2020

ANTIBIOTIC POLICY

ALL INDIA INSTITUTE OF MEDICAL SCIENCES, RISHIKESH

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Introduction

General:

These guidelines are developed by a multi-disciplinary working group to ensure balanced input. It has considered the antimicrobial choice for specific conditions, and the existing policies for specific agents. The latest available evidence backed guidelines and recommendations were followed with due modification to the antibiotic choices where it was warranted by local anti-bio-gram. The list of drugs includes commonly used antibiotics in the OPD and Inpatients. These guidelines do not include anti-tubercular, antiviral and antiretroviral drugs. We believe that by following the guidelines it will be possible to maintain a high standard of patient care, delivered in a consistent way across this University.

This manual will be revised as and when new recommendations come or with the change in the local anti-bio-gram within a time period not extending more than a year as recommended by (National Board of Hospitals and Health Care Providers (NABH).

The choice of antimicrobial may need to be modified in the following situations:

- Hypersensitivity to first choice antimicrobial (see guidance on hypersensitivity)
- Recent antimicrobial therapy or preceding cultures indicating presence of resistant organisms
- In pregnant or lactating patients
- In renal or hepatic failure (see data for individual antimicrobials)
- Where significant drug interactions may occur.

With present day knowledge we can only provide a general guideline in choosing the best available antibiotic, and hence any deviation must be justified in documentation in the case records, as this will be followed by prescription. The compliance to general principles (as mentioned in the section – **GOOD PRACTICE**) is especially subjected to clinical audit as deviation in these aspects without evidence base will be considered as endangering the patient safety.

Antimicrobial Prescribing: Good Practice

1. Send for the appropriate investigations in all infections as recommended. This is the minimum requirement for diagnosis, prognosis and follow up of these infections.

2. **Microbiological samples must always be sent prior to initiating antimicrobial therapy.** Rapid tests, such as Gram stain, can help determine therapeutic choices when empiric therapy is required.

3. Differentiation between contamination, colonization and infection is important to prevent overuse of antibiotics.

4. **Choice of antibiotics**: This depends on antibiotic susceptibility of the causative organism. There are some infections which can be treated by one of several drugs. The choice can be based on toxicity, efficacy, rapidity of action, pharmacokinetics and cost. **Use the most effective, least toxic and least expensive antibiotic for the precise duration of time needed to cure or prevent infection.** Before prescribing consider following**:**
    a. Which organism is likely to cause the syndrome?
    b. What is the clinical diagnosis and what are the steps should be taken to improve the diagnostic precision?
    c. Which antimicrobial agents are available and active against the presumed cause of the illness? Is their range of antimicrobial activity appropriate and what information is available about the likelihood of drug resistance?
    d. Check for factors which will affect drug choice & dose, e.g. renal function, interactions, allergy, pregnancy and lactation.
    e. Check that the appropriate dose is prescribed. If uncertain, contact Physician or check in the formulary.
    f. What is the duration of treatment?
    g. Is treatment working?

5. **Clinical Diagnosis:**

The antibiotic treatment chosen must be based on some assumption regarding nature of disease. The treating doctor may not have difficulty in choosing the appropriate antibiotic to treat a disease caused by a single microorganism e.g., typhoid, anthrax, as microbiological

diagnosis is implicit in clinical diagnosis. However, diseases such as pneumonia, meningitis and urinary tract infection can be caused by any number of different micro-organism and doctor may be wrong if he has to guess which antimicrobial agent to use. In such instances one should seek a bacteriological diagnosis.

6. **Empiric Therapy**:

   Empiric Therapy may be started, if the causative agent is not known and there is urgency to initiate the therapy and delay would be life threatening or risky. In such cases, Antimicrobial Therapy based on a clinically defined infection and in consonance with hospital Anti-bio-gram is justified. However, following points should be taken into consideration:

   a) Must collect the necessary specimens before commencing therapy.
   b) Cover all possible microbial causes.
   c) Try to attain synergy.
   d) Consider possible interaction with other drugs.
   e) Accuracy of diagnosis should be reviewed regularly and treatment altered / stopped when microbiological results become available.
   f) Use drugs which are available in Hospital formulary, where possible.

7. The need for antimicrobial therapy should be reviewed on daily basis. For most infections 5-7 days of antimicrobial therapy is sufficient.

8. In critical cases, the therapy to be started with injectable antibiotics for 48–72 hours, subsequently the consideration for oral alternatives to be explored. This should be done in the light of new microbiological or other information (e.g. fever, effervescence, for at-least 24 hrs, marked clinical improvement; low CRP) should at this stage often permit as oral antibiotic(s), or switch to an IV narrow spectrum alternative, or cessation of antibiotics (no infection present).

9. Once culture reports are available, the physician should step down to the narrowest spectrum, most efficacious and most cost effective option. If there is no step down availed, the reason shall be documented and is subjected to clinical audit.

10. **Some guiding principles for de-escalation/escalation:**
    a) If ESBL+ve : drug choice is monotherapy with carbepenems .Group I carbepenem. Piperacillin – Tazobactum & Cefoperazone – Sulbactum can be used if in vitro sensitive and for mild infections.
    b) Vancomycin should be used only for confirmed MRSA infections and not MSSA.
    c) In case of Pan drug resistant *Pseudomonas* / *Acinetobacter spp.* combination therapy using Colistin along with β lactams should be discussed with microbiologist / physician.

11. **Treatment with antibiotic combinations**:

In order to avoid antagonism between drugs and undesirable side effects of several antibiotics it is advisable to use a single drug wherever possible. There are situations however, when the use of antibiotic combination is desirable. The situations are:

a) During the investigation of an obscure illness
b) To prevent the development of bacterial resistance in long term therapy e.g. treatment of tuberculosis.
c) To achieve synergistic effect, e.g. in treating infective endocarditis.
d) Mixed infection, when one drug is not effective against the pathogen.
e) To permit a reduction of the dose of potentially toxic drug.

The choice of drug should be that they act synergistically. The following combinations are synergistic

i. Aminoglycoside and β–lactam antibiotic.
ii. β–lactam antibiotic and β–lactamase inhibitor.
iii. β–lactam antibiotic and cell wall inhibitor (Vancomycin)
iv. Sulphamethoxazole and Trimethoprim.

12. **Is Treatment working?**

Where treatment is apparently failing, advice from an physician should normally be sought rather than blindly changing to an alternative choice of antimicrobial agent. Antimicrobial drug therapy cannot be considered in isolation and other aspects of therapy must be taken into account in judging the effect of treatment. Even an appropriate antibiotic may be ineffective if pus is not drained, septic shock treated and hypoxia and anemia corrected. There are several conditions in which chemotherapy alone cannot eliminate an infection. Obstructive lesions can cause infection to recur, unless they can be dealt with surgically. Also chemotherapy cannot obviate the necessity for draining an abscess or removing sequester or calculi. Failure of treatment can also be due to a super-added infection, e.g. phlebitis, development of resistance during therapy or poor tissue penetration.

13. **Laboratory control of the effects of the treatment:**

Whether treatment has been successful or not is best judged by clinical criteria, but it is useful to know whether the infecting organism has been eliminated. Repeated cultures are, therefore sometimes indicated.

Reserve Antimicrobials

These antibiotics are held in reserve to maintain their effectiveness in treating certain difficult infections by reducing the spread of microbial resistance and to encourage cost effective prescribing. The issue of reserve antibiotic to be done only on request of treating consultant.

The following criteria have been proposed to protect the Carbapenems and Linezolid from overuse:

a) Severe sepsis as defined by more than one organ failure of new onset and/ or elevated serum lactate.
b) Clinical failure of other classes of antibiotics over 48 hours in terms of worsening inflammatory markers, un-resolving fever and new /worsening hemodynamic instability.
c) Underlying severe immune–suppression–Neutropeniea, immuno-suppressive therapy, or Diabetic Ketoacidosis (DKA).
d) The organism is susceptible to only carbapenems / linezolid, as per culture report.

The following criteria have been proposed for initiating Colistin:

a) Pan-resistant organism as per culture report with evidence of invasive disease–fever/ leucocytosis /elevated procalcitonin (PCT) or culture from a sterile site.
b) Clinical failure of all other classes of antibiotics over 72 hours.

The following criteria have been proposed for initiating Rifampicin:

a) Empiric or proven TB as a part of ATT (4 drug regimen)
b) As anti-bacterial, only if prescribed as a combination regimen where the companion drug and Rifampicin, both are proven as susceptible as per culture report.

RIFAMPICIN WILL NOT BE ISSUED ALONE AS AN ANTI-BACTERIAL.

The following criteria have been proposed for initiating amino glycosides:

a) Only as a part of initial empiric regimen of a combination therapy–shall step down to single drug after culture report.
b) Others after drug options have been ruled out in a culture report.

Hypersensitivity

All patients should be asked about drug allergies. This is the responsibility of the doctor who writes the patient's history. If a patient reports a drug allergy clarify whether this is an allergy or drug intolerance. In some cases, there will be an overlap between drug allergy and drug intolerance.

- **Clinical features suggestive of drug allergy:**

  One or more symptoms developed during or following drug administration including difficulty breathing, swelling, itching, rash, and anaphylaxis, swelling of the lips, loss of consciousness, seizures or congestion involving mucous membranes of eyes, nose and mouth.

- **Clinical features suggestive of drug intolerance:**

  One or more symptoms developed during or following drug administration including gastrointestinal symptoms e.g. nausea, vomiting,

diarrhea, abdominal pain and feeling faint.

- **If patients are unable to give an allergy history**:
The doctor should take reasonable steps to contact someone who can provide are liable allergy history. It is the prime responsibility of the prescribing doctor to ensure that allergy history is documented in drug chart as
a) No known allergy (NKA).
b) History not available.

Importance of Infection Control (IC) to Control Antimicrobial Resistant:

The use of antimicrobial agents inevitably adds to the emergence of resistant microorganisms. It also destroys the normal flora of the body and renders patients far more susceptible to colonization with micro-organisms introduced from elsewhere in the hospital through the process of cross infection.

- Hospitals may be considered as reservoirs and breeding grounds within the world of antibiotic resistance.
- Prevention of cross infection and good quality antimicrobial prescribing contribute to the prevention of antimicrobial resistance. Infection Control and Clinical Microbiology are inextricably linked.
- There is no substitute of hand washing in preventing hospital acquired infection and the spread of antibiotic resistant micro-organisms.
- High standards of hospital cleanliness may be important in controlling the spread of resistant organism in the environment.e.g. MRSA, *Acinetobacter baumannii* etc.

I. Upper Respiratory Tract Infections				
Condition	**Most likely organisms**	**Drug**	**Dose**	**Duration**
Acute bacterial rhinosinusitis	Streptococcus pneumoniae H. influenzae M. catarrhalis	Amoxycillin- Clavulanate	875/125 mg PO q 12 hours	7 days
		In case of Penicillin allergy: Azithromycin	500 mg PO q 24 hours	3 days
Acute pharyngitis	Streptococcus pyogenes Viruses [Antibiotic administration only for patients who are most likely to have S. pyogenes infection: fever, tonsillar exudates, no cough, & tender anterior cervical lymphadenopathy]	Penicilin V OR	500 mg PO q 12 hours	10 days
		Amoxycillin	500 mg PO q 8 hours	10 days
		In case of Penicillin allergy: Azithromycin	500 mg PO OD	5 days
Acute epiglottitis [Airway management essential]	<u>Children:</u> H influenzae Streptococcus pyogenes Streptococcus	Ceftriaxone OR	50 mg/kg IV 24 hourly	
		Cefotaxime OR	50 mg/kg IV 8 hourly	

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	pneumoniae S. aureus Adult: H influenzae Streptococcus pyogenes	Levofloxacin AND	10 mg/kg IV 24 hourly	
		Clindamycin	7.5 mg/kg IV 6 hourly	
Malignant otitis externa (usually diabetic or immunocompromised) Debridement usually required. Osteomyelitis to be ruled out.	Pseudomonas aeruginosa in > 90% cases	For early disease: Ciprofloxacin	750 mg PO q 12 hours	Up to 5 days after signs of inflammation resolve. 6 weeks in case of bone involvement.
		For advanced disease: Ceftazidime OR	2 gm IV q 8 hours	
		Piperacillin-Tazobactum	4.5 gm IV 6 hourly	
Acute Otitis Media Treat children <2 years. If >2 years, afebrile & no ear pain: consider analgesics & defer antibiotics	Streptococcus pneumoniae H. influenzae M. catarrhalis	Amoxycillin- Clavulanate	90/6.4 mg/kg/day PO q 12 hours	If age <2 years: 10 days If age >2 years : 5-7 days
		If treated in past 1 mon: Cefuroxime-Axetil	250 mg PO q 12 hours	

1. The recommendations listed above are for empirical administration. Antibiotic usage should be de-escalated judiciously following the availability of culture- sensitivity reports.
2. The duration shown denotes the length of treatment in case the empirical antibiotic is continued.

