensitivity %	Watch Group Antibiotics ²	Sensitivity %	Reserve Group Antibiotics ²	Sensitivity %	Recommende d Antibiotics
	Amoxicillin +clavulanic <5 acid	<5	Cefotaxim e	<5	Tigecycline	>90	Nitrofurantoin	
				Cefixime	<5	<5 <		Tigecycline
	3%			Ceftazidim e	<5			Colistin- banned from
1	E.Coli 19, 38	Amikacin	<40	Ceftriaxon e	5			2019 and re- allowed by DRAP from 2020 and
1	Ë	Nitrofuran toin	<90	Ciprofloxa cin	5			
			Cefoperaz one+Sulba <20 ctam			shows activity of >90%		
				Imipenem	<20			

Evidence:

- i. shows that **E.Coli spp** are commonest organism grown from urine culture and shows 90% sensitivity to Nitrofurantoin and Tigecycline (Level of Evidence: High)
- ii. Combination therapy like Amikacin with Imipenem/ Sulzone may be used for suspected E.Coli spp infection in urinary tract (Level of Evidence: Low)

<u>Recommendation</u>:

- Recommendation I: Nitrofurantoin or Tigecycline may be used for treatment of suspected E.Coli infection in urinary tract in ICU patients as first line (Strong Recommendation)
- ii. Recommendation II:

Combination therapy like Amikacin with Imipenem/ Sulzone may be used for treatment of suspected E.Coli infection in urinary tract in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=50	Access Group Antibiotic s ²	Sensitivit y %	Watch Group Antibiotic s ²	Sensitivit y %	Reserve Group Antibiotic s ²	Sensitivity %	Recommend ed Antibiotics	
2	cus 6%	Clindamy cin	<5	Moxifloxa cin	<10	Linezolid	100	Vancomucin	
	Enterococ spp n=13, 2	erococ spp 13, 2	Penicillin	<10	Vancomy cin	100			Linezolid
		Gentamici n	<10						

i. shows that **Enterococcus spp** grown from urine culture shows 100% sensitivity to Vancomycin and Linezolid (Level of Evidence: High)

<u>Recommendation</u>:

i. Recommendation I:

Vancomycin, or Linezolid may be used for treatment of suspected Staphylococcus infection in urinary tract in ICU patients as first line (Strong Recommendation)

Sr. #	Organis m N=50	Access Group Antibiotic s ²	Sensitivity %	Watch Group Antibiotic s ²	Sensitivity %	Reserve Group Antibiotic s ²	Sensitivity %	Recommende d Antibiotics	
		Amoxicilli n +clavulani c acid	<5	Cefotaxim e	<5	Tigecyclin e			
		Amikacin	<40	Ceftriaxon e	<5			Tigecycline Colistin-	
	Klebsiellaspp n=6, 12%	Nitrofuran toin	<90	Cefixime	<5			banned from 2019 and re-	
3				Ceftazidim e	<5			allowed by DRAP from	
		AA A	Ке			Ciprofloxa cin	<5		
				Tazocin	50			of >90%	
				Cefoperaz					
				one+Sulba ctam	50				
				Imipenem	<70				

- i. shows that **Klebsiella spp** grown from urine culture shows 90% sensitivity to Nitrofurantoin and Tigecycline (Level of Evidence: High)
- ii. Imipenem shows 70% activity against Klebsiella in urinary tract infections (Level of Evidence: Moderate)
- iii. Combination therapy like Amikacin with Imipenem/ Sulzone/ Tazocin may be used for suspected Klebsiella infection in urinary tract (Level of Evidence: Low)

Recommendation:

i. Recommendation I:

Nitrofurantoin or Tigecycline may be used for treatment of suspected Acinetobacter infection in urinary tract in ICU patients as first line (Strong Recommendation)

- Recommendation II:
 Imipenem may be used for treatment of suspected Klebsiella infection in urinary tract in ICU patients as first line (Weak Recommendation)
- iii. Recommendation III:

Combination therapy like Amikacin with Imipenem/ Sulzone/ Tazocin may be used for treatment of suspected Acinetobacter infection in urinary tract in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=50	Access Group Antibiotic s ²	Sensitivity %	Watch Group Antibiotic s ²	Sensitivity %	Reserve Group Antibiotic s ²	Sensitivity %	Recommende d Antibiotics
				Cefotaxim e	<5	Tigecyclin e	>90	
		Amikacin	<5	Ceftriaxon e	<5			Tigecycline Colistin- banned from 2019 and re- allowed by DRAP from 2020 and shows activity
	omonas spp :5, 10%	Aztreona m	<40	Cefixime	<5			
4		Nitrofuran toin	<90	Ciprofloxa cin	<5			
	n⊧			Imipenem	<5			
	Pse			Ceftazidim e	<5			
				Cefoperaz one+Sulba ctam	<20			0129070

Evidence:

i. shows that **Pseudomonas spp** grown from urine culture shows 90% sensitivity to Nitrofurantoin and Tigecycline (Level of Evidence: High)

ii. Combination therapy like Aztreonam and Sulzone may be used for suspected Pseudomonas infection in urinary tract (Level of Evidence: Low)

<u>Recommendation</u>:

- Recommendation I: Nitrofurantoin or Tigecycline may be used for treatment of suspected Pseudomonas infection in urinary tract in ICU patients as first line (Strong Recommendation)
- ii. Recommendation II:

Combination of Aztreonam, and Sulzone may be used for treatment of suspected Pseudomonas infection in urinary tract in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=50	Access Group Antibiotic s ²	Sensitivity %	Watch Group Antibiotic s ²	Sensitivity %	Reserve Group Antibiotic s ²	Sensitivity %	Recommende d Antibiotics
		Amoxicilli n +clavulani c acid	<5	Cefotaxim e	<5	Tigecyclin e	>90	Tigocyclina
	L	Amikacin <5 Ceftriaxon <5			Colistin-			
F	cinetobacteı n=4, 8%	Nitrofuran toin	<90	Cefixime	<5			2019 and re- allowed by DRAP from
Э				Ciprofloxa cin	<5			
	4			Imipenem	<5			shows activity
				Ceftazidi me	<5			of >90%
				Cefoperaz one+Sulba ctam	<5			

Evidence:

i. shows that **Acinetobacter spp** grown from urine culture is 90% sensitivity to Nitrofurantoin and Tigecycline (Level of Evidence: High)

<u>Recommendation</u>:

i. Recommendation I:

Nitrofurantoin or Tigecycline may be used for treatment of suspected Acinetobacter infection in urinary tract in ICU patients as first line (Strong Recommendation)

Sr. #	Organis m N=50	Access Group Antibiotic s ²	Sensitivity %	Watch Group Antibiotic s ²	Sensitivity %	Reserve Group Antibiotic s ²	Sensitivity %	Recommende d Antibiotics
	Staph spp/MRSA n=3, 6%	Clindamyci n	<5	Moxifloxac in	<40	Linezolid	100	Vancomycin Teicoplanin Linezolid
6		Penicillin	<5	Vancomyci n	100			
		cefoxitin	33.3	Teicoplani n	100			
		Gentamici n	<40					

- i. shows that **Staphylococcus spp** grown from urine culture shows 100% sensitivity to Vancomycin, Teicoplanin and Linezolid (Level of Evidence: High)
- ii. Combination therapy like Gentamicin with Moxifloxacin may be used for suspected Staphylococcus spp infection in urinary tract (Level of Evidence: Low)
- iii. Gentamicin or Moxifloxacin shows 40% activity against Staphylococcus spp in urinary tract infections (Level of Evidence: Low)

Recommendation:

i. Recommendation I:

Vancomycin or Teicoplanin or Linezolid may be used for treatment of suspected Staphylococcus infection in urinary tract in ICU patients as first line (Strong Recommendation)

ii. Recommendation II:

Gentamicin + Moxifloxacin may be used for treatment of suspected Staphylococcus infection in urinary tract in ICU patients as first line (Weak Recommendation)

4.5 Wound Infections

Treatment is always more effective if adequate source control is achieved, such as debridement of necrotic tissue, drainage of abscesses, and removal of infected prosthetic devices. Whenever possible, control at the primary site of infection should be addressed appropriately early in treatment.

