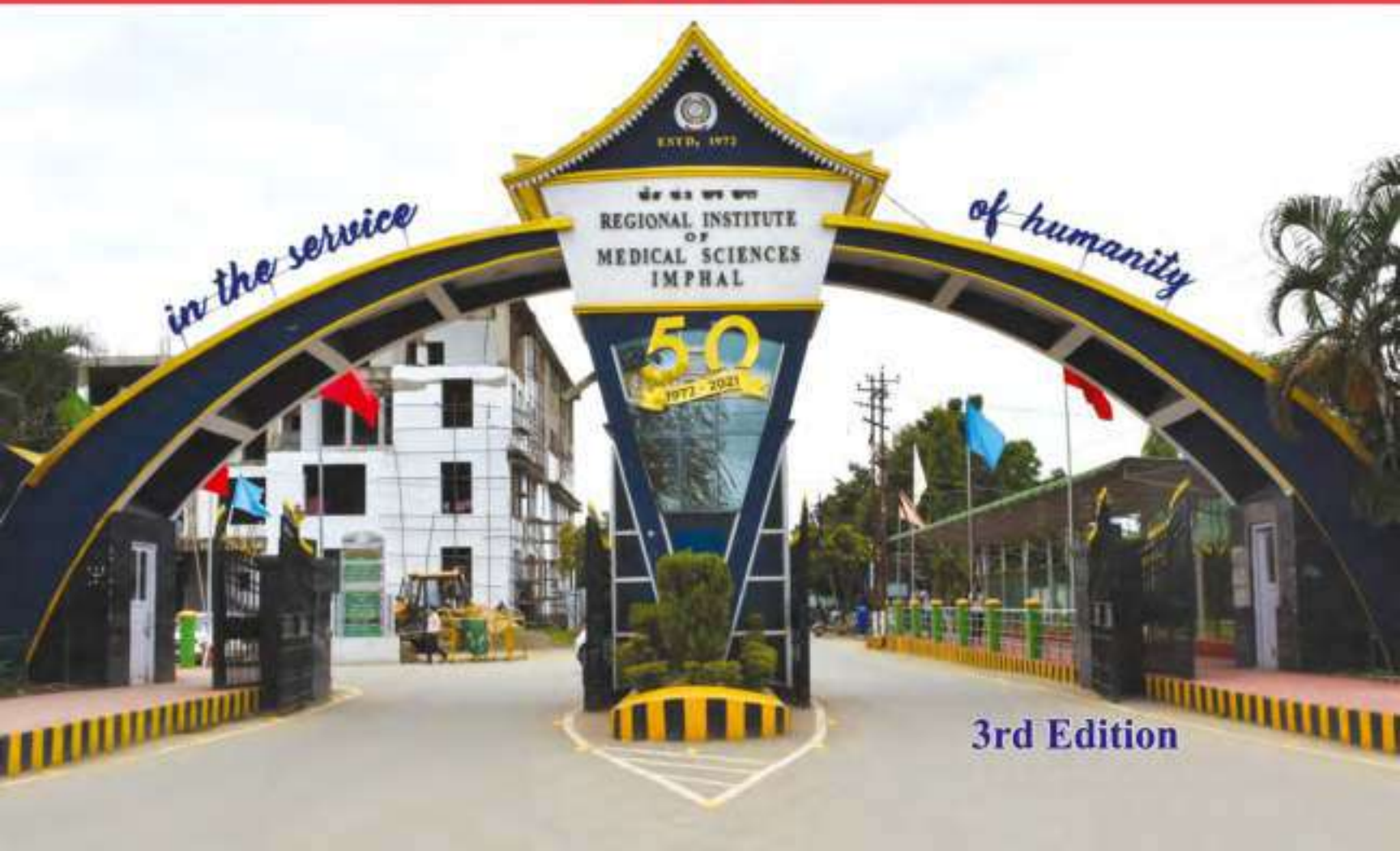
एंटीबायोटिक पोलिसी

ꯑꯟꯇꯤꯕꯥꯌꯣꯇꯤꯀ ꯄꯣꯂꯤꯁꯤ ꯂꯥꯏꯊꯤꯡ

ANTIBIOTIC POLICY

REGIONAL INSTITUTE OF MEDICAL SCIENCES

IMPHAL



3rd Edition

क्षेत्रीय आयुर्विज्ञान संस्थान, इंफाल

REGIONAL INSTITUTE OF MEDICAL SCIENCES HOSPITAL, IMPHAL

(An autonomous Institute under the Ministry of Health & Family Welfare, Govt. of India)

ORDER

Imphal, the 17th November, 2023

No. 460/RIMSH/HICC/97/1074 It is hereby notified to all concerned that the Antimicrobial Stewardship Committee, RIMS Hospital is re-constituted as given here under. This is in supersession of all previous notifications of this office in this regard.