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II. Lower Respiratory Tract Infections

Condition	Most likely organisms	Drug	Dose	Duration
Acute exacerbation of chronic bronchitis	S. pneumoniae H. influenzae M. catarrhalis Viruses Chlamydophila pneumoniae	OPD patient: Amoxicillin OR	500-1000 mg thrice a day	5-7 days
		Azithromycin	500 mg once a day	3 days
		Indoor patient: Amoxicillin-clavulanic acid OR	625 mg thrice a day	5-7 days
		Cefuroxime OR	500 mg BD	5-7 days
		Cefixime	200 mg BD	5-7 days
Bronchiectasis, acute exacerbation	H. influenzae, P. aeruginosa	Amoxicillin-clavulanic acid	625 mg thrice a day	5-7 days
		Long term (in case of repeated exacerbation): Azithromycin	500 mg thrice a week	1-2 months
Community-acquired pneumonia (CAP) [non-hospitalized patient]	No comorbidity M. pneumoniae, S. pneumoniae Viruses	Azithromycin OR	500 mg OD	3 days
		Amoxicillin	500-1000 mg thrice a day	5 days

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Community-acquired pneumonia (CAP) [Hospitalized (Non ICU) patient or with comorbidities]	M. pneumoniae, S. pneumoniae Viruses	Amoxicillin-clavulanic acid OR	1.2 gm IV TDS	5-8 days
		Cefotaxime OR	2-4 gm OR day IV	7-10 days
		Ceftriaxone AND	2 gm IV OD	5-8 days
		Azithromycin	500 mg IV OD	7-10 days
CAP in ICU (No risk factor for pseudomonas)	S. pneumoniae, H. influenzae, M. catarrhalis, Legionella spp.	Amoxicillin-clavulanic acid OR	1.2 gm IV TDS	5-8 days
		Cefotaxime OR	2-4 gm OR day IV	7-10 days
		Ceftriaxone AND	2 gm IV OD	5-8 days
		Azithromycin	500 mg IV OD	7-10 days

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Condition	Most likely organisms	Drug	Dose	Duration
CAP in ICU (risk factor for multi-drug resistant bacteria like: i. Antimicrobial therapy in preceding three months ii. Present hospitalization of ≥5 days iii. High frequency of antibiotic resistance in the community or in the specific hospital unit. iv. Hospitalization for ≥48 hours in preceding three months v. Home infusion therapy including antibiotics vi. Home wound care vii. Chronic dialysis within one month viii. Family member with MDR pathogen ix. Immunosuppressive drug and/or therapy	P. aeruginosa Acinetobacter Enterobacteriaceae	Piperacillin-Tazobactam ADD	4.5 gm IV QID	10-14 days
		Amikacin	1 gm IM/IV OD	10-14 days

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Condition	Most likely organisms	Drug	Dose	Duration
MDR Pseudomonas Risk factor: Immunocompromised state, Chronic respiratory conditions like COPD, Asthma, Bronchiectasis; Enteral tube feeding, Cerebrovascular accident, Chronic neurological conditions.	P. aeruginosa	Piperacillin-Tazobactam CAN ADD	4.5 gm IV QID	10-14 days
		Amikacin	1 gm IM/IV OD	10-14 days
Methicillin Resistant Staph Aureus MRSA is rare in Indian ICU; So if MRSA is strongly suspected in late onset VAP/HAP in ICU having documented MRSA, only then Start MRSA empiric treatment.	MRSA	Empiric Vancomycin OR Teicoplanin (For 14 Days) Linezolid should be reserved due to potential Antitubercular effect and should be preferred only if pt is vancomycin intolerant or has concomitant renal failure or vancomycin resistant organism.		
Aspiration pneumonia± lung abscess	Anaerobes 34%, Gram-positive cocci 26%,	Ceftriaxone AND	1 gm IV q 24 hours	For aspiration pneumonia- 5 to 7

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	Strep. milleri 16%, Klebsiella pneumoniae 25%, Nocardia 3%	Metronidazole OR	500 mg IV q 8 hours	days Lung abscess-4 - 6 weeks
		Clindamycin	1 gm IV q 12 hours	

III. CNS Infections

Condition	Situation/Severity	Most likely organisms	Drug	Dose	Duration
Meningitis	Immunocompetent	S pneumoniae N meningitidis H influenzae	Ceftriaxone OR	2 gm IV q 12 hours	10-14 days
			Cefotaxime	2 gm IV q 4-6 hours	10-14 days
			Chloramphenicol (in case of Penicillin Allergy)		
	Immunocompromised	S pneumoniae N meningitidis H influenza GNR	Ceftriaxone AND	2 gm IV q 12 hours	10-14 days
			Meropenem	2 gm IV q 8 hours	10-14 days
	Post neurosurgery Penetrating head trauma	Staphylococcus epidermidis, Staphylococcus aureus, Propionibacterium acnes, Pseudomonas aeruginosa, Acinetobacter baumanii	Vancomycin AND	1.5gm IV Loading 1 gm IV q 12 hours	10-14 days
			Meropenem	2g IV q 8 hours	10-14 days
	Infected shunt	S aureus GNR (rare)	Vancomycin AND	1 gm IV q 12 hours	10-14 days
			Meropenem	2 gm IV q 8 hours	10-14 days

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	Meningitis with basilar skull fractures Dexamethasone 0.15mg/kg IV q6h for 2-4 days (1st dose with or before first antibiotic dose)	S pneumonia H. Influenzae	Ceftriaxone	2 gm IV q 12 hours	14 days

Condition	Situation/Severity	Most likely organisms	Drug	Dose	Duration
	Organism specific therapy	S pneumoniae	Ceftriaxone	2 gm IV q 12 hours	10-14 days
		N meningitidis	Ceftriaxone	2 gm IV q 12 hours	7 days
		H influenzae	Ceftriaxone	2 gm IV q 12 hours	7 days
		E coli	Ceftriaxone	2 gm IV q 12 hours	21 days
		S. aureus-MSSA	Oxacillin	2 gm IV q 4 hours	10-14 days
		S. aureus-MRSA	Vancomycin	1gm IV q 12 hours	10-14 days
		Enterococcus	Ampicillin AND	2 gm IV q 4 hours	
			Gentamicin	5 mg/kg IV q 24 hours	
		Candida species	Amphotericin B	1 mg/kg IV q 24 hours	
		Cryptococcus	Amphotericin B AND	1 mg/kg IV q 24 hours	
			Flucytocine	25 mg/kg PO q 6 hours	
Encephalitis		HSV/VZV	Acyclovir	10 mg/kg IV q 8 hours	14-21 days
Brain abscess Exclude TB,	Source unknown	Streptococci, Bacteroides,	Vancomycin AND	1 gm IV q 12 hours	Duration guided by
			Ceftriaxone AND	2 gm IV q 12 hours	

Nocardia, Aspergillus, Mucor		Enterobacteriaceae, S. aureus	Metronidazole	500 mg IV q 6 hours	response
	Source : Sinusitis	S pneumoniae Anaerobes	Ceftriaxone AND	2 gm IV q 12 hours	
			Metronidazole	500 mg IV q 6 hours	

Condition	Situation/Severity	Most likely organisms	Drug	Dose	Duration
If abscess<2.5cm & patient neurologically stable, await response to antibiotics, Otherwise, consider aspiration/surgical drainage and modify antibiotics as per sensitivity of aspirated/ drained secretions.	Source : Chronic otitis	S pneumonia Anaerobes	Ceftriaxone AND	2 gm IV q 12 hours	
			Metronidazole	500 mg IV q 6 hours	
	Source: Post neurosurgery	S aureus GNR	Vancomycin AND	1 gm IV q 12 hours	
			Meropenem	2 gm IV q 8 hours	
	Source: Cyanotic heart disease	Streptococci	Ceftriaxone	2 gm IV q 12 hours	

Note:

a) Antibiotic therapy must be started within 30 minutes of suspecting a CNS infection.

b) Please give Dexamethasome to all patients with suspected meningitis in the dose of 0.15 mg/kg IV q 6 hours for 2-4 days, ideally first dose 10-20 minutes before an antibiotic.

c) STOP Antibiotic treatment if LP culture obtained prior to antibiotic therapy is negative at 48 hours OR no PMNs on CSF cell count.

IV. Skin and Soft Tissue Infections

Condition	Situation/ Severity	Most likely organisms	Drug	Dose	Duration
Cellulitis See note 1 below	Non-suppurative	Streptococci	Amoxicillin-clavulanic acid OR	625 mg PO q 8 hours	5-7 days
			Amoxicillin-clavulanic acid OR	1.2 gm IV q 8 hours	5-7 days
			Ceftriaxone OR	2 gm IV q 24 hours	5-7 days
			Clindamycin	600-900 mg IV q 8 hours	5-7 days
	Suppurative cellulitis or cutaneous abscess	S aureus	Doxycycline OR	100 mg PO q 12 hours	5-7 days
			Clindamycin OR	300 mg PO q 8 hours	5-7 days
			Clindamycin OR	600 mg IV q 8 hours	5-7 days
			Vancomycin	1 gm IV q 12 hours	5-7 days
	Cat/dog bite	P multocida	Amoxicillin-clavulanic acid	625 mg PO q 8 hours	5-7 days
Diabetic foot See notes 2,3,4,5,6 as Below	Mild infection	S aureus	Amoxicillin-clavulanic acid OR	875 mg PO q 12 hours	7-10 days
			Cephalexin OR	500 mg PO q 6 hours	7-10 days
			Clindamycin	300 mg PO q 8 hours	7-10 days
	Moderate infection	S aureus Streptococci Psuedomonas Enterobacteriacae	Ertapenem OR	1 gm IV q 24 hours	7-10 days
			Ciprofloxacin AND	500 mg PO q 12 hours	7-10 days
			Metronidazole OR	400 mg PO q 8 hours	7-10 days
			Clindamycin	300 mg PO q 8 hours	7-10 days
	Severe infection	S aureus Streptococci	Piperacillin-Tazobactum OR	4.5 gm IV q 6 hours	7-10days
			Ciprofloxacin OR	500 mg IV q 12 hours	7-10days

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		Psuedomonas Enterobacteriacae Anaerobes	Aztreonam AND	1 gm IV q 8 hours	7-10days
			Clindamycin	600 mg IV q 8 hours	7-10days
			Piperacillin-Tazobactum AND	4.5 gm IV q 6 hours	7-10days
			Vancomycin	1 gm q 12 hours	7-10days
Condition	**Situation/ Severity**	**Most likely organisms**	**Drug**	**Dose**	**Duration**
Necrotizing fasciitis See note 7 as below		S aureus Clostridia Anaerobes Streptococci	Piperacillin-Tazobactum AND	4.5 gm IV q 6 hours	Duration depends on the progress
			Clindamycin	600-900 mg IV q 8 hours	
			OR		
			Imipenem OR	1 gm IV q 8 hours	
			Meropenem AND	1 gm IV q 8 hours	
			Clindamycin OR	600-900 mg IV q 8 hours	
			Linezolid	600 mg IV BD	

Note:

a) Incision and drainage is preferred therapy in case of cutaneous abscess. Antibiotics are indicated if infection is severe, associated with extensive cellulitis, septic phlebitis, diabetes, advanced age, or no response to I & D.

b) Uninfected diabetic foot has no purulence or inflamamtaion (erythema, pain, tenderness, warmth, induration).

c) Mild diabetic foot infection: Presence of purulence and one sign of inflammation.

d) Moderate diabetic foot infection: Mild inflammation and >2 cm of cellulitis, lymphangitic streaking, deep tissue abscess, gangrene, involvement of muscle, tendon, joint, or bone.

e) Ulcer floor should be probed carefully. If bone can be touched with a metal probe, then the patient should be treated for osteomyelitis with antibiotics in addition to surgical debridement.

f) Duration of treatment depends on response. Usually 7-10 days after surgical debridement. Treatment is prolonged with osteomyelitis.

g) In necrotizing fasciitis, antibiotics are only an adjunct to surgical debridement.