Sr. #	Organis m N=41, 63%	Access Group Antibiotic s	Sensitivity %	Watch Group Antibiotic s	Sensitivity %	Reserve Group Antibiotic s	Sensitivity %	Recommende d Antibiotics
1	inetobacter =18, 44%	Amoxicilli n +clavulani c acid	5	Cefotaxim e	<5	Tigecyclin e	100	Tigecycline
		Amikacin	<5	Ceftriaxon e	<5			
				Cefixime	<5			
				Ciprofloxa cin	<5			
	Ac			Imipenem	<5	<5		
				Ceftazidim e	<5			
				Cefoperaz one+Sulba ctam	<5			

i. shows that commonest organism grown from pus culture is **Acinetobacter spp**. with 90% sensitivity to **Tigecycline** (Level of Evidence: High)

Recommendation:

i. Recommendation I:

Tigecycline may be used for treatment of suspected Acinetobacter infection in wound infection in ICU patients as first line (Strong Recommendation)

Sr. #	Organis m N=41, 63%	Access Group Antibiotic S	Sensitivit y %	Watch Group Antibiotic S	Sensitivit y %	Reserve Group Antibiotic s	Sensitivity %	Recommende d Antibiotics
2	Staph spp/MRSA n=2, 5%	Gentamici n	<5	Moxifloxa cin	50	Linezolid	100	
		Penicillin	<5	Vancomyc in	>90			Vancomycin Teicoplanin
		cefoxitin	30	Teicoplani n	>90			Linezolid
		Clindamyc in	50					

Evidence:

 i. shows that Staphylococcus spp grown from respiratory culture shows 100% sensitivity to Vancomycin, Teicoplanin and Linezolid (Level of Evidence: High)

- ii. Combination therapy like Clindamycin with Moxifloxacin may be used for suspected Staphylococcus spp infection in respiratory tract infections (Level of Evidence: Low)
- iii. Clindamycin or Moxifloxacin shows 50% activity against Staphylococcus spp in respiratory tract infections (Level of Evidence: Low)

<u>Recommendation:</u>

i. Recommendation I:

Vancomycin, Teicoplanin or Linezolid may be used for treatment of suspected Staphylococcus infection in respiratory tract in ICU patients as first line (Strong Recommendation)

ii. Recommendation II:

Combination therapy like Clindamycin with Moxifloxacin may be used for treatment of suspected Staphylococcus infection in respiratory tract in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=41, 63%	Access Group Antibioti cs	Sensitivit y %	Watch Group Antibioti cs	Sensitivit y %	Reserve Group Antibioti cs	Sensitivity %	Recommen ded Antibiotics
	E.Coli 9, 22%	Amoxicill in +clavulan ic acid	<5	Cefotaxi me	<5	Tigecycli ne	100	
		Amikacin	<70	Ceftriaxo ne	<5			
				Ceftazidi me	<5			Tigecycline
3				Cefixime	<5			
	Ξu	للله Ciproflox acin	<20					
				Imipene m	<40			
				Cefopera zone+Sul bactam	<40			

- i. shows that **E.Coli spp** grown from pus cultures shows 90% sensitivity to Tigecycline (Level of Evidence: High)
- ii. Amikacin shows 70% activity against E.Colispp in wound infections (Level of Evidence: Moderate)
- iii. Combination therapy like Amikacin with Imipenem/ Ciprofloxacin/ Sulzone may be used for suspected E.Coli spp in wound infections (Level of Evidence: Low)

<u>Recommendation</u>:

- Recommendation I: Tigecycline and Colistin may be used for treatment of suspected E.Coli infection in wound in ICU patients as first line (Strong Recommendation)
- ii. Recommendation I: Amikacin may be used for treatment of suspected E.Coli infection in wound in ICU patients as first line (Weak Recommendation)
- iii. Recommendation III: Combination therapy like Amikacin with Imipenem/ Ciprofloxacin/ Sulzone may be used for treatment of suspected E.Coli infection in wound in ICU patients as first line (Weak Recommendation)

Sr. #	Organis m N=41, 63%	Access Group Antibioti Cs	Sensitivit y %	Watch Group Antibioti cs	Sensitivit y %	Reserve Group Antibioti cs	Sensitivity %	Recommen ded Antibiotics
	Amoxicill in +clavulan ic acid Amikacin Aztreona m %L1 , 2 2 2 2 2 3 2 2 3 2 2 3 2 3 2 3 2 3	Amoxicill in +clavulan ic acid	<5	Cefotaxi me	<5	Tigecycli ne	90	
		<5	Ceftriaxo ne	<5				
		Aztreona m	<5	Cefixime	<5			Tigogyaling
4				Ciproflox acin	<5			пдесустте
	Pseu			Imipene m	Imipene <5 <5			
				Ceftazidi me	<5			
				Cefopera zone+Sul bactam	<30			