1.	Prof. N. Sanjib Singh	Medical Superintendent, RIMSH	- Chairman
2.	Prof. Kh. Ranjana Devi	Head, Dept. of Microbiology	- Member
3.	Prof. Dhanaraj Singh Ch.	Head, Dept. of Medicine	- Member
4.	Prof. AK. Kaku Singh	Head, Dept. of Urology	- Member
5.	Prof. M. Rameswar Singh	Head, Dept. of Obst. & Gynae	- Member
6.	Prof. S. Ranita Devi	Head, Dept. of Surgery	- Member
7.	Prof. Ch. Shyamsunder Singh	Head, Dept. of Paediatrics	- Member
8.	Prof.Ksh.Birendra Singh	Dept.of Medicine	- Member
9.	Prof. Ng. Gunindro Singh	Dept. of Pharmacology	- Member
10.	Prof. Ksh. Mamta Devi	Dept. of Microbiology	- Member
11.	Dr. Chetan Maibam	Asst. Prof. Dept of Surgery	- Member
12.	Dr. L. Trinity Meetei	Asst. Prof. Dept. of Obst. & Gyane	- Member
13.	Dr. Y. Arunkumar Singh	Asst. Prof. Dept. of Anaesthesiology	- Member
14.	Smt. W. Ibeyaima Devi	Nursing Superintendent, RIMSH	- Member
15.	Smt. Sobita Ngangbam N	Nursing Officer, RIMSH	- Member
16.	Prof. T. Jeelenkumar Singh	Dept. of Medicine	- Member Secretary

The term of reference of the committee shall be to oversee & transect all relevant matters, pertaining to Antimicrobial stewardship.

This shall come into force with immediate effect.

(Prof. N. Sanjib Singh)
Medical superintendent
RIMS Hospital, Imphal

Memo No. 460/RIMSH/HICC/97/1074 Imphal, the 17th November, 2023

Copy to-

1. The P.S. to the Director for kind information of the Director, RIMS, Imphal.
2. All concerned members.
3. Concerned file.

(Prof. N. Sanjib Singh)
Medical superintendent
RIMS Hospital, Imphal

ANTIBIOTIC POLICY

Regional Institute of Medical Sciences
Imphal

3rd edition
2024

डॉ० गुरुअरिबम सुनिल कुमार शर्मा
Dr. Guruaribam Sunil Kumar Sharma
निदेशक / **Director**
आर.आई.एम.एस., इम्फाल, मणिपुर
RIMS, Imphal, Manipur

E-mail:director@rims.edu.in
eigasunil@gmail.com
Regional Institute of Medical Sciences
Imphal-795004, Manipur, India
Phone: 2414629, 2414750, 2414720 (O)

MESSAGE

I am, indeed, very glad to learn that, the 3rd edition of the "Antibiotic policy of Regional Institute of Medical Sciences, Imphal" is being published by the Antibiotic Stewardship Committee of the institute. This much needed endeavor would have not been possible without the overall guidance of the ICMR, New Delhi, through the ongoing Anti Microbial Stewardship Project (AMSP). The Medical Superintendent, all relevant Departments /units /sections, nursing officers and the entire team of the Committee deserve all words of appreciation for their untiring and seamless effort.

Antimicrobial resistance is a major public health challenge, which is recognized as high priority area by the Government of India. The important factors causing antimicrobial resistance are irrational prescription of broad-spectrum antibiotics, poor regulations of sale of antibiotics, self-medication, lack of education and awareness regarding rational use of antibiotics. Prioritizing development of guidelines regarding use of antibiotic is indeed a high priority area towards combating antimicrobial resistance. The overarching goal of National Action Plan (NAP-on AMR) is to effectively combat antibiotic resistance in India and contribute towards the global efforts to tackle this public health threat. Ultimate aim is to improve patient outcome, decrease emergence of bacterial resistance and ensure longevity of the existing antibacterial agents. Hence, this effort is of immense value.

I am extremely thankful to all the experts who have contributed their valuable ideas and experiences to the guidelines. I do hope that this policy document will inform, encourage and support health care providers, of all levels, to implement antimicrobial stewardship initiatives and contribute towards mitigating the menace of antibiotic resistance.

I wish the endeavor all success.

(Prof. G. Sunil Kumar Sharma)
DIRECTOR

Imphal,
The 9th February, 2024

OFFICE OF THE MEDICAL SUPERINTENDENT
REGIONAL INSTITUTE OF MEDICAL SCIENCES HOSPITAL
IMPHAL – 795 004, MANIPUR (INDIA)
(An autonomous Institute under the Ministry of Health & Family Welfare, Govt. of India)

MESSAGE

I am happy to learn that the Antimicrobial Stewardship Programme (AMSP-III), RIMS, Imphal is publishing **"RIMS Hospital Antibiotic Policy- Volume 03"** (*Handbook booklet reference*).

Antibiotic policy is mandatory in the hospital as well in the community. The publication of RIMS Hospital Antibiotic Policy-volume 03 will immensely contribute in enhancing the standard of treatment guidelines; promote rational use of antibiotics. This will also lead the health care delivery system of the Institute to new heights.

I sincerely appreciate the efforts made by the Antimicrobial Stewardship Programme (AMSP-III) and the clinical Heads of the Departments, RIMS, Imphal for making the publication a big success.