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V. Genitourinary Infections

Condition	Most likely organisms	Drug	Dose	Duration
Pelvic Inflammatory Disease (PID), salpingitis, tubo-ovarian abscess Outpatient t/t: Patients with temp <38°C, WBC <11,000 per mm^3, minimal evidence of peritonitis, active bowel sounds & able to tolerate oral nourishment Initial inpatient evaluation/therapy suggested for patients with tubo-ovarian abscess. Drainage of tubo-ovarian abscess wherever	N. gonorrhoeae, Chlamydia, Bacteroides, Enterobacteriaceae, Streptococci Gardenella vaginalis S. aureus .	**Outpatient regimen option 1:** Doxycycline AND	100 mg PO BID	14 days
		Ceftriaxone CAN ADD	250 mg IM OR IV	Single dose
		Metronidazole	400 mg PO BID	14 days
		Outpatient regimen option 2:		
		Cefoxitin AND	2 gm IM	Single dose
		Probenecid AND	1 gm PO	Single dose
		Doxycycline AND	100 mg PO BID	14 days
		Metronidazole	400 mg PO BID	14 days
		Inpatient regimen: Ceftriaxone AND	250 mg IM single dose	For inpatient regimens, continue treatment until satisfactory response for ≥ 24-hr before
		Clindamycin CAN ADD	900 mg IV q 8 hours	

.indicated. Evaluate and treat sex partner.		Gentamicin	2 mg/kg loading dose	switching to outpatient regimen.
		Then switch to outpatient regimen	Then 1.5 mg/kg q 8 hours	

Condition	Most likely organisms	Drug	Dose	Duration
Vaginitis **Candidiasis** Pruritus, thick cheesy discharge, pH <4.5	Candida albicans 80–90%. C. glabrata, C. tropicalis may be increasing - they are less susceptible to azoles	**Oral azoles:** **Fluconazole**	150 mg PO	Single dose
		Intravaginal azoles: Clotrimazole OR	200 mg vaginal tabs at bedtime	3 days
			1% cream (5 gm) at bedtime	7-14 days
			100 mg vaginal tab	7 days
			500 mg vaginal tab	Single dose
		Miconazole	200 mg vaginal suppository at bedtime	3 days
			100 mg vaginal suppository q 24 hours	7 days
			2% cream (5 gm) at bedtime	7 days
Recurrent candidiasis **(4 or more episodes/ yr)**		Fluconazole	150 mg PO q week	6 months
		Clotrimazole	Vaginal suppositories 500 mg q week	6 months

Balanitis Occurs in 1/4 of male sex partners of women infected with candida.	Candida 40%, Group B Strep, gardnerella	Oral or topical **azoles** as for vaginitis		

Condition	Most likely organisms	Drug	Dose	Duration
Bacterial vaginosis Malodorous vaginal discharge, pH >4.5 • Reported 50% ↑ in cure rate if abstain from sex or use condoms • Treatment of male sex partner **not** indicated unless balanitis present.	Etiology unclear: Gardnerella vaginalis, Mobiluncus, Mycoplasma hominis, Prevotella sp., Atopobium vaginae etc.	Metronidazole OR	**Metro** 400 mg PO BID	7 days
			Metro vaginal gel 1 applicator intravaginally at bedtime	5 days
		Tinidazole OR	2 gm PO once daily	2 days
			1 gm PO once daily	5 days
		Clindamycin	300 mg PO bid	7 days
			2% vaginal cream 5 gm at bedtime	7 days
Vaginal Trichomoniasis Copious foamy discharge, pH >4.5 Treat male sexual partners: Metronidazole 2 gm as single dose	Trichomonas vaginalis	Metronidazole OR	2 gm PO single dose	
			400 mg PO BID	7days
		Tinidazole	2 gm PO single dose **For treatment failure: Metronidazole** 400 mg PO BID	7 days
			2nd failure: Metronidazole 2 gm PO q 24 hours	3-5 days

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Urethritis, cervicitis, proctitis (uncomplicated)	N. gonorrhoeae (50% of pts with urethritis, cervicitis have concomitant C. trachomatis). Empirical t/t to cover both pathogens	Ceftriaxone AND	250 mg IM	Single dose
		Azithromycin OR	1 gm PO	Single dose
		Doxycycline	100 mg PO q 12 hours	7 days

Condition	Most likely organisms	Drug	Dose	Duration
Epididymo-orchitis Age <35 years	N. gonorrhoeae, Chlamydia trachomatis	Ceftriaxone AND	250 mg IM	Single dose
		Azithromycin OR	1 gm PO	Single dose
		Doxycycline	100 mg PO bid	10 days
Age >35 years or homosexual men (insertive partners in anal intercourse)	Enterobacteriaceae (coliforms)	Levofloxacin OR	500-750 mg IV/PO once daily	10-14 days
		Ciprofloxacin	500 mg PO OR 400 mg IV twice daily	10-14 days
Acute Prostatitis ≤35 years of age	N. gonorrhoeae, C. trachomatis	Ceftriaxone AND	250 mg IM	Single dose
		Azithromycin OR	1 gm PO	Single dose
		Doxycycline	100 mg PO bid	10 days
≥35 years of age Note: Urine and prostatic massage culture samples to be taken prior to antibiotics. De-escalate after the availability of culture sensitivity reports.	Enterobacteriaceae (coliforms)	Levofloxacin OR	500-750 mg IV/PO once daily	10-14 days
		Ciprofloxacin OR	500 mg PO OR 400 mg IV twice daily x	10-14 days
		Sulfamethoxazole-Trimethoprim	1 double strength (160/800 mg) tablet PO BID	10-14 days

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Acute, uncomplicated cystitis/ urethritis in women	E. coli, other members of Enterobacteriaceae, Staphylococcus saprophyticus, Enterococci	Nitrofurantoin OR	100 mg PO BD	7 days

Condition	Most likely organisms	Drug	Dose	Duration
Young woman with typical symptoms, pyuria present, culture-negative	Chlamydia trachomatis	Azithromycin OR	1 gm PO	Single dose
		Doxycycline	100 mg PO q 12 hours	7 days
Acute pyelonephritis Note: Urine culture samples to be taken prior to initiation of antibiotic therapy and used to guide antibiotic regiment once the report is available. Monitor renal function	E. coli, other members of Enterobacteriaceae, Enterococci	Amikacin OR	1 gm OD IM/IV OR	14 days
		Gentamicin	7 mg/kg/day OD IM/IV	14 days
UTI in hospitalized patient on long-term urinary catheter	Enterobacteriaceae, Pseudomonas aeruginosa, Acinetobacter spp., Enterococci	Wait for C/S result. If patient is in sepsis, start		
		Colistin AND	2 million IU IV q 12 hours	
		Vancomycin	1 gm IV q 12 hours	
		until C/S results are available		
Chorioamnionitis	Group B Streptococcus, Gram negative bacilli, chlamydiae, ureaplasma and	Clindamycin OR Vancomycin Teicoplanin AND		

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	anaerobes, usually Polymicrobial	Cefoperazone-Sulbactum		
		If patient is not in sepsis then IV Ampicillin		

Condition	Most likely organisms	Drug	Dose	Duration
Septic abortion **Endomyometritis and Septic Pelvic Vein Phlebitis**	Bacteroides, Prevotella bivius, Group B, Group A Streptococcus, Enterobactereaceae, C. trachomatis, Clostridium perfringens.	If patient has not taken any prior antibiotic (start antibiotic after sending cultures)		
		Ampicillin AND	500 mg QID	
		Metronidazole	500 mg IV TDS	
		It patients has been partially treated with antibiotics, send blood cultures and start Piperacillin-Tazobactam OR Cefoperazone-sulbactum till the sensitivity report is available.		

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Obstetric Sepsis during Pregnancy	Group A beta-haemolytic Streptococcus, E. coli, anaerobes.	It patient is in shock and blood culture reports are pending, then start Piperacillin-Tazobactam OR Cefoperazone-sulbactam till the sensitivity report is available and modify as per the report.		

Condition	Most likely organisms	Drug	Dose	Duration
		If patient has only fever, with no features of severe sepsis start Amoxicillin-clavulanate OR	625 mg TDS PO/ 1.2 gm TDS IV	
		Ceftriaxone AND	2 gm IV OD	
		Metronidazole CAN ADD	500 mg IV TDS	
		Gentamicin	7 mg/kg/day OD	
		If admission needed. MRSA cover may be required if suspected or colonized (Vancomycin/ Teicoplanin)		

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Obstetric Sepsis following pregnancy Source of sepsis outside Genital tract Mastitis UTI Pneumonia Skin and soft tissue (IV site, surgical site, drain site etc.)	S. pyogenes, E. coli, S. aureus S. pneumoniae Meticillin-resistant S. aureus (MRSA), C. septicum & Morganella morganii.	Same as above		

VI. Infective Endocarditis				
Condition	**Most likely organisms**	**Drug**	**Dose**	**Duration**
Infective Endocarditis: Native valve(awaiting cultures) Indolent	Viridans Streptococci, other Streptococci Enterococci	Penicillin G OR	20 MU IV divided doses 4 hours	4-6 weeks
		Ampicillin AND Gentamicin	2 gm IV 4 hours 1 mg/kg IM or IV 8 hours	4-6 weeks
Infective Endocarditis: Navtive valve (awaiting cultures) In Severe Sepsis	S.aureus (MSSA or MRSA) Risk for gram-negative bacilli	Vancomycin AND	25-30 mg/kg loading followed by 15-20 mg/kg IV 12 hourly (maximum 1gm 12) hourly)	4-6 weeks
		Meropenem	1 gm IV 8 hours	4-6 weeks
Endocarditis(< 2 months); Prosthetic Valve	Staph Gram Negative Rods Diptheroids	Vancomycin AND	25-30 mg/kg loading followed by15-20 mg/kg IV 12 hourly(maximum 1 gm 12) hourly)	
		Meropenem OR	1 gm IV 8 hours	
		Imipenem	500 mg IV q 6 hours	

Endocarditis(> 2 months); Prosthetic Valve	CONS Enterococcus S.aureus	Vancomycin AND	25-30 mg/kg loading followed by 15-20 mg/kg IV 12 hourly (maximum 1 gm 12) hourly)	
		Gentamicin	1 mg/kg body weight IV 8 hourly, modified according to renal function	

VII. Gastrointestinal & Intra-Abdominal Infections

Condition	Most likely organisms	Drug	Dose	Duration
Acute Gastroenteritis Food poisoning	Viral, Entero-toxigenic & Entero-pathogenic E. Coli S. aureus, B. cereus, C. botulinum	None	None	None
Cholera	V. cholerae	Doxycycline OR	300 mg Oral	Single dose
		Azithromycin OR	1 gm Oral	3 days
		Ciprofloxacin	500 mg BD	3 days
Bacterial dysentery	Shigella sp., Campylobacter, Non-typhoidal Salmonellosis	Ceftriaxone OR	2 gm IV OD	5 days
		Cefixime OR	10-15 mg/kg/day	5 days
		Azithromycin (drug of choice for Campylobacter)	1 gm OD	3 days
Amoebic dysentery	E. histolytica	Metronidazole OR	400 mg Oral TDS	7-10 days
		Tinidazole	2 gm Oral OD	3 days

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Giardiasis	Giardia lamblia	Metronidazole OR	250-500 mg Oral TDS	7-10 days
		Tinidazole	2 gm Oral	Single dose
Hospital acquired diarrhea	C. difficile	Metronidazole OR	400 mg Oral TDS	10 days
		Vancomycin	250 mg Oral QDS	10 days
Enteric fever (Outpatients)	S. Typhi, S. Paratyphi A	Cefixime OR	20 mg/kg/day	14 days
		Azithromycin OR	500 mg BD	7 days

Condition	Most likely organisms	Drug	Dose	Duration
Enteric fever (Inpatients)	S. Thyphi, S. Paratyphi A	Ceftriaxone (Ceftriaxone to be changed to oral cefixime when patient is afebrile to finish total duration of 14 days) OR	2 gm IV BD	2 weeks
		Azithromycin	500 mg BD	7 days
Biliary tract infections (cholangitis, cholecystitis)	Enterobacteriaceae (E.coli, Klebsiella sp.)	Amikacin OR	1 gm IM/IV OD	7-10 days
		Piperacillin-Tazobactam	4.5 gm IV 8 hourly	7-10 days
Biliary tract infections (cholangitis, cholecystitis) (For serious patients and documented ESBL producers)	Enterobacteriaceae (E.coli, Klebsiella sp.)	Imipenem OR	500 mg IV 6 hourly	7-10 days
		Meropenem	1 gm IV 8 hourly	7-10 days
Spontaneous Bacterial Peritonitis	Enterobacteriaceae (E.coli, Klebsiella sp.)	Amikacin OR	1 gm IM/IV OD	Duration of treatment is based on source control and clinical improvement
		Piperacillin-Tazobactam	4.5 gm IV 8 hourly	
Spontaneous Bacterial Peritonitis (For serious patients and documented ESBL producers)	Enterobacteriaceae (E.coli, Klebsiella sp.)	Imipenem OR	500 mg IV 6 hourly	
		Meropenem	1 gm IV 8 hourly	
Secondary Peritonitis, Intra-	Enterobacteriaceae	Amikacin OR	1 gm IM/IV OD	Duration of treatment

abdominal abscess/ GI perforation	(E.coli, Klebsiella sp.), Bacteroides (colonic perforation), Anaerobes	Piperacillin-Tazobactam OR	4.5 gm IV 8 hourly	is based on source control and clinical improvement
		Imipenem OR	500 mg IV 6 hourly	
		Meropenem	1 gm IV 8 hourly	
		In very sick patients, if required, addition of cover for yeast (fluconazole IV 800 mg loading dose day 1, followed by 400 mg 2nd day onwards) & and for Enterococcus (vancomycin OR teicoplanin) may be contemplated		