Evidence:

i. shows that **Pseudomonas spp** grown from *pus* culture shows 90% sensitivity to Tigecycline (Level of Evidence: High)

<u>Recommendation</u>:

- i. Recommendation I:
- ii. Tigecycline may be used for treatment of suspected Pseudomonas infection in wound in ICU patients as first line (Strong Recommendation)

Sr. #	Organis m N=41, 63%	Access Group Antibioti cs	Sensitivit y %	Watch Group Antibioti cs	Sensitivit y %	Reserve Group Antibioti cs	Sensitivity %	Recommen ded Antibiotics
	osiellaspp 5, 12%	Amoxicill in +clavulan ic acid	<5	Cefotaxi me	<5	Tigecycli ne	100	
		Amikacin	20	Ceftriaxo ne	<5			
F				Cefixime	<5			
5				Ciproflox acin	<5			Tigecycline
	Kle n=			Ceftazidi me	ftazidi me <5			
				Imipene m	20			
				Cefopera				
				zone+Sul	20			
				bactam				

i. shows that **Klebsiella spp** grown from pus culture shows 90% sensitivity to **Tigecycline** (Level of Evidence: High)

Recommendation:

i. Recommendation I:

Tigecycline may be used for treatment of suspected Klebsiella infection in wound in ICU patients as first line (Strong Recommendation)

SECTION-III

Causal Associations Between Antimicrobial Use And The Emergence Of Antimicrobial Resistance

- i. Changes in antimicrobial use are paralleled by changes in the prevalence of resistance.
- ii. Antimicrobial resistance is more prevalent in health care–associated bacterial infections, compared with those from community-acquired infections.
- iii. Patients with health care–associated infections caused by resistant strains are more likely than control patients to have received prior antimicrobials.
- iv. Areas within hospitals that have the highest rates of antimicrobial resistance also have the highest rates of antimicrobial use.
- v. Increasing duration of patient exposure to antimicrobials increases the likelihood of colonization with resistant organisms.

NOTE:

A causal association between antimicrobial use and the emergence of antimicrobial resistance has been reviewed elsewhere and is strongly suggested on the basis of several lines of evidence that are derived from patient and population levels of analysis, colonization and infection data, and retrospective and prospective studies.

Barriers/Way-Forward

Addressing AMR in intensive care units has been a priority because these settings are breeding and spreading antibiotic-resistant pathogens. Following are few points regarding antibiotic resistance.

	Barriers / gaps	Way forward
1	Non availability to antibiotic policy	Continuous update of antibiotic guidelines
2	Non adherence to antibiotic policy	Strict adherence to guidelines
3	Gaps in the knowledge among different specialties	Clinical audit
4	Inadequate continuing education	Initiate infection control and antibiotic awareness activities
5	Inadequate education regarding antibiotic utilization	Continuing Medical Education (CME) in antibiotic usage and infection control
6	Aggressive marketing of antibiotic	Cost-effectiveness
7	Misuse of antibiotics:	Rationale use of antibiotics
	viral infections	Specific disease management
	 broad-spectrum antibiotics 	Narrower-spectrum antibiotics
		Culture and sensitivity

Despite these formidable barriers, it is the local nature of the problem which provides optimism that resistance can be contained and curbed if susceptible microbes can be re-established within defined areas. Individual institutions and health practitioners that use antibiotics more prudently will restore bacterial equilibrium in favor of susceptible bacteria and thereby preserve the effectiveness of antibiotic therapy in their communities.

While the WHO Global Strategy provides a thorough and comprehensive foundation, it is up to each nation, local institution and local provider to tailor specific initiatives to their particular resistance problems, resources, and practices.

The literature now documents that institutional initiatives can dramatically reduce the prevalence of antibiotic resistance. The strict enforcement of antibiotic use policies in hospitals can achieve a drastic reduction in the incidence of resistant organisms.

It is the combined efforts of individual interventions that will become the global solution

References

- 1. AMR-National-Action-Plan-Pakistan 2018
- 2. World Health Organization Model List of Essential Medicines 2019
- 3. Antibiotic Guidelines 2020 North Bristol NHS Trust