(Prof. N. Sanjib Singh)
Medical Superintendent,
RIMS Hospital, Imphal

FORWARD

I am glad to know that the Antimicrobial Stewardship Committee of RIMS Hospital is continuing its good services actively and coming out with the third edition of Antibiotic Policy 2024. The activities of the HAICC, RIMS Hospital have become more meaningful and have been greatly enhanced by the ongoing AMSP of RIMS Hospital. Active monitoring of antibiotic uses, analysing the data on resistance patterns and the impact of AMSP on clinical outcomes greatly influence the antimicrobial prescribing habits of clinicians. It simply interprets to rational use of antibiotics in the hospital. Data analysis and review are much needed to safely prescribe antibiotics, thereby improving patient care and positive outcomes. I am sure many of the treating clinicians have benefitted from the earlier antibiotic policy document in prescribing the right antibiotic to the right patient, at the right time for the right duration in the right dose and formulations. With the new antibiogram, it's time for all departments to relook and observe the trends and if necessary implement change in the empirical antibiotic strategies. Antibiotics are a double - edged sword - an indispensable tool in modern medical practice and at the same time possessing the potential to cause serious public health crisis. The purpose of "Antibiotic policy" will be served successfully if the document could guide the clinicians in prescribing antibiotics and practice rational use of antibiotics accordingly in the respective departments.

(Dr. Khuraijam Ranjana Devi)
Member Secretary
HAICC, RIMSH
Prof. & Head, Dept. of Microbiology
Regional Institute of Medical Sciences, Imphal

PREFACE

I am truly delighted and feel honored to be part of the endeavor to bring out the 3rd edition of "RIMS Hospital Antibiotic Policy" in time. This effort is being attempted following the successful publication and dissemination of the earlier two editions. While much of the hard work is endured collectively by the hardworking committee members, under the able leadership of the Medical Superintendent & Chairman, AMS committee, RIMS, Imphal to bring out the policy document; the blessings of our respected Director, unconditional support from all the relevant Departments and all valued stakeholders are truly remarkable and duly acknowledged.

Medical profession today is faced with numerous challenges. Ever increasing issue of antibiotic resistance, in the face of dried up of new antibiotics is undoubtedly a challenge to be faced head on by all. Medical Professionals are indeed under tremendous pressure to keep pace with the rapidity in which medical science is being challenged by the rising menace of resistance in the contemporary world. The ever-increasing quantum of irrational use of antibiotics even by the general populace in the society has further compounded the challenge manifold.

Instruments such as the "Hospital Antibiotic Policy" are an important objective of AMSP of ICMR. It provides us the much-needed scientific platform to sensitize and reorient our clinical thoughts in the form of voluntary, persuasive, restrictive methodology in rationalizing antibiotic use in our hospital. It is in essence a compilation of works based on the principle of evidence-based medicine with valuable inputs from different department. Inspirational support and valuable guidance provided by the editorial team is unparallel, in realizing this venture. I do hope and pray that the message of rational use of antibiotic echoes far and wide.

Together let us fight antibiotic resistance.

(Prof. T. Jeetenkumar Singh)
Convenor,
Antibiotic Stewardship Committee,
RIMS Hospital, Imphal
&
Principal Investigator,
AMSP (RIMS) under ICMR, New Delhi

CONTENTS

1. ANTIBIOTIC STEWARDSHIP PROGRAMME (PHASE-III) IN RIMS HOSPITAL, IMPHAL

Introduction: Antibiotic Stewardship Programme (AMSP) is a coordinated measure designed to ensure judicious use of antibiotics to contain resistance. It is attempted to achieve AMSP through structural, persuasive, enabling or restrictive interventions. Increasing levels of drug resistance in pathogens of public health importance and dried up pipeline of new antibiotics has created a situation of emergency in India and globally. Antimicrobial resistance has indeed become a major public health challenge. Hospitals in India are reporting high levels of resistance to fluoroquinolones, carbapenems and are also documenting increasing resistance to polymyxins like colistin as the use of polymyxins in health care settings increases. Recognizing the need to create AMSP structures in health care institutions in the country as a priority, ICMR carried out four workshops on AMSP capacity building across the country in 2nd quarter of 2017. Following which the project on AMSP was initiated across the country. This project is aimed at initiating AMSP activities, in the 23 hospitals in India in a methodical manner. Regional Institute of Medical Sciences, Imphal was also being identified as a centre for the multi centric national project.

Regional Institute of Medical Sciences, Imphal has successfully completed the AMSP Phase - I & II in the stipulated timeline set by ICMR. Subsequently, the AMSP-III was initiated on 11th October, 2023.

Title of the project - "Regional Institute of Medical Sciences Hospital, Imphal: Implementation of Antimicrobial Stewardship Program (AMSP) in various tertiary care centres across India".

Objectives of the AMSP-III

1. To implement AMSP interventions (audit and feedback).
2. To study the impact of AMSP interventions in resistance patterns.
3. To study the impact of AMSP interventions in clinical outcomes.

Objective 1: To implement AMSP interventions (audit and feedback)

a) To create antibiotic policy based on the hospital antibiogram.
b) Monthly point prevalence of cultures to be done for beds for which AMSP is being implemented.
c) To measure antibiotic consumption for antibiotics of interest* using DOT and DDD.
d) To monitor and capture duration of antibiotic therapy
    - No. of patients who got antibiotics for more than 14 days.
    - No. of patients who got more than three antibiotics at same time for at least 5 consecutive days.

Objective 2: To study the impact of AMSP interventions in resistance patterns

The AMR surveillance through the institute/hospital clinical microbiology lab previously established as part of AMR surveillance network will be continued and supported through the funds provided to support laboratory work in this project.

Microbiological - Change in resistance pattern of gram negatives (both Enterobacteriaceae and non-enterobacteriaceae) and gram positives (Staphylococcus and Enterococcus) over the time (quarterly).