Condition	Most likely organisms	Drug	Dose	Duration
Pancreatitis Mild- moderate		No antibiotics		
Post necrotizing pancreatitis: infected pseudocyst; pancreatic abscess	Entrobacteriaceae, Enterococci, S. aureus, S. epidermidis, anaerobes, Candida sp.	Amikacin OR	1 gm IM/IV OD	
		Piperacillin-Tazobactam OR	4.5 gm IV 8 hourly	Duration of treatment is based on source control and clinical improvement
		Imipenem OR	500 mg IV 6 hourly	
		Meropenem	1 gm IV 8 hourly	
		In very sick patients, if required, addition of cover for yeast (fluconazole IV 800 mg loading dose day 1, followed by 400 mg 2nd day onwards) & and for Enterococcus (vancomycin /teicoplanin) may be contemplated		
Diverticulitis- Mild (OPD treatment)	Gram negative rods, Anaerobes	Amoxicillin-Clavulanate acid	625 mg TDS	7 days
Diverticulitis- Moderate	Gram negative rods, Anaerobes	Metronidazole OR	500 mg IV TDS	Duration of treatment is based on source control and clinical improvement
		Piperacillin-Tazobactam AND	4.5 gm IV 8 hourly	
		Amikacin	1 gm IM/IV OD	
Diverticulitis- Severe	Gram negative rods, Anaerobes	Imipenem OR	500 mg IV 6 hourly	Duration of treatment is based on source control and clinical improvement
		Meropenem	1 gm IV 8 hourly	
Liver Abscess	Polymicrobial	Metronidazole OR	500 mg IV TDS / 800 mg Orally TDS	2 weeks. USG-guided drainage

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		Piperacillin-Tazobactam AND Use the "Insert Citation" button to add citations to this document.	4.5 gm IV 8 hourly	indicated in large abscesses, signs of imminent rupture and no response to medical treatment.
		Amikacin	1 gm IM/IV OD	

VIII. Ophthalmic Infections				
Eye lid infections	**Likely organisms**	**First line/ Suggested Regimen**	**Alternate regimen**	**Remarks**
External Hordeolum (Stye)	*S. aureus*	Hot pack Topical and oral antibiotic e/d and e/o in some cases incision and drainage of the stye.	Amoxicillin 500 mg PO QDS x 5 days Or Ampiclox (250 mg each) PO TDS x 5 days	if associated conjunctivitis Gatiflox 0.3% / Moxifloxacin 0.5% e/d QDS x 1 week
Internal Hordeolum				
Blephritis	MSSA/ *S. epidermidis*	Oral Cloxacillin 250-500mg QID or Oral Cephalexin 500mg QID	Lid margin care with baby shampoo & warm compresses 24hourly. Artificial tears if associated with dry eye.	
	MRSA	Oral Trimethoprim Sulphamethoxazole 960 mgBD or Linezolid 600mg BD		
Conjunctival infections				

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Viral conjunctivitis (pinkeye)		No antibiotics required treat for symptoms		Highly contagious. If pain & photophobia suggestive of keratitis.
Bacterial conjunctivitis	*S.aureus, S.pneumoniae, H.influenzae*	Ophthalmologic solution: Gatifloxacin 0.3%, Levofloxacin 0.5%, Moxifloxacin 0.5% 1-2 drops q2h while awake during 1st2days, then q4-8h up to 7days		Uncommon causes- Chlamydia trachomatis N. gonorrhoeae
Corneal infections				
Herpes Simplex keratitis	H. simplex type 1& 2	Trifluridine ophthalmic soln 1drop 2hourly, upto 9times/day until re-epithilised. Then 1 drop 4hourly upto 5times/ day for total duration of 21days	Ganciclovir 0.15% ophthalmic gel for acute herpitic keratitis.	Flurescine staining shows topical dendritic figures. 30-50% recur within 2yr.
	Varicella–zostervirus	Famciclovir 500mg BD Or TID OR Valacyclovir 1gm oral TID x10 days	Acyclovir800mg5times/dx10days	.

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Varicella Zoster ophthalmicus	*S.aureus, S.pneumoniae, S.pyogenes, Haemophilus spp*	Moxifloxacin topical (0.5%): 1drop 1hourly for first 48hr, then reduce as per response Tobramycin or Gentamicin 14mg/ml+ Piperacilin or Ticarcillin eye drops (6-12mg/mL) q15-60 min around	Gatifloxacin 0.3% ophthalmic Solution 1drop 1hourly for 1st 48hrs then reduceas per response Ciprofloxacin ophthalmic 0.3% or Levofloxacin Ophthalmic 0.5%	Moxifloxacin. Preferable. Treatment may fail against MRSA.
Acute bacterial keratitis (No comorbidities)				
Acute Bacterial (Contact lens users)	*P. aeruginosa*			

Fungal keratitis	Aspergillus, Fusarium, Candida and others	Natamycin (5%)1drop1-2 hourlyforseveraldays,then3-4hourlyforseveraldays dependingonresponse	Amphotericin B (0.15%) 1drop q1-2 hourly for several days depending on the response	Empirical therapy is not recommended.
Protozoan	Acanthamoeba spp.	Optimal regimen uncertain Suggested– (Chlorhexidine	-	Uncommon. & soft contact

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(soft contact lens users)		0.02% or Polyhexamethylene biguanide 0.02%)+ (Propamidineisethionate 0.1% or Hexamidine 0.1%) eye drops 1 drop every 1 hourly during daytime, Taper according to clinical Response		Lenses are risk factors
Orbital infections				
Orbital cellulitis	*S.pneumoniae, H.influenzae,* *M.catarrhalis, S.aureus,* Anaerobes, GroupA Streptococcus, Occasionally Gram Negative bacilli post trauma.	Cloxacillin 2gm IV q4h+ Ceftriaxone 2gm IV q24 hourly+ Metronidazole 1gm IV 12h	If Pencillin /Cephalosporin allergy: Vancomycin 1gm iv q12h+ levofloxacin 750mg IV once daily+ Metronidazole iv 1gm 24h	If MRSA is suspected substitute Cloxacillin with Vancomycin
Endophthalmits	*S.epidermidis* *S.aureus,* Streptococci,	Immediate ophthalmological	Adjuvant systemic antibiotics	.

Bacterial Post-ocularsurgery	enterococci, Gram-bacilli	consultation. Immediate vitrectomy+ Intravitreal antibiotics (Inj Vancomycin+ Inj ceftazidime)	(doubtful value in post cataract surgery endophthalmitis) Inj Vancomycin+ Inj Meropenem	
Hematogenous	*S.pneumoniae,* *S.aureus,* GroupB streptococcus, *K. pneumoniae* *N meningitidis*	Intra vitreal antibiotics Inj Vancomycin+ Inj Ceftazidime + Systemic antibiotics Inj Meropenem 1gm iv q8h/Inj Ceftriaxone 2gm iv q24h+ Inj Vancomycin 1g iv q12h		

Endophthalmitis Mycotic (Fungal)	Candida sp, Aspergillus sp.	Intavitreal amphotericinB 0.005-0.01mg in 0.1 ml Systemic therapy: AmphotericinB 0.7-1mg/kg+ Flucytosine 25mg/kg qid	Liposomal AmphotericinB 3-5mg/kg Or Voriconazole	Duration of treatment 4-6 week sor longer depending upon clinical response.

				Patients with chorioretinitis and ocular involvement other than endophthalmitis often respond to systemically administered

IX. Bones and Joint Infections

Condition	Likely causative Organisms	Empiric antibiotics	Alternative antibiotics	Comments
Acute osteomyelitis OR Septic arthritis	*S.aureus, Streptococcus pyogenes* Enterobacteriaceae	Ceftriaxone2gIVOD FollowedbyOraltherapybyCloxacillin500mgq8h Or Cephalexin500mgq6h	Piperacillin-tazobactam4.5gmIVq6horCefoperazone-sulbactam3gmIVq12h AND Clindamycin600-900mgIVTDS	Treat based on culture of blood/ synovialfluid/ bone biopsy Orthopedic Consultation is essential for surgical debridement Duration: 4-6 weeks (From initiation or last major debridement)
Chronic Osteomyelitis OR Chronic synovitis		No empiric therapy		Definitive treatment guided by bone/ synovial biopsy culture **Treat for 6 weeks minimum** Investigate for TB, Nocardia, fungi Extensive surgical debridement. Total duration of treatment depends on the joint and the organism. Choose antibiotic based on sensitivity.
Prosthetic	Coagulase negative	Ceftriaxone 2g IV OD.		4 weeks

joint infection	staphylococci, *Staphylococcus aureus*, Streptococci Gram-negative bacilli, *Enterococcus,* Anaerobes	Add Vancomycin 1gm IV BD or Teicoplanin 800mg x3 doses followed by 400mg Once daily		

X. Ear Nose & Throat Infections

Ear infection	Likely Etiology/	Suggested Regimen	Alternate	Remarks
Malignant otitis externa	*P. aeruginosa* (in >90% cases)	Piperacilin+Tazobactam 4.5gm IV 6h Or Imipenem/Meropenem Ciprofloxacin	Ceftazidime	Debridementusuallyrequired.Ruleoutosteomyelitis;DoCTorMRI,Ifbone involved,treatfor4-6 wks.
Acute otitis media	S.*pneumoniae* *H.influenzae* *Morexella catarrahalis*	Amoxicillin+clavulanate 90/6.4mg/kg/ daybidor cefpodoxim/ cefuroxime Axetil 250mg BD	Ceftriaxone 50mg/kg I/M for 3days	Treat children <2years If >2 years, a febrile and No ear pain-consider analgesics and defer antibiotics Duration of treatment If age<2 years:10days If age>2years:5-7 days
Mastoiditis				
Acute	S.*pneumoniae* *S.aureus* *H.influenzae* *P.aeruginosa*	Cefotaxime 1-2gm iv 4-8 Hourly Ceftriaxone 2gm iv OD		Modify as per culture Unusual causes- Nocardia, TB, Actinomyces.
Chronic	Polymicrobial	Piperacillin-tazobactam 4.5g IV8h Meropenem 1gm iv 8h		

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Acute Pharyngitis/ tonsillitis				
Exudative/ Diffuse Erythema	Mostlyviral GroupA, C,GStrept ococcus,Infecti ousmononucle osis,	Penicillin Voralx 10days or Be nzathine Penicillin 1.2 MUIM x 1dose or Cefdinirorcefpodoxime x 5days		Penicillinallergic,Clindamyci n 300-450 mg orally 6-8 hourly x 5days. Azithromycin clarithromycin are alternatives.

Membranous pharyngitis	*C.diptheriae*,	Erythromycin500mgIVQI DorPenicillinG50,000units /kgIV12hourly. Diptheriaantitoxin:Horses erum. <48hrs:20,000-40,000units,Nasopharyngeal membranes:40,000-60,000units >3days&bull neck:80,000-1,20,000units		
Epiglotitis (Supraglotis)	Children: *H.influenzae, S.pyogenes, S.pneumoniae ,S.aureus*.	Cefotaxime 50mg/kg IV 8hourly or ceftriaxone 50mg/kg IV 24 hourly	Levofloxacin 10mg/kg IV 24hourly+ clindamycin 7.5mg/kg IV 6hourly.	

Laryngitis (hoarseness)	Viral (90%)	No antibiotic indicated		

XI. Surgical Antimicrobial Prophylaxis

- To be administered within 1hr before the surgical incision.
- Single dose is recommended. Consider for second intra-operative dose in prolong surgery based on the choice of antibiotic used for prophylaxis.
- Prophylaxis should **not** be given beyond surgery duration (except for cardiothoracic surgery, upto 48 hours permissible)

SURGERY	**MEDICATION**
Breast	Inj.Cefazolin 2gm or Inj. Cefuroxime 1.5gm IV stat
Gastroduodenal & biliary	Inj. Cefaperazone-Sulbactam 2gm IV stat & BD for 24hrs (maximum)
ERCP	Inj. Piperacillin-Tazobactum 4.5 gm or Inj. Cefaperazone-Sulbactam 2 gm IV stat
Cardiothoracic	Inj. Cefuroxime 1.5gm IV stat & BD for 48 hrs
Colonic surgery	Inj. Cefaperazone-Sulbactam 2gm IV stat & BD for 24hrs (maximum)
Abdomina lsurgery(hernia)	Inj. Cefazolin2gmorInj.Cefuroxime 1.5gmIV stat
Head & Neck/ENT	Inj. Cefazolin2gmIVstat
Neurosurgery	Inj. Cefazolin 2gm or Inj.Cefuroxime 1.5gm IV stat
Obstetrics & Gynecology	Inj. Cefuroxime 1.5gm IV stat

Orthopaedic	Inj. Cefuroxime 1.5gm IV stat & BD for 24hrs (maximum) or Inj. Cefazolin 2gmIV stat Open reduction of closed fracture with internal fixation-Inj. Cefuroxime 1.5 gm IV stat and q12 h or Inj. Cefazolin 2gm IV stat and q12 h for 24hrs
Trauma	Inj. Cefuroxime 1.5gm IV stat and q 12h (for 24hrs) or Inj. Ceftriaxone 2gm IV OD
Urologic procedures	Antibiotics only to patients with documented bacteriuria
Trans-rectal prostatic surgery	Inj. Cefaperazone-Sulbactam 2 gm IV stat