Objective 3: To study the impact of AMSP interventions in clinical outcomes measures

1. Antibiotic Consumption-

a) Comparison of consumption of antibiotics of interest over the time (quarterly calculation) - using DDD and DOT
b) Compliance rates of de-escalation (monthly)
c) Compliance rates of empirical antibiotics with antibiotic policy (monthly)
d) Compliance rates of surgical antibiotic prophylaxis with antibiotics policy (monthly)
    - Choice of drug
    - Timing of drug
    - Duration of drug prescribed

2. Clinical Outcomes-

a) Rates of nosocomial infections (HAP/VAP/CAUTI/CLABSI/SSI) over the time (quarterly)
b) Overall mortality rates of patients on beds for which AMSP is implemented (monthly)
c) Attributable mortality to infection of patients on beds for which AMSP is implemented (monthly)
d) Median length of stay in hospital for patients who were started on antibiotics of interest* (monthly)
e) Cost of therapy (only related to antibiotics) - using DDD (based on Jan Ausdahi) (quarterly)

Selection criteria: ICU and wards beds

a. Selection of ICU beds for AMSP study should be from Medical, Surgical, Cardiothoracic, Neuro, Burns and Chest ICUs
b. For surgical prophylaxis, only elective surgeries will be considered
c. ICU beds selection -
    - If the total number of ICU beds is more than 100, consider 50% or 50 ICU beds whichever is lower
    - If the total number of ICU beds is less than 100, consider 50% or 50 ICU beds whichever is higher

d. Wards - For AMSP study, total number of beds should be 150. So for wards, follow 150 - ICU beds = ward beds

e. In this study, only those wards will be selected which have either higher antibiotic consumption or higher AMR figures.

ICUs & Wards selected for AMSP study at RIMS, Imphal

Intensive care units

Sl. no	Department	ICU name	Bed no
1	Medicine - ICU	MICU	17
2	Chest - ICU	MICU	
3	Surgery - ICU	SICU	15
4	Cardiothoracic (CT) - ICU	SICU	
5	Burn - ICU	SICU	
6	Neuro - ICU	NICU	14
7	Trauma - ICU	TICU	14
		Grand total	**60**

Wards

Sl. no	Ward name/Department	Bed no
1	Female medicine ward (FMW)	46
2	Female surgery ward (FSW ii/iii)	45
3	Post-natal ward (Gynae - ward)	15
	Grand total	**106**

The objectives are to be fulfilled over a prescribed time line and the outcome of the project will be compared amongst the participating centers and Institutes will be graded for their AMSP initiatives. It calls for a multidisciplinary effort, cutting across specialties and different strata of the health care delivery system. All stake holders involved in the care and treatment of patients are requested to fully cooperate towards fulfilling the mandate of the project so that the menace of antibiotic resistance is tackled headon.

2. APPROPRIATE CLINICAL SAMPLES COLLECTION METHODS FOR OPTIMUM OUTCOME

Introduction: A good Microbiological report needs a good specimen. Specimen collection in microbiology to isolate and identify the causative agents forms backbone of the investigative procedures. Specific procedures in collecting specimens will certainly improve the quality of services in Microbiology department.

Information derived from the results has impact on diagnosis of infectious diseases, antibiotic prescribing, and formulation of antibiotic policy and for infection control measures.

Successful laboratory investigations need advance planning, collection of appropriate and adequate specimens, labelling and documentation of specimen and transportations to appropriate laboratory.

1. BLOOD

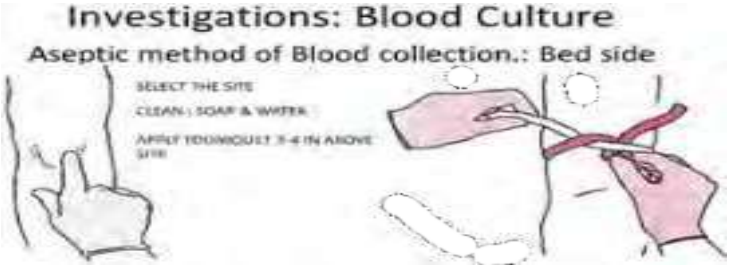
Collection and transport

Purpose: To reduce blood culture contamination rate, collection may be improved by taking the following precautions[1,2,3,4].

Note: This is an emergency procedure. The sample should be processed and reported immediately. The results of the smear should be informed to the concerned clinician and documented in the critical alert register.

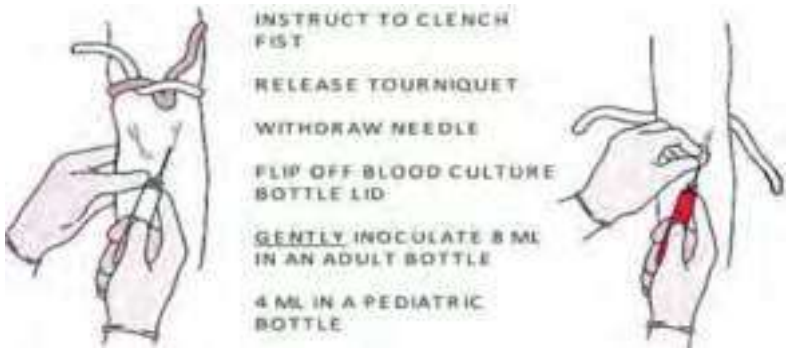
Prepare the site

- Select the site of venipuncture. If the patient is unusually dirty, wash the intended site with soap and water prior to venipuncture.
- Apply a tourniquet, 3 to 4 inches above the intended site of venipuncture. Alternatively this can be done after cleaning.
- Put on examination gloves.
- Vigorously cleanse with 70 % isopropyl or ethyl alcohol to remove surface dirt and oils.
- Scrub the venipuncture site gently but firmly with the cotton beginning in the center and continuing in an outward direction circularly for an area of 4 to 5 inches in diameter.
- Allow to dry.