XII. Pediatric Infections

Diseases /Conditions	1st line Antibiotics (Who did not received antibiotic for the present condition)	1st line antibiotics (Received oral antibiotics for < 5 days)	2nd line Antibiotics (Received multiple or prolonged antibiotics)
Central Nervous System Infection			
Acute Bacterial Meningitis	Ceftriaxone ± Vancomycin (in Shock)	Ceftriaxone ± Vancomycin (in Shock)	Meropenem/Cefepim e + Vancomycin/ Teicoplanin
Brain abscess	Ceftriaxone + Vancomycin + Metronidazole	Ceftriaxone + Vancomycin + Metronidazole	Cefepime or Meropenem + Vancomycin
Shunt infection	Ceftriaxone + Vancomycin	Ceftriaxone + Vancomycin	Cefepime or Meropenem + Vancomycin
Acute encephalitis syndrome	Ceftriaxone ± Vancomycin + Acyclovir	Ceftriaxone ± Vancomycin + Acyclovir	Meropenem/Cefepim e + Vancomycin/ Teicoplanin (add Azithromycin if atypical organisms suspected)
Respiratory Tract Infections			
Community acquired pneumonia Evidence of staph infection (± Shock)	Ceftriaxone + Amoxicillin-clavulanate	Ceftriaxone+ Amoxicillin-clavulanate	Piperacillin- tazobactam + Vancomycin

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	Ceftriaxone + Vancomycin	Ceftriaxone + Vancomycin	
Atypical Pneumonia	Azithromycin	Azithromycin	Fluoroquinolones
Empyema	Amoxicillin-clavulanate	Amoxicillin-clavulanate (if already received in IV dose) then start Vancomycin + Ceftriaxone	Vancomycin + Cefoperazone- sulbactam
Cystic Fibrosis (CF)-pulmonary exacerbation	Cefoperazone-sulbactam/ Piperacillin-tazobactam+ Amikacin	Cefoperazone-sulbactam/ Piperacillin-tazobactam + Amikacin	Meropenem OR Ofloxacin OR Colistin + Vancomycin OR Linezolid
Suppurative lung disease	Cefoperazone-sulbactam+ Amikacin	Cefoperazone-sulbactam+ Amikacin	Piperacillin- tazobactam + Vancomycin
Immunodeficiency condition + LRTI	Cefoperazone-sulbactam+ Amikacin	Cefoperazone-sulbactam+ Amikacin	Piperacillin-tazobactam + Vancomycin
Infection related to Kidney and Urinary Tract			
Nephrotic syndrome with peritonitis	Ceftriaxone ± Vancomycin (in Shock)	Ceftriaxone ± Vancomycin (in Shock)	Teicoplanin + Piperacillin-tazobactam

Nephrotic syndrome with cellulitis	Amoxicillin-clavulanic acid OR Cloxacillin + Cefotaxime	Amoxicillin-clavulanic acid OR Cloxacillin + Cefotaxime	Teicoplanin + Piperacillin-tazobactam
Nephrotic syndrome with pneumonia	Ceftriaxone ± Vancomycin (in Shock)	Ceftriaxone ± Vancomycin (in Shock)	Teicoplanin + Piperacillin-tazobactam
Haemodialysis with suspected catheter related bloodstream infection	Ceftazidime + Vancomycin	Ceftazidime + Vancomycin	Remove line (place another after 48 hr; preferred) Piperacillin- tazobactam + Vancomycin
UTI (complicated)	Ceftriaxone	Ceftriaxone	Culture and sensitivity guided
Infection of Bone and Joints			
Acute Bacterial Osteomyelitis (Empirical) MSSA MRSA	Ceftriaxone + Vancomycin Cefazolin/Cloxacillin/Nafcill in Vancomycin or Clindamycin(If no Bacteremia and child is no severely ill)		Ceftazidime/Piperaci llin-tazobactam + Vancomycin

Septic Arthritis (Empirical) MSSA MRSA	Ceftriaxone + Vancomycin Cefazolin/Cloxacillin/Nafcill in Vancomycin or Clindamycin		Ceftazidime/Piperaci llin-tazobactam + Vancomycin
Infections of Skin and Soft Tissues			
Cellulitis	Oral Amoxicillin-Clavulanate/Cephalosporin/Clindamycin	Ceftriaxone/Cefazolin/Amoxicillin-Clavulanate /Clindamycin (IV)	Vancomycin + Piperacillin – tazobactam
Infection of Gastrointestinal System			
Liver abscess	Cefazolin + Ceftriaxone	Vancomycin + Ceftriaxone	Teicoplanin + Meropenem
Acute Cholangitis	Piperacillin – tazobactam	Piperacillin – tazobactam	Meropenem
Infected pancreatic collection	Piperacillin – tazobactam	Piperacillin – tazobactam	Meropenem
Infection in Pediatric Intensive Care Unit (PICU)			
Sepsis without focus (community acquired)	Ceftriaxone	Ceftriaxone	Piperacillin- tazobactam + Vancomycin
Nosocomial Sepsis (Without focus)	Piperacillin-tazobactam + vancomycin	NA	Colistin + Vancomycin
Septic shock	Ceftriaxone + Vancomycin	Piperacillin-tazobactam + Vancomycin	Piperacillin- tazobactam /Cefoperazone- sulbactam +Vancomycin

Ventilator Associated Pneumonia	Piperacillin-tazobactam + Vancomycin	NA	Colistin ±/ Vancomycin

Suspected fungal pneumonia			Add fluconazole or amphotericin B
DKA with suspected sepsis	Ceftriaxone	Ceftriaxone	Piperacillin- Tazobactam+ Vancomycin
Meningococcal sepsis	Ceftriaxone	Ceftriaxone	Piperacillin- Tazobactam+ Vancomycin
Central line associated Blood stream Infection	Vancomycin	Meropenem	Colistin±vancomycin
Infection in Immunocompromised Children			
Febrile Neutropenia (No focus)	Cefoperazone-sulbactam/ Piperacillin-tazobactam + Amikacin	NA	Add/increase gram positive cover (Vancomycin/Linezolid)
FN-Pneumonia	Amoxicillin-clavulanate + Amikacin	Cefoperazone-sulbactam + Amikacin ± Vancomycin/Linezolid	Meropenem + Vancomycin/Linezolid Add antifungals if fever persists > 5-7 days

FB-GIT	Cefoperazone-sulbactam + Ofloxacin/ Metronidazole	Add gram positive cover (Vancomycin/Linezolid)	Meropenem + Vancomycin/Linezolid Add antifungals if fever persists > 5-7 days
Febrile neutropenia with shock	Cefoperazone-sulbactam/ Piperacillin-tazobactam+ Vancomycin	NA	Meropenem + Vancomycin Add Amphotericin B (if fever persists >5-7 days)
FN-meningitis	Ceftriaxone + Vancomycin	NA	Meropenem + Vancomycin
Sepsis	Piperacillin-tazobactam + vancomycin Add Amphotericin- B in case of strong suspicion of fungal infection.	Piperacillin-tazobactam + vancomycin Add Amphotericin-B in case of strong suspicion of fungal infection	Colistin + Vancomycin Add Amphotericin-B
PCP Pneumonitis	Cotrimoxazole	Cotrimoxazole	
Infection in Neonatal Intensive Care Unit (NICU)			
Early-onset sepsis	Ciprofloxacin + Amikacin	NA	Piperacillin- tazobactam + Amikacin
Late-onset sepsis	Ciprofloxacin + Amikacin	NA	Piperacillin- tazobactam + Amikacin

Meningitis	Piperacillin-tazobactam+ Amikacin	NA	Meropenem + Amikacin
Sepsis	Cefotaxime + Amikacin	NA	Piperacillin-
(Community Acquired)			tazobactam + Amikacin
Osteomyelitis	Cefotaxime + Cloxacillin In MRSA replace Cloxacillin with Vancomycin		
Septic Arthritis	Cefotaxime + Cloxacillin In MRSA replace Cloxacillin with Vancomycin		

XIII. Fungal Infections

Routine antifungal prophylactic therapy in critically ill patients is NOT recommended. Fungal therapy is usually started based on positive cultures or systemic evidence of fungal infection. It is advised to take paired cultures if fungal infection is suspected. Evidence includes persistent sepsis / SIRS despite broad spectrum antibiotic (exclude sepsis, abscess, drug fever, DVT etc). Treat according to identification and antifungal sensitivity of Candida isolate.

Fluconazole IV/oral 800 mg OD first day (12mg/kg) and then 400 mg OD (6mg/kg from second day) if fluconazole naïve or sensitive

Or

2nd line Liposomal Amphotericin B (for Candida krusei and C.glabrata as inherently resistant to Fluconazole.) or Caspofungin (As Caspofungin is inherently inactive against Zygomycetes, Cryptococcus, Fusarium and TrichosporonSpp) Liposomal Amphotericin B IV 3mg/kg OD or Caspofungin dose: IV 70mg on Day 1 (loading), 50mg OD (<80kg) or 70mg OD (if >80kg) thereafter.Moderate to severe hepatic dysfunction: reduce the subsequent daily dose to 35mg OD. Check for drug interactions. To be decided by Microbiologist/ID physician based on patient's hepatic / renal functions/Severity of infection /drug interactions e.g. rifampicin, carbamazepine, phenytoin, efavirenz, nevirapine, cyclosporin, dexamethasone, tacrolimus etc.

Post-Cardiovascular Surgery Infections

Surveillance regarding the Infections following CTVS should be done in each institute

1. Antibiotic Prophylaxis to be guided by the institutional prevalence of MRSA infection and in patients at increased risk for MRSA colonization
2. Nasal screening before CTV surgery is recommended to rule out MRSA colonization

S.no.	Surgery	Antibiotic Prophylaxis			Comments
		1st line	2nd line	Special Antibiotic/Combination	
1.	CABG	Cefazolin	Cefuroxime	-	Vancomycin /Teicoplanin to be used in case of high prevalence of MRSA infections only Using only Vancomycin/Teicoplanin is NOT recommended due to lack of coverage of GNB Vancomycin infusion to be given over 1 hour & to be started 2 hrs before the surgical incision Teicoplanin dosing to start with 800 mg x 3 doses and then 6 mg/kg to complete prophylxis

					Duration of Prophylaxis: Continued till 48 hours after the surgery

Empirical Treatment after appropriate specimen for stain & cultures have been collected

S.no.	Infection/ Syndrome	Likely Causative agents	Antibiotics			Comments
			1st line	2nd line	Special Antibiotic/ Combination	
1	Sternotomy site infection	Not known	BL-BLI (Piperacillin-tazobactam, Cefoperazone-sulbactam, cefipime-	Daptomycin/ Linezolid with carbapenem	Consider de-escalation to TMP/SMX , doxy/minocycline, cloxacillin, cefazolin, If	1) Removal of the foreign body (steel wires) should be

			tazobactam) with or without amikacin. With Vancomycin/ teicoplanin		these are sensitive	considered
2	Infection of vascular catheters	Not known	BL-BLI (Piperacillin-tazobactam, Cefoperazone-sulbactam, cefipime-tazobactam) with or without amikacin with Vancomycin/ teicoplanin	Carbapenem (Empirical anti-MRSA drug if the incidence of MRSA CRBSI is high)		Consider de-escalation as per the isolate, susceptibility, MICs, adverse effects, drug allergy
3	Pneumonia	Not known	BL-BLI (Piperacillin-tazobactam, Cefoperazone-sulbactam) with or without amikacin	Carbapenem		Consider de-escalation as per the isolate, susceptibility, MICs, adverse effects, drug allergy
4	Mediastinitis	Not known	BL-BLI (Piperacillin-tazobactam,	Carbapenem with or without		Consider de-escalation as per the isolate,

			Cefoperazone-sulbactam) with or without amikacin With Vancomycin/ teicoplanin	Amikacin		susceptibility, MICs, adverse effects, drug allergy
5	Urinary tract infection	Not known	BL-BLI (Piperacillin-tazobactam, Cefoperazone-sulbactam with or without amikacin	Carbapenem with or without Amikacin		Consider de-escalation as per the isolate, susceptibility, MICs, adverse effects, drug allergy

Definitive Treatment after appropriate specimen for stain & cultures have been collected

S.No.	Infection/ Syndrome	Likely Causative agents	Antibiotics			Comments
			1st line	2nd line	Special Antibiotic/ Combination	

1	Sternotomy site infection	Coagulase Negative Staphylococci	Vancomycin, Teicoplanin	Daptomycin Linezolid	Consider de-escalation to Cotrimoxazole or Cloxacillin or Cefazolin Consider de-escalation to TMP/SMX or doxy/minocycline	1) Consider MICs, risk of nephrotoxicity, bone penetration for choosing the antibiotic 2) Removal of the foreign body (steel wires) should be considered 3) Longer duration of duration – 6- 12 months may be required
		MRSA	Vancomycin, Teicoplanin,	Daptomycin Linezolid	If these are sensitive Consider de-escalation to Ampicillin/ Ampi-sulbactam	
		Enterococcus	Vancomycin, Teicoplanin,		Consider de-escalation to oral agent if possible after 2-6 weeks of antibiotic therapy	
		GNB (Enterobacteri--acae, Pseudomonas, Acinetobacter)	BL-BLI (Piperacillin-tazobactam, Cefoperazone-sulbactam, with or without amikacin	Carbapenem (Meropenem, Imipenem)		
		Candida	L-AmB/AmB-d for 3 weeks followed by		De-escalation to Fluconazole 800 mg loading followed by 200 mg BD	For Candida osteomyelitis, longer duration of treatment (12 months) is recommended

			Fluconazole (If susceptible)			

Febrile Neutropenia

Febrile Neutropenia-definition

- Neutropenia-ANC<500/$mm^3$and expected to fall below 500/mm^3 in 48hrs
- Fever-single oral temperature of 38.3^oC(101^0F) on one occasion or 38^oC (100.4^0F) on atleast 2 occasions (1 hour apart)
- Neutropenic patients may not have usual signs of infection. Redness, tenderness and fever may be the only signs.