- Swab or wipe concentric circles of 2 % w/v chlorhexidine with 70 % isopropyl alcohol or 10% w/v povidone iodine/tincture iodine, in a similar manner as given earlier-beginning in the center and continuing in an outward direction circularly for an area of 4 to 5 inches in diameter.
- Allow the povidone iodine to dry (2 minutes). For chlorhexidine gluconate (2 % w/v)/ tincture iodine (10 % w/v), drying period is ~ 30 seconds. Do NOT touch the site after cleaning.

- Instruct patient to clench and unclench the fist.
- Perform phlebotomy using the needle and syringe.
- Release the tourniquet and withdraw the needle.



- Apply pressure to the site of venipuncture and place a bandage over the puncture site.
- Skin preparation with either alcohol, alcoholic chlorhexidine (2% w/v), or tincture of iodine (10% w/v) leads to lower blood culture contamination rates than does the use of povidone iodine[1,2].

For pediatric patients

< 2 months: Omit the iodine step, and clean two additional times with separate preparation pads saturated with 70 % isopropyl alcohol or ethyl alcohol.

> 2 months: Chlorhexidine gluconate as a skin antiseptic is approved for use in pediatric patients two months of age and older [4].

Prepare the bottle

Prepare the septum of the blood culture bottle and the rubber stoppers on bottles or tubes. Label the bottles with the patient's name and the date and time of draw. Site of draw may be listed.

Note: In particular, please mention whether blood is collected from a central line or from peripheral venipuncture.

Collection through an intravenous line

- It is not necessary to discard the initial volume of blood or flush the line with saline to eliminate residual heparin or other anticoagulants[4].
- Vigorously wipe septa with 70 % alcohol and allow drying completely, for 30 to 60 seconds.
- Pediatric bottles should not be used for adult patients except for those elderly patients in whom it's difficult to obtain larger amounts of blood.

Table 1. Recommended total volume and numbers of blood cultures [4]

Age & body weight	Amount (divided between 2 blood)	Remarks
Neonates to 1 year (< 4 Kg)	0.5 – 1.5 ml	Atleast 1 ml Two separate venipuctures are generally not possible
Children (< 40 Kg)	10 – 20 ml	Blood culture volumes should be limited to <1 % of total blood volume (usually about 0.7 ml/kg). e.g. total sample limit would be 7 ml for a 10 kg patient and 28 ml for a 40 kg patient
Adults & children (> 40 kg)	30 – 40 ml	Atleast10 - 20 ml of blood

Adult patient (50 kg): 10 to 20 ml, divided between two blood cultures from separate, peripheral venipuncture sites. Anerobic blood cultures should be taken only if there are adequate resources[5].

Pediatric patient: 6 to 10 ml, divided between two blood cultures.

Initially obtain 3 blood culture sets within a 30 min. period before administration of empiric antimicrobial agents from patients presenting with possible infective endocarditis. If those sets are negative at 24 hrs, obtain 2 more sets of cultures, for a total of 5 sets overall[4].

Timing of blood cultures

Note: Although drawing blood cultures before or during the fever spike is optimal for recovery, *Volume is more important than* timing in the detection of agents of septicemia. Thoroughly mix bottles to avoid clotting.

Don't forget: After phlebotomy, remove residual tincture of iodine from the patient's skin by cleansing with alcohol to avoid skin irritation.

Manual blood culture inoculation

For conventional blood culture method, blood culture for bacterial infections should be carried out in two bottles containing 50 ml each of tryptone soya broth and bile broth. After removing the kraft paper, inoculate the blood culture bottles. Incubate at 37ºC and examine daily for 7 days for evidence of growth, indicated by turbidity, hemolysis, gas production, discrete colonies, or a combination of these.

Transport of blood culture bottles

In case of delay between collection and processing, **never refrigerate the bottle**. Preferably keep the bottle in a 35ºC incubator, if available. Otherwise, leave the bottle at room temperature.

2. CEREBRO SPINAL FLUID

Collection and transport

Purpose: To identify the organisms causing pyogenic meningitis.

Note: This is an emergency procedure. The samples should be processed and reported immediately. The results of the smear should be informed to the concerned clinician and documented in the critical alert register.

SPECIMEN COLLECTION

1. Lumbar puncture

- Cap, face mask, gown and gloves for physician drawing CSF are useful adjuncts to infection prevention. Disinfect the puncture site with antiseptic solution and alcohol in a manner identical to phlebotomy skin preparation for blood culture to prevent specimen contamination and introduction of infection.
- Insert a needle with stylet at the L3-L4, L4-L5, or L5-S1 interspace. When the subarachnoid space is reached, remove the stylet; spinal fluid will appear in the needle hub.
- Measure the hydrostatic pressure with a manometer.
- **Note:** Lumbar puncture opening pressure should not be considered a reliable measure of intracranial pressure in children[6].
- Collect the CSF into five calibrated sterile labeled tubes.

- Physicians should be instructed to sequentially collect 2.0 ml of CSF each into three sterile calibrated tubes if only routine chemistry (total protein and glucose), bacteriology (culture & susceptibility), and hematology (cell count) are required.

2. Ventricular shunt fluid

- Clean the reservoir site with antiseptic solution and alcohol prior to removal of fluid to prevent introduction of infection.
- Remove fluid by aspiration of CSF from the Ommaya reservoir or by collection from the ventricular drain or shunt.
- Collect CSF into a minimum of three sterile calibrated tubes if only routine chemistry (total protein and glucose, tube no.1), bacteriology (culture & susceptibility, tube no.2), and hematology (cell count, tube no.3) are required.
- An initial CSF sample should be collected prior to antimicrobial therapy for highest diagnostic sensitivity.

Specimen transport

- Submit to laboratory as soon as possible and alert laboratory that specimen is in transit.
- Do not refrigerate.
- Each sterile calibrated tube containing CSF must be properly labeled with the patient's name, unique identification number, and the date and time of collection.
- Requisition must be complete with demographic and specimen collection information. Record the patient diagnosis for proper processing of specimen.

Rejection criteria

- Call physician to prioritize requests if there is insufficient volume.
- Specimens in leaky containers must be processed, but alert the physician of the possibility of contamination.

3. BODY FLUIDS FROM STERILE SITES

Specimen collection

- Body fluids from sterile sites should be collected by percutaneous aspiration for pleural, pericardial, peritoneal, amniotic, and synovial fluids.
- Use care to avoid contamination with commensal microbiota.
- Clean the needle puncture site with alcohol, and disinfect it with an iodine solution [1- 2 % tincture of iodine or a 10 % solution of povidone iodine (1 % free iodine)] to prevent specimen contamination or infection of patient (if tincture of iodine is used, remove with 70 % ethanol after the procedure to avoid burn).

- Aseptically perform percutaneous aspiration with syringe and needle to obtain pleural, pericardial, peritoneal, or synovial fluid. Use safety devices to protect from needle exposure.
- Immediately place a portion of the joint fluid or peritoneal fluid collected from patients with CAPD or SBP into aerobic and anaerobic blood culture bottles, retaining some (0.5 ml) in syringe for Gram stain and direct plating.
- Use the minimum and maximum volumes recommended by the bottle manufacturer (generally up to 10 ml is the maximum for each bottle).
- Alternatively, inoculate the blood culture bottles after receipt in the laboratory.
- Submit other fluids and the remainder of specimens after inoculation of blood culture bottles in one of the following: a sterile, gassed-out tube or a sterile blood collection tube without preservative; however, fluids in such tubes may clot during transport.

Specimen transport

- Submit to laboratory as soon as possible and, if from a normally sterile site, alert laboratory that specimen has been submitted.
- Do not refrigerate.
- Label specimens with patient demographics and date, time and site of collection. *e.g*. left knee joint fluid.
- Record the patient diagnosis for improved processing of specimen.

Note:

- If specimens inoculated into blood culture bottles are received, Gram stain cannot be performed.
- Collect specimen prior to antimicrobial therapy for greatest diagnostic sensitivity.
- Do not submit specimens from drains after they have been infused with antimicrobial agents.
- Call physician when fluid specimens are received on a swab.
- Contact physician if specimen is insufficient for the number of tests requested.
- Swabs constitute the least desirable sample for culture of body fluids and should be discouraged, since the quantity of sample may not be sufficient to ensure recovery of a small number oforganisms.
- Routine bacterial culture is sufficient for culture for *Candida* species, if blood culture bottles are used or specimen is centrifuged.

Important considerations

4. OCULAR SPECIMENS[3]

Note: For detailed procedures http:// on ocular microbiology, please refer to www.ijmm.org/documents/ocular.pdf [7].

Specimen collection and transport

Note: Most eye specimens should be collected by an ophthalmologist. These specimens should be inoculated onto culture media at the bedside, in the clinic or the physician's office. A variety of techniques are used to collect material from different parts of the eye. The conjunctiva is constantly contaminated by various bacteria from the environment and ocular adnexa. Therefore, specimens from the conjunctiva serve as a control when compared with specimens collected by more aggressive or invasive techniques.

Considerations

- Provide fresh media to the clinical areas routinely collecting ocular cultures, and instruct physicians to immediately transport inoculated media and slides to the laboratory.
- Obtain viral and chlamydial samples before topical anesthetics are instilled.
- Obtain samples for chlamydial cultures with calcium alginate swabs.
  Note: Calcium alginate swabs may be toxic for *Neisseria gonorrhoeae* (for which rayon or cotton swabs could be used) [8].
- For viral cultures, use Dacronor cotton swabs with non-wood shafts [9].

COLLECTION BY ANATOMIC SITE [7]

Conjunctiva (bacterial conjunctivitis) and lid margin (blepharo conjunctivitis)

- Obtain the specimen with a sterile, pre-moistened cotton or calcium alginate swab.
- Roll the calcium alginate or cotton swab over the conjunctiva before topical medications are applied.
- Culture both eyes with separate swabs.
- Immediately inoculate the material at the bedside on to BAP and CHOC.
- Inoculate the swab from the right conjunctiva in horizontal streaks, and inoculate the swab from the left conjunctiva in vertical streaks, each on one half of the same agar plate.
- Inoculate specimens from the right and left lid margins, if collected, by making an R and an L to represent the respective sites on another agar plate.
- Obtain conjunctival scrapings for a smear preparation as follows -
  - Instill 1 or 2 drops of proparacaine hydrochloride.
  - Using a Kimura spatula, gently scrape across the lower right tarsal conjunctiva.
  - Smear the material in a circular area 1cm in diameter on a clean glass slide.
  - Prepare at least two slides.
  - Immerse the slides in 95% methyl alcohol or 95 % methanol for 5 minutes.
  - Repeat steps for the left conjunctiva.