Protocol:

- Critical examination of areas usually harboring infections, including but not limited to, oral cavity, axillary region, scalp, groin, perineal region.
- Send blood Cultures 2 sets (each bottle 10ml x 4 bottles)
- Other relevant investigations: urea, creatinine, ALT, urine culture, Chest Xray, separate culture from central line, etc.

Patient-Haemodynamically stable

- Blood culture 2 sets
- Start IV Ceftazidime 1gm IV 8 hourly
- **Piperacillin-Tazobactam/Carbapenem/Cefoperazone-sulbactam in *hemodynamically stable* FN patients too (document mentions only Ceftazidime)**
- No need to add glycopeptides in the initial regimen (except in specific situations, given below)

Patient-Haemodynamically unstable

- Start BL-BLI agent (Cefoperazone-Sulbactam 1.2gm IV 8 hourly/ piperacillin- tazobactam 4.5gm IV 8 hourly) OR Carbapenem (meropenem 1gm IV 8 hourly/imipenem 500mg IV 6 hourly/doripenem 500mg IV 6 hourly)
- No need to add glycopeptides in the initial regimen (except in specific situations, givenbelow)

Reassess after 48 hours:

If blood cultures are negative, haemodynamically stable but still febrile

- Reculture blood
- Add amikacin 500mg IV BD for 3days
- Add colistin (instead of amikacin) if indicated (see below)

If blood cultures are negative, haemodynamically unstable but still febrile

- Inj Colistin (+/-Carbapenem) + glycopeptides + Echinocandin/ L-AmphoB

Blood culture growing Gram negative bacilli

- Patient afebrile- continue the empirical antibiotic till antibiotic sensitivity is available.
- Rationalise as per susceptibility profiles

When to add glycopeptides?

1. Haemodynamic instability,or other evidence of severe sepsis, septic shock or pneumonia
2. Colonisation with MRSA or penicillin-resistant *S. pneumonia*
3. Suspicion of serious catheter-related infection *e.g. chills or rigours within fusion through catheter and cellulitis around the catheter exit site*
4. Skin or soft-tissue infection at any site
5. Positive blood culture for gram-positive bacteria, before final identification and susceptibility testing is available
6. Severe mucositis

When to add empirical colistin in febrile neutropenic patients?

1. Heamodynamic instability.
2. Colonisation with carbapenem resistant gram-negative bacteria.
3. Previous infection with carbapenem resistant gram-negative bacteria.

4. GNB in blood, sensitivity pending, persistent fever with haemodynamic instability.

Empirical Antifungal Therapy

- No response to broad spectrum antibiotics (3-5days)- add L-AmphoB/echinocandin
- When a patient is located at a remote area and may not have access to emergency healthcare services, febrile neutropenia can be life threatening. Under such circumstances, availability of broad-spectrum oral antibiotics with the patient can help them gain time to reach emergency healthcare service.

Useful tips

- Febrile after 72hrs- CT chest and consider empirical antifungal.
- If fever persists on empirical antibiotics, send two sets blood cultures/day for 2 days
- Send further cultures if clinical deterioration
- Unexplained persistent fever in otherwise stable patient doesn't require change in empirical antibiotic regimen.

Continue the regimen till ANC is >500cells/mm^3

- If glycopeptides started as a part of empirical regimen, STOP after 48hrs, if no evidenc of Gram positive infection
- Antibiotic treatment should be given for atleast seven days with an apparently effective antibiotic, with atleast four days without fever.
- Once Neutrophil count has recovered, with no culture positivity and heamodynamically stable; antibiotics can be stopped and patient observed, even if remains febrile. Evaluate for fungal infection, ifatrisk.

Antibiotic Prophylaxis

Though quinolone prophylaxis is recommended by International guidleines, it is not useful in Indian scenario due to high resistance.

Antiviral prophylaxis

- For HSV IgG positive patients undergoing allo-HSCT or leukemia induction needs acyclovir prophylaxis
- All patients being treated for cancer need to receive annual influenza vaccination with an inactivated vaccine.
- Neutropenic patients presenting with influenza like illness should receive empirical treatment with neuraminidase inhibitor.

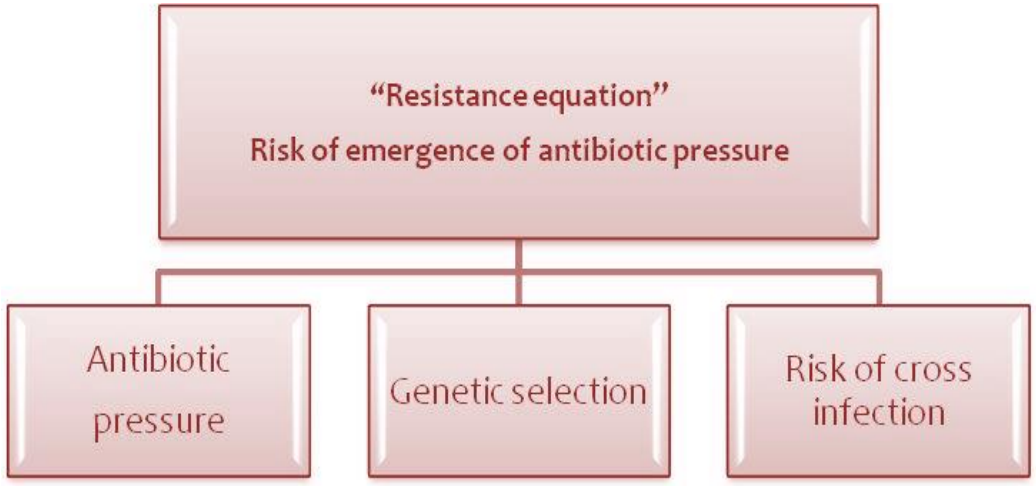
Antifungal prophylaxis

b) Induction chemotherapy of Acute Leukemia: Posoconazole
c) Post allo BMT
Pre engraftment:
Voriconazole/ echinocandin Post engraftment:
Posoconazole

XIV. Antimicrobial policy

1. Introduction

Antimicrobial resistance (AMR) is a global threat today and has overshadowed the potential gain in reducing deaths due to infections. It is estimated that by the year 2050, Asia will have 4.7 million deaths that could be directly attributed to AMR. Antimicrobial resistance is rampant in India with up to 12-59 % of E. coli being extended beta lactamase (ESBL) producers and up to 30% being carbapenemase producers (CP). Klebsiella pneumoniae has emerged over the last few years as a highly resistant pathogen with up to 50% resistance to carbapenems and rapidly increasing resistance to polymyxins. In addition, methicillin resistance in Staphylococcus aureus is seen in up to 30% of S. aureus isolates nationally. It is well documented that antibiotic abuse is one of the major drivers of antibiotic resistance and thus optimising usage of antibiotics is the need of the hour. India is the



largest consumer of antibiotics in the world i.e., 13 billion standard units in 2010 and from 2000 to 2010 the per capita consumption increased by 66%.

In May 2015, the World Health Assembly adopted a resolution to endorse a global action plan on antimicrobial resistance.

The plan set out five objectives:

1. To improve awareness and understanding of antimicrobial resistance;
2. To strengthen surveillance and research;
3. To reduce the incidence of infection;
4. To optimise the use of antimicrobials;
5. To ensure sustainable investment in countering antimicrobial resistance.

The strategic objectives of the Indian National Action Plan –Antimicrobial resistance (NAP-AMR) are aligned to the Sustained Developmental goals (SDGs) and the Global action plan on antimicrobial resistance adopted by the World Health Assembly in 2015. The main objectives put forth by the World Health Assembly were adopted and in addition, a 6th priority was identified – strengthening India's leadership on AMR.

1.	Causal associations between antimicrobial use and emergence of antimicrobial resistance
a.	Changes in antimicrobial use are paralleled by the prevalence of resistance
b.	Antimicrobial resistance: more prevalent in HA infection than CA infection
c.	Health care–associated infections are more likely to be caused by resistant strains especially in those who

	have received prior antimicrobials
d.	Hospitals that have the highest rates of antimicrobial resistance also have the highest rates of antimicrobial use
e.	Patient exposed to longer duration of antimicrobials have an increased risk of colonization with resistant organisms

2.	Mortality rate correlates with the presence of multi drug resistant organisms
a.	Association between development of antimicrobial resistance in Staphylococus aureus, Enterococci, gram negative bacilli and mortality
b.	Enterococcal infections have been associated with mortality rates exceeding 30%
c.	A Meta-analysis of published studies have found that patient with methicillin resistant Staphylococcus aureus (MRSA) bacteremia had a increased risk of mortality compared with methicillin susceptible Staphylococcus aureus (MSSA)

3.	Stop killing the beneficial bacteria
a.	Consensus about antibiotics focus on bacterial resistance but permanent changes to our protective flora have more serious consequences

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4.	Collateral damage
a.	Average child receives 10-20 courses of antibiotics before 18 years of age
b.	Antibiotic affect our resident microbiota and may not fully recover after a course of antibiotics
c.	Over use of antibiotics may be contributing to obesity, DM, IBD, allergies and asthma

5.	Why we need to improve antibiotic use
a.	Antibiotics are the only drug where use in one patient can impact the effectiveness in another
b.	Improving antibiotic use improves patient outcome and saves money
c.	Antibiotic misuse adversely impact patient and society
d.	Antibiotics are misused across the continuum of care
e.	Inappropriate use of antibiotics in animals
f.	Improving antibiotic use is a public health imperative-WHO considers AMR an emerging threat to global health

An effective antimicrobial stewardship program (ASP) coupled with comprehensive infection control program has shown to limit the emergence and transmission of antimicrobial resistant pathogens. Moreover, to restrict the misuse or unnecessary antibiotic prescription, the Policy Statement on Antimicrobial Stewardship by SHEA, IDSA, and PIDS strongly encourages healthcare institutions to develop stewardship programs.

Antimicrobial stewardship program (ASP) helps clinicians to improve:

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1. The quality of patient care
2. Patient safety

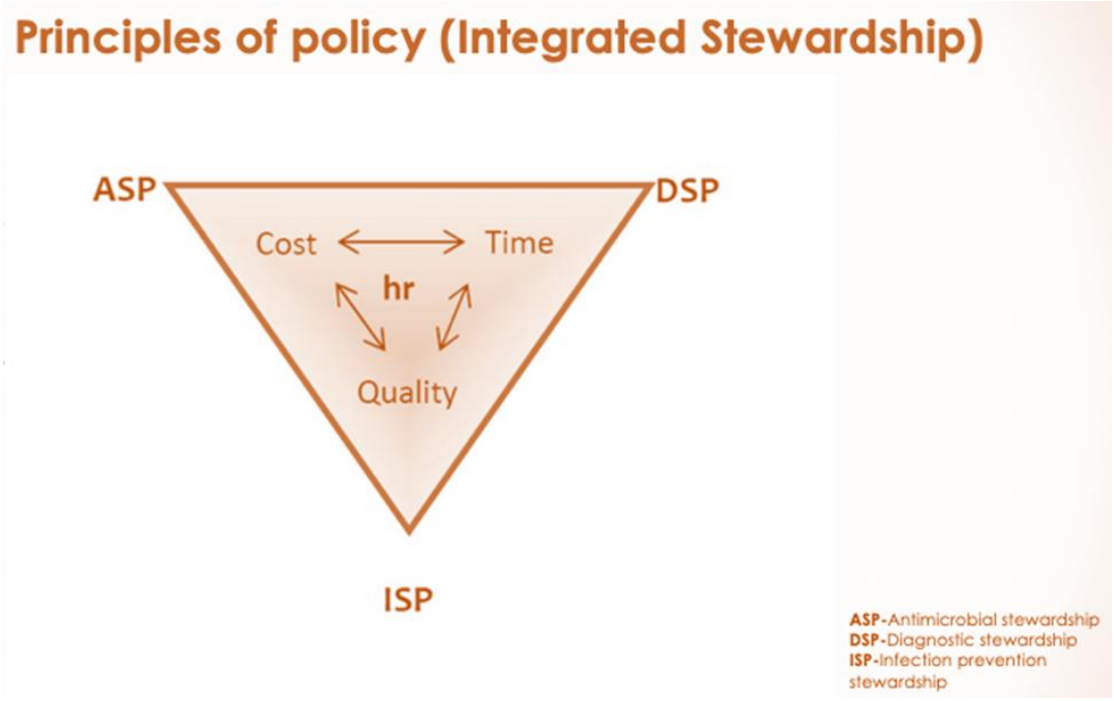
3. Reduced treatment failures
4. Increasing frequency of prescribing appropriate therapy and prophylaxis
5. Reduces the CDI rates
6. Reduces antimicrobial resistance

Director of our institute has mandated in 2018 for completing openWHO course (free online available; https://openwho.org/courses/AMR-competency). Other competency based courses are available, one can go through. With the single aim of optimal utilization of antimicrobials, diagnostics, and infection preventions, our institute is promised to maintain the same. Hence one comprehensive model is developed through the involvement of microbiology, pharmacology, and clinical departments in connection with other central institutions of the country. However, it needs major feedbacks so that best possible model could be developed with time.

2. Integrated stewardship model: antimicrobial, infection prevention, and diagnostic (AID)

AID stewardship model is the combination of Antimicrobial Stewardship Programs (ASPs), Infection Prevention Stewardship Programs (ISP) as well

as Diagnostic Stewardship Programs (DSP). This combined model aims at optimizing (laboratory) diagnostics, interpreting results, and initiating correct and appropriate antimicrobial therapy. Furthermore, they act at the network level, aiding in taking the right infection control measures in order to provide a safe environment for patients and healthcare workers. Ultimately, this should also lead to more cost-effective healthcare in the mid-to-long term.



Integration of infection control and prevention measures into AID model improves overall infection management. Without the proper infection prevention measures, other interventions such as ASPs and DSPs will not yield the optimal effect. Within the AID stewardship model, infection prevention stewardship entails early detection and close surveillance of MDROs, as well as an adequate rapid reaction to every possible transmission. Diagnostic stewardship is state-of-the-art right diagnostics which are performed timely, for right patient before initiating antimicrobial therapy. Diagnostics must be appropriate for the individual patient, target all pathogens causing acute infections and detect colonization and/or infection. Diagnostic test should provide results in < 48 hours of admission. Molecular diagnostics and point-of-care assay (testing different biomarkers) should be considered. The use of innovative methods (next-generation sequencing) is an exciting evolving field within clinical microbiology and infection control, which is advocated as the solution for antimicrobial resistance. These diagnostic assays and next-generation diagnostics are mostly based on molecular technologies and are therefore more expensive compared with classical culture-based methodology. But they are faster, delivering results within hours.

3. Objectives of antimicrobial policy

Broad:

1. Improving optimal utilization of antimicrobials
2. Decreasing turn-around time for all microbiological diagnosis

3. Zero tolerance to hospital acquired infections
4. Achieving 100% vaccination to all health care workers

Narrow:

1. Reducing empiric antibiotic prescriptions without cultures performed prior to initiation to <1% within 60 weeks
2. Reducing unnecessary use of antibiotics > 7 days to <1% of courses within 60 weeks
3. Reducing unnecessary use of antibiotics > 14 days to <1% of courses within 60 weeks
4. Reducing concurrent use of ≥ 4 antibiotics to <1% within 60 weeks
5. Reducing "double" or redundant antibiotic cover to <1% within 60 weeks
6. Attaining 0% of hospital acquired infections within 60 weeks

4. Steps of rational antimicrobial use

Step 1: Making a clinical diagnosis is often not given enough importance leading us to most often stumble upon a diagnosis while sending multiple lab tests. A clinical diagnosis most often helps us to predict causative pathogens fitting in to a clinical syndrome which would tailor the correct antibiotic rather than blindly relying on fever, procalcitonin levels, WBC counts, cultures or radiology to make a diagnosis of infection. Our thought process here should be

Diagnosis of infection

- Is it an infection?
- A risk assessment of how likely is it that the patient has an infection?

- What are the possible non-infectious mimics?
- Have we taken the appropriate cultures to confirm the final diagnosis?

Step 2: Limiting empiric antibiotic therapy to genuine seriously ill patients. Generally, empiric antibiotic therapy is ONLY recommended for a select group of patients as described below after taking appropriate cultures

- Febrile neutropenia
- Severe sepsis and septic shock
- Community acquired pneumonia
- Ventilator associated pneumonia
- Necrotizing fasciitis

Hence, it is important to start smart and then focus, i.e., evaluate if empiric therapy can be justified or de-escalated and then make a plan with regard to the duration of therapy.

Step 3: Know your bugs

Approach includes

- Identify the clinical syndrome

- Elucidate possible sources of infection
- Predict possible microbial pathogens
- Predict the local resistance pattern based on institutional antibiogram

Step 4: Choose the appropriate antibiotic

- Based on the spectrum of the antibiotic taking into account possible resistant patterns
- Use the correct dose, route and duration
- Ensure chosen antibiotic has adequate tissue penetration at the site of infection
- Optimize PK-PD parameters according to co-morbidities

Step 5: De-escalation/modification

- Modify empiric broad spectrum antibiotics depending on culture and antimicrobial susceptibility reports and patient status
- Stop polymyxins and glycopeptides if no carbapenem resistant organisms (CRO) or methicillin resistant Staphylococcus aureus (MRSA) identified on cultures
- Avoid double or redundant gram negative or anaerobic coverage
- Discontinue antibiotics if a non-infectious mimic identified
- De-escalate combination therapy to a single agent

- Change a broad spectrum antibiotic to a narrow spectrum one
- Change IV to oral antibiotics

De-escalation is safe in all patients including febrile neutropenia and septic shock and reduces mortality and length of hospital stay.

Step 6: Stop antibiotics in the following clinical situations

i. Respiratory tract syndromes
   - Viral pharyngitis
   - Viral rhinosinusitis
   - Viral bronchitis
   - Non-infectious cardio-pulmonary syndromes misdiagnosed as pneumonia

ii. Skin and Soft Tissue Infections
   - Subcutaneous abscesses
   - Lower extremity stasis dermatitis

iii. Asymptomatic bacteriuria and pyuria including in catheterized patients

iv. Microbial colonization and culture contamination

v. Low grade fever

Step 7: Reduce the duration of therapy

Duration of therapy should be optimized to minimum possible to reduce selection pressure. Practice guidelines and recommendations for optimum duration of therapy for various infectious disease syndromes suggest the following durations:

Community acquired pneumonia: 5 days

Hospital acquired pneumonia: 8 days

Skin and Soft tissue infections: 5 days

Urinary tract infections

- Cystitis: 3-5 days
- Pyelonephritis: 5-14 days
- Catheter associated: 7 days
- Staphylococcal aureus bacteraemia - low risk of complications = 2 weeks
  - High risk of complications = 4-6 weeks

Intra-abdominal infection: 4-7 days

Surgical antibiotic prophylaxis: 1 dose

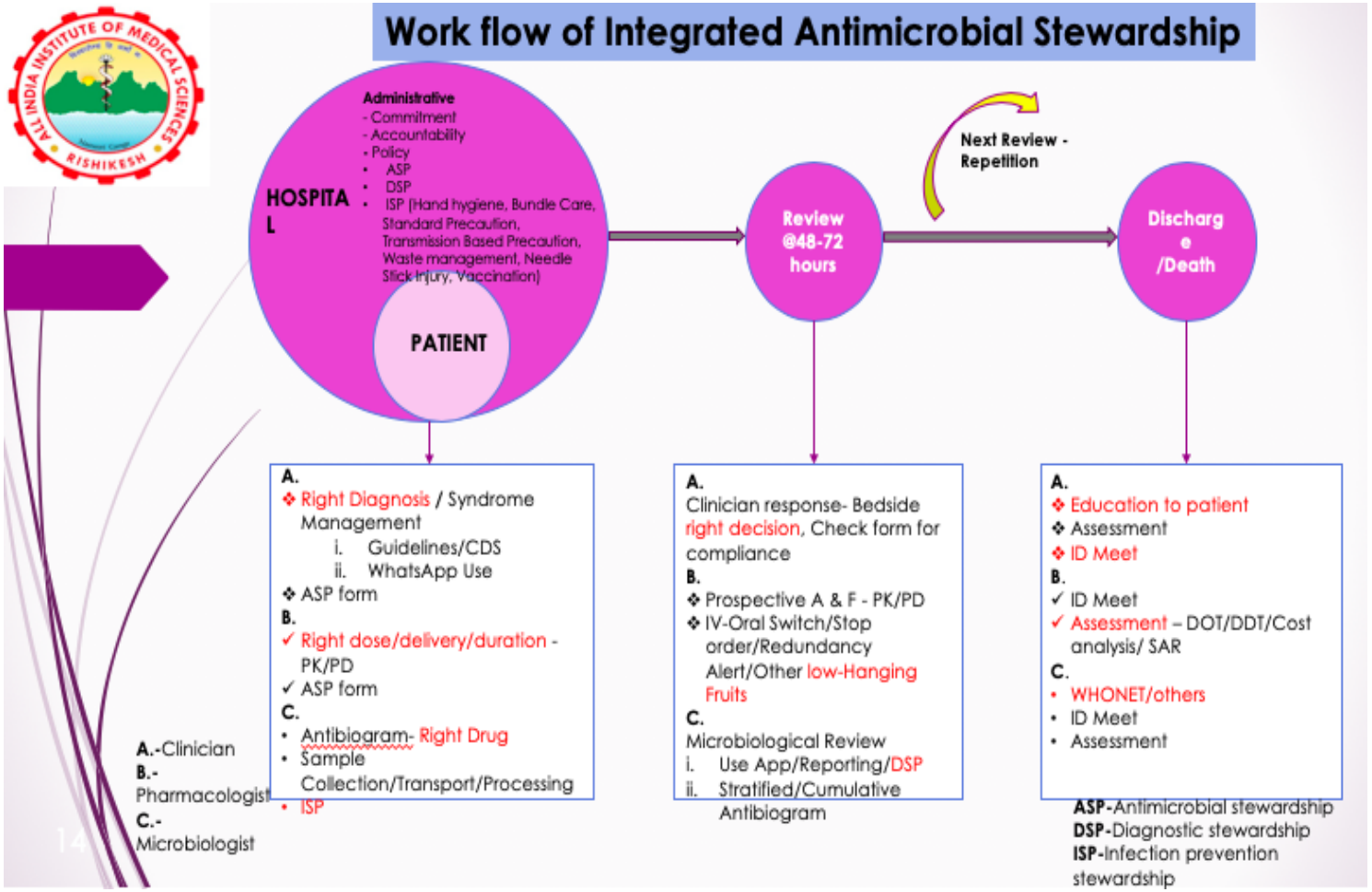
A stop date should be planned and recorded in advance to ensure antibiotic is not given beyond the recommended duration.

Step 8: Optimize PK-PD parameters

We cannot influence how a drug gets metabolized but we can influence drug administration for maximum efficacy. Age and co-morbidities like renal failure, sepsis and burns also influence the outcomes of the patients. Overall, exposure of the infective agent to the unbound antibiotic drug fraction at

the relevant effect site seems to be the most important factor. Optimizing Pk-PD parameters include loading doses when needed, therapeutic drug monitoring for toxicity and efficacy and optimization of drug infusion or administration. For e.g.,

- Loading dose of Colistin 9 million units stat and then followed by 3 million units Q8H or 4.5 million units Q12H [to target Colistin Average Steady State Plasma Concentration (Css,avg = 2-2.5 mg/L)
- Inj vancomycin 1g IV Q12H and dose to be adjusted to maintain a trough level between 15-20 µg/ml [however there are increasing recent data that suggests that AUC/MIC may be a better indicator of clinical efficacy than a trough level]
- Extended infusion of beta-lactams.


Work flow of Integrated Antimicrobial Stewardship
HOSPITAL
Administrative
- Commitment
- Accountability
- Policy
• ASP
• DSP
• ISP (Hand hygiene, Bundle Care, Standard Precaution, Transmission Based Precaution, Waste management, Needle Stick Injury, Vaccination)
PATIENT
Review @48-72 hours
Next Review - Repetition
Discharge /Death
A.
❖ Right Diagnosis / Syndrome Management
i. Guidelines/CDS
ii. WhatsApp Use
❖ ASP form
B.
✓ Right dose/delivery/duration - PK/PD
✓ ASP form
C.
• Antibiogram- Right Drug
• Sample Collection/Transport/Processing
• ISP
A.
Clinician response- Bedside right decision, Check form for compliance
B.
❖ Prospective A & F - PK/PD
❖ IV-Oral Switch/Stop order/Redundancy Alert/Other low-Hanging Fruits
C.
Microbiological Review
i. Use App/Reporting/DSP
ii. Stratified/Cumulative Antibiogram
A.
❖ Education to patient
❖ Assessment
❖ ID Meet
B.
✓ ID Meet
✓ Assessment – DOT/DDT/Cost analysis/ SAR
C.
• WHONET/others
• ID Meet
• Assessment
A.-Clinician
B.-Pharmacologist
C.-Microbiologist
ASP-Antimicrobial stewardship
DSP-Diagnostic stewardship
ISP-Infection prevention stewardship

5. Facility specific Standard Treatment Guidelines (STG) for common infectious diseases syndrome

The development of standard treatment guidelines (STG) should be based on cumulative antibiogram of organisms, antimicrobial policy, surveillance on antimicrobial resistance, antibiotic consumption data, and hospital acquired infection (HAI). These STG should contain disease/ condition specific intervention based on evaluation, diagnostic studies, treatment/prevention. Treatment of infectious diseases/conditions in the following tables is based on evidence based electronic data (published studies) and level of recommended evidence but not on antibiogram which will be released soon. Furthermore, one practical book named "Right diagnosis and right antibiotic" is available in our institute that can be utilized for reference purpose.

Attached all tables of syndromic diagnosis.