Cornea (bacterial keratitis)

- Instill 1 or 2 drops of proparacaine hydrochloride (local anesthetic for ophthalmic instillation).

- Obtain conjunctival samples as described above, and then obtain corneal scrapings from the advancing edge of the ulcer by scraping multiple areas of ulceration and suppuration with a sterile Kimura spatula, using short, firm strokes in one direction (keep the eyelid open, and be careful not to touch the eyelashes).
- Obtain approximately three to five scrapings per cornea.
- Inoculate each set of scrapings onto BAP and CHOC, using a 'C' formation for each scraping.
- Prepare smears by applying the scrapings in a gentle circular motion over a clean glass Slide or by compressing material between two clean glass slides and pulling the slides apart.

Bacterial endophthalmitis

- Collect an aspirate of the vitreous fluid or perform a paracentesis of the anterior chamber using a needle aspiration technique to collect intraocular fluid.
- Collect specimens for conjunctival cultures along with the fluid to determine the significance of indigenous microbiota.
- If a small volume of fluid is collected, inoculate cultures at the bedside by inoculating 1 or 2 drops of fluid onto culture media.

5. RESPIRATORY SPECIMENS[3]

Purpose: To isolate and identify the potentially pathogenic organisms from upper and lower respiratory tracts (URT and LRT) aiding in the diagnosis of infections.

Sputum cultures are done primarily to identify the pathogens that cause pneumonia or bronchopneumonia: community-acquired or hospital-acquired.

Specimen collection and transport

a) Sputum

- Spontaneous: Early morning specimen generated after a bout of cough.
- Having the patient brush his or her teeth and gargle with water immediately before obtaining the sputum specimen reduces the number of contaminating oropharyngeal bacteria.
- Collect specimen resulting from deep cough in a sterile screw-cap cup or other suitable sterile collection assembly of about 100 ml capacity.
- To prevent contamination of the outside of the container, the patient should be instructed to press the rim of the container under the lower lip to catch the entire expectorated cough sample.
- Tightly screw on the cap of the container. Wipe off any spilled material on its outside with a tissue moistened with disinfectant, but take care not to let any disinfectant enter the container. Such communication with patients can be rewarding. In addition, patients should remove dentures during the specimen collection.

- Early-morning sputum samples should be obtained because they contain pooled overnight secretions in which pathogenic bacteria are more likely to be concentrated. Twenty four hour collections should be discouraged[6,7,19].
- Deliver the specimen to the laboratory as quickly as possible, preferably within 2 hours, for delicate bacterial, viral and mycoplasma pathogens may die out during longer delay.

b) Endotracheal aspirate (ETA)[8]

- Endotracheal aspiration should be done with a sterile technique using a 22 inch, 12 F suction catheter. The catheter should be introduced through the endotracheal tube for at least 30 cm. Gentle aspiration is then performed without instilling saline solution. The first aspirate is discarded.
- The second aspirate should be collected after tracheal instillation of 5 ml saline in a mucus collection tube. [If very little secretion is produced by the patient, chest vibration or percussion for 10 minutes should be used to increase the retrieved volume ($\geq$ 1ml)].
- The specimens should be sent to laboratory and cultured within 1 hour of collection.

c) Broncho-alveolar-lavage (BAL)[9]

In this procedure 120 ml of saline should be infused into a lung segment through the bronchoscope to obtain cells and protein of the pulmonary interstitium and alveolar spaces. Send a portion of it to the laboratory.

d) Sinus aspirate

Collection of specimens from patients with sinusitis should be performed by otolaryngologists who perform nasal endoscopy or sinus puncture and aspiration.

Type of container

Collect in a sterile leak proof screw-cap container.

Rejection criteria

For sputum and endotracheal aspirate specimens

- Reject duplicate specimens received on the same day unless the initial sample was inappropriate for culture according to microscopic evaluation.
- Do not accept repeat cultures at intervals of less than every 48 hour
- Reject the following specimens for diagnosis of lower respiratory tract disease -
  - 24 hours sputum collection
  - Contaminated sputum and endotracheal specimens as per Gram stain rejection criteria (see below)
  - Specimens that are visually saliva only

- Specimens that are visibly contaminated with toothpaste or other substances
- Nasal washes or swabs of nares to diagnose sinusitis
- Sputum samples are highly contaminated with normal anaerobic flora of the upper respiratory tract. Therefore, anaerobic culture should not be done.

6. PUS

Purpose: To isolate and identify bacterial etiological agent(s) in deep-seated pus/wound specimens.