6. Other essential strategies

Prophylaxis in surgery

Attach here table of surgical prophylaxis

Antimicrobial order forms

Antimicrobial order forms decrease antimicrobial consumption through the use of automatic stop orders and the requirement of physician justification. They aid in the utilization of developed guidelines. Defining the optimal timing and duration of perioperative antimicrobial prophylaxis, use of perioperative prophylactic order forms with automatic discontinuation at two days resulted in a decrease in the mean duration of antimicrobial prophylaxis. Automatic stop orders should not replace clinical judgment, and renewal requirements must be clearly communicated to providers to avoid inappropriate treatment interruptions.

AWaRe classification by WHO is to be used mandatorily in each department and ward nursing incharges will maintain an authorization checklist (can be availed from dept of Medicine) while using reserve category of antimicrobials and it will be audited at monthly/quarterly.

List of Antimicrobials classified as per WHO 'AWaRe' group to be used by doctors		
Access (Authorization by all)	**Watch (Authorization only by SR or Faculty)**	**Reserve (Authorization only by ID doctor or two faculties after discussion)**
1. Amoxicillin 2. Amoxicillin and clavulanic acid 3. Ampicillin 4. Benzathine benzylpenicillin 5. Benzylpenicillin 6. Cefalexin 7. Cefazolin 8. Chloramphenicol	1. Anti-pseudomonal penicillins with beta-lactamase inhibitor (eg, piperacillin and tazobactam) 2. Carbapenems or penems (eg, faropenem, imipenem and cilastatin, meropenem) 3. Cephalosporins third generation (with or without beta-lactamase inhibitor; eg cefixime, cefotaxime ceftazidime, ceftriaxone) 4. Glycopeptides (eg, teicoplanin, vancomycin) 5. Macrolides (eg, azithromycin, clarithromycin, erythromycin)	1. Aztreonam 2. Cephalosporins fourth generation (eg, cefepime) 3. Cephalosporins fifth generation (eg, ceftaroline) 4. Daptomycin 5. Fosfomycin (intravenous) 6. Oxazolidinones (eg, linezolid) 7. Polymyxins (eg, colistin, polymyxin B) 8. Tigecycline

9. Clindamycin 10. Cloxacillin 11. Doxycyline 12. Gentamicin 13. Amikacin 14. Metronidazole 15. Nitrofurantoin 16. Phenoxymethylpenicillin 17. Procaine benzylpenicillin 18. Spectinomycin 19. Sulfamethoxazole and trimethoprim 20. **Azithromycin**	6. Quinolones and fluoroquinolones (eg, ciprofloxacin, levofloxacin, moxifloxacin, norfloxacin) ❖ **Watch class** antibiotics have higher toxicity concerns or resistance potential ✓ These should not be used for prophylactic uses in food producing animals and agriculture. ✓ A small number of antibiotics from this group act also as first or second choice treatments for a few specific indications (Access group)	**Antimicrobials that should be treated as last-resort options like Antifungals, Antivirals, other higher antibiotics, etc**

21. **Cefixime** 22. **Cefotaxime** 23. **Ceftriaxone** 24. **Ciprofloxacin** 25. **Clarithromycin** 26. **Piperacillin and tazobactam** 27. **Meropenem** 28. **Vancomycin (oral)** 29. **Vancomycin (Parenteral)**	❖ **Access group** has first and second choices for the empirical treatment of 21 common or severe clinical syndromes ✓ First choices were generally narrow spectrum agents with a low toxicity risk ✓ Second choices for specific syndromes were broader spectrum antibiotics than the first choices, which might have an increased risk of toxicity or resistance selection	

Antimicrobial use measures

Antibiotic use can be measured by two strategies, days of therapy (DOT) or defined daily dose (DDD). DOT is an aggregate sum of days for which any amount of a specific antimicrobial agent is administered or dispensed to a particular patient divided by a standardized denominator (patient days). DDD metric estimates antibiotic use in hospitals by aggregating the total number of grams of each antibiotic purchased, dispensed or administered during a period of interest divided by WHO assigned DDD. Compared to DOT, DDD estimates are not appropriate for children and those with reduced drug excretion such as renal impairment.

However, with recent release of AWaRe classification by WHO, their use can be nullified.

Combination therapy

The rationale for combination antimicrobial therapy includes broad-spectrum empirical therapy for serious infections, improved clinical outcomes, and the prevention of resistance. However, the available data are insufficient to recommend the routine use of combination therapy to prevent resistance. Hence, in many situations, combination therapy is redundant and unnecessary.

Dose optimization

Dose optimization takes several factors into account. This includes, PK/PD – characteristics, patient characteristics, causative organism, and site of infection. PK monitoring and adjustment program can reduce cost and decrease adverse effects. It is recommended to implement PK monitoring for aminoglycosides and vancomycin. This dose optimization strategy reduces nephrotoxicity, length of hospital stay, and mortality. Dept of Pharmacology is to be consulted in complicated cases for better dose optimization.

Duration optimization

While duration optimization helps to avoid automatic 10-14 days course of therapy, following is the new evidence of duration of therapy.

Infections	Duration of therapy
Uncomplicated UTI	**5 days**
Community acquired pneumonia	**7 days**
Ventilator associated pneumonia	**58 days**
CR-BSI Coagulase negative staphylococci	**7 days**

Acute Hemosteomyelitis in children	21 days
Meningococcal meningitis	7 days
Uncomplicated secondary peritonitis with source control	7 days
Uncomplicated SSTI	5 days

Streamlining/de-escalation

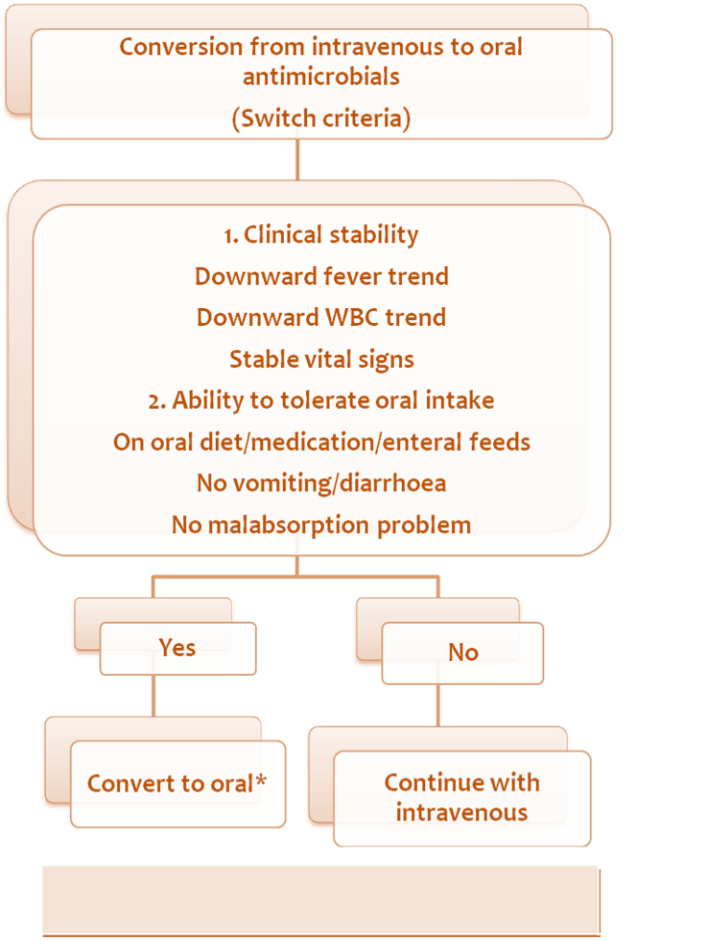
Excessively broad spectrum therapy contributes to the selection of antimicrobial resistant pathogens. This conflict can be resolved when culture results become available which in turn promote judicious use of antibiotics by streamlining or de-escalating empiric therapy to more targeted therapy that decreases antimicrobial exposure and contains cost.

Based on the diagnostic information, hospitalized patients are often empirically treated with antibiotics. However, prescribers often do not revisit the selection of antibiotics after microbiological data become available. An antibiotic time out promotes the reassessment of continuation, choice of antibiotic, or change to targeted therapy. All clinicians should perform a review of antibiotics 48 hours after prescription.

Switch from parenteral to oral therapy

Antimicrobial therapy for patients with serious infections requiring hospitalization is generally initiated with parenteral therapy. Enhanced oral

bioavailability among certain antimicrobials—such as fluoroquinolones, oxazolidinones, metronidazole, clindamycin, trimethoprim-sulfamethoxazole, fluconazole, and voriconazole—allows conversion to oral therapy once a patient meets defined clinical criteria. This can decrease length of hospital stay and health care costs. It may be facilitated by the development of clinical criteria and guidelines allowing conversion. There may be some exception to this especially when dealing with endovascular infections, osteomyelitis, etc. where a longer duration of iv antibiotics is required.



***Unless**
Severe sepsis, febrile neutropenia, deep seated abscess

The switch of IV to oral decreases the risk of IV associated complications like thrombophlebitis, catheter related infections, and improves the outcome of the patient. It also promotes earlier discharge and saves the health care costs.

A few suggested conversion regimen - antibiotic for dosing in specific indications:

IV		ORAL	
Antimicrobial	**Usual dose**	**Antimicrobial**	**Usual dose**
Ampicillin	1-2 g IV QID	Ampicillin	500 mg – 1 g oral TDS
Azithromycin	500 mg IV daily	Azithromycin	300 mg oral daily
Benzyl penicillin	1.2 g IV QID	Benzyl penicillin	500 mg oral QID
Cephazolin	1 g IV TDS	Cephazolin	500 mg oral QID
Ciprofloxacin	200-400 mg IV BD	Ciprofloxacin	250-500 mg oral BD
Flucloxacillin	1g IV QID	Flucloxacillin	500 mg oral QID

Lincomycin	600-900 mg IV TDS	Lincomycin	300-600 mg oral TDS
Fluconazole	200-400 mg IV daily	Fluconazole	200-400 mg oral daily
Metronidazole	500 mg IV BD	Metronidazole	400 mg oral TDS

Role of microbiology laboratory

The clinical microbiology laboratory plays a critical role in the timely identification of microbial pathogens and the performance of susceptibility testing. Susceptibility testing can aid in the prudent use of antimicrobials and direct appropriate therapy based on local guidelines. Molecular diagnostics allows the identification of difficult-to-culture pathogens, potentially avoiding the need for extended courses of broad-spectrum empirical therapy. Clinical microbiology laboratory should be actively involved in resistance surveillance. Role of rapid diagnostics and biomarkers in antimicrobial stewardship is recognized as a key recommendation by the IDSA.

Local antibiogram with pathogen-specific susceptibility data should be updated at least annually, to optimize expert-based recommendations for empirical therapy. Computerized surveillance can facilitate more-frequent monitoring of antimicrobial resistance trends. The laboratory is an important partner with infection control in the identification and molecular epidemiologic investigation of local outbreaks of infection. The development of resistance organisms which allow the implementation of infection control measures to prevent secondary spread. Clonal characterization of resistant strains through molecular typing can help focus appropriate interventions, leading to a reduction in nosocomial infections with associated cost savings.

- Appropriate culture should be obtained before starting antimicrobial therapy. Prior therapy may interfere with bacterial growth
- Promote optimal usage of diagnostic services such as ensuring the specimens are appropriate, clinically relevant and timely
- Undertake selective antimicrobial susceptibility testing especially those that are listed in formulary
- Clinical interpretations to laboratory reports
- With hold the susceptibility reports when clinical information is inadequate. Failure to do will result inexperienced prescriber to assume that the results have been interpreted by the laboratory and are clinically significant and to initiate antibiotics inappropriately.
- Selective reporting of only relevant/first line drugs alone Undertake rapid identification and susceptibility testing
- Collect and collate surveillance data and report trends and susceptibility profiles to guide empirical therapy.

Essential measurements

Following measurements are to be used as per requirements:

Structural indicators

- Availability of integrated stewardship team
- Availability of guidelines for empiric treatment, definitive treatment, and prophylaxis
- Provision of education in the last year
- Availability of funding for policy to implement and do research

Process measures

- Amount of antibiotic in DDD/100 bed days
- Percentage of appropriate use of WHO ‘AWaRe’ classified antibiotics

- Percentage of appropriate use of guidelines
- Percentage of appropriate de-escalation
- Percentage of appropriate switch from IV to oral
- Compliance with surgical prophylaxis
- Compliance with Hand hygiene
- Compliance with care bundles

Outcome measures

- C. difficile rates
- Surgical site infection
- Surveillance of resistance
- Mortality

Balancing measures

- Mortality
- SSI rates
- Re-admission within 30 days of discharge
- Admission to ICU
- Rate of complications
- Treatment-related toxicity

Future strategy

Integrated stewardship model (AID) will be implemented with one chairperson, one secretary, three nodal officers, and one represented from each clinical departments. All will sit together and formulate guidelines for each dept/area. Next version of the book “Right diagnosis and right antibiotic” is to be released. Details of antimicrobial measurements will be updated. Cumulative antibiogram will be developed. Computerised data entry will be mandated including audit of the compliance to institute antimicrobial policy.