Specimen collection

- Preferably collect specimen prior to initiation of therapy and only from wounds that are clinically infected or deteriorating or that fail to heal over a long period.
- Cleanse surrounding skin or mucosal surfaces.
- For closed wounds and aspirates, disinfect with 2% chlorhexidine or 70 % alcohol followed by an iodine solution [1 to 2% tincture iodine or a 10% solution of povidone-iodine (1% free iodine)]. Remove iodine with alcohol prior to specimen collection.
- For open wounds, debride, if appropriate, and thoroughly rinse with sterile saline prior to collection. Sample viable infected tissue, rather than superficial debris.

a) Wound or abscess aspirates

- Samples collected by using a syringe and needle should be placed in a sterile container or blood collection tube without anticoagulant (*e.g.*, Vacutainer or similar type) for submission to the laboratory.
- A portion of the sample should also be placed in a sterile tube containing anaerobic medium like RCM if an anaerobic culture is required.

b) Open wounds

- Cleanse the superficial area thoroughly with sterile saline, changing sponges with each application. Remove all superficial exudates.
- Remove overlying debris with scalpel and swabs or sponges.
- Collect biopsy or curette sample from base or advancing margin of lesion.

c) Pus

- Aspirate the deepest portion of the lesion or exudates with a syringe and needle.
- Collect a biopsy sample of the advancing margin or base of the infected lesion after excision and drainage.
- For bite wounds, aspirate pus from the wound, or obtain it at the time of incision, drainage, or debridement of infected wound.

d) Tissues and biopsy samples

- Tissue biopsy samples should be collected from areas within and adjacent to the area of infection. Large enough tissue samples should be collected to perform all of the tests required (i.e., 3 to 4 mm biopsy samples).

- If anaerobic culture is required, a separate piece of tissue should be submitted in a sterile tube containing anaerobic medium like RCM.
- Collect swabs only when tissue or aspirate cannot be obtained.
- Limit swab sampling to wounds that are clinically infected or those that are chronic and non-healing.
- Remove superficial debris by thorough irrigation and cleansing with non-bacteriostatic sterile saline. If wound is relatively dry, collect with two cotton-tipped swabs moistened with sterile saline.
- Gently roll swab over the surface of the wound approximately five times,focusing on area where there is evidence of pus or inflamed tissue.

Note: Organisms may not be distributed evenly in a burn wound, so sampling different areas of the burn is recommended. Blood cultures should be used to monitor patient status.

Standard precautions to be followed while handling the specimen

Note: Syringes with the needle attached should not be accepted due to the sharps and biohazard risk to staff.

Grossly contaminated specimen or leaky containers and collection containers of doubtful sterility must be noted and mentioned. Deliver aspirates and tissues to the laboratory within 30 minutes for best recovery. Keep tissues moist to preserve organism viability. Do not refrigerate or incubate before or during transport. If there is a delay, keep sample at room temperature, because at lower temperature there is likely to be more dissolved oxygen, which could be detrimental to anaerobes.

Rejection criteria

- For anaerobic culture, avoid swab collection if aspirates or biopsy samples can be obtained**.**
- Do not accept specimens for microbiological analysis in container with formalin.

7. URINE [14,15]

The most common urine specimen received is the per-urethral voided urine. Healthy urethra is unsterile and it is extremely critical that urine specimens be collected carefully to minimize urethral contamination. There are several types of urine specimens and the results of each type are determined by different guidelines. Therefore, it is essential that each urine specimen received by the laboratory is clearly labelled as to the type of collection of urine specimen.

COLLECTION OF URINE

a) Midstream clean catch urine

- The midstream clean catch urine is the most common type of urine specimen.
- The technique involved in collection is based on voiding the first portion of urine, which is most likely to be contaminated by urethral commensals.

- It is recommended that the first voided morning specimen be collected, as bacteria would have multiplied to high levels after overnight incubation in the bladder.
- If not possible, the urine can be collected during the day, preferably 4 hours after the last void, keeping in mind that the counts may be lower, yet significant.
- Midstream clean catch urine should be collected in a sterile, wide mouth, screw capped bottle after very thorough preliminary cleaning of external genitalia with soap and water. Antiseptics should not be used for this purpose.

b) Indwelling catheter

- Hospitalized patients with indwelling catheter are especially at risk of developing UTI.
- To avoid contamination, the specimen should be collected by disinfecting a portion of the catheter tubing with alcohol & puncturing the tubing directly with a sterile syringe with needle and aspirating the urine.
- The urine *must not* be collected from the drainage bag.

c) Suprapubic collection

- The suprapubic collection avoids urethral contamination but is invasive.
- This procedure is usually reserved for infants and adults, from whom it is difficult to obtain a midstream clean catch urine specimen.
- Disinfect the skin above the bladder and plunge a sterile needle with syringe into the bladder; aspirate the urine and transfer to a sterile container.

d) Percutaneous nephrostomy (PCN) aspirate

- Percutaneous nephrostomy aspirate is urine collected directly from renal pelvis.
- If the sample is a PCN catheter sample, collection must be done as explained for indwelling catheters and not from the drainage bag.

e) Cystoscopy specimens

- Cystoscopy specimen is urine collected from the bladder during cystoscopy.

f) Ileal conduit specimen

- Ileal conduit specimen is collected after cleaning stoma site.
- A fresh drain of urine is collected. It must not be collected from the urine drainage bag.

g) Intermittent catheter specimen

- A red rubber catheter should be introduced into the urethra periodically to drain urine from the bladder.
- It should be collected directly into a specimen container.

Specimen transport

- Urine must be transported to the lab as soon aspossible.

- It should be cultured as early as possible after collection, preferably within 2 hours.
- In case of delay, it may be refrigerated up to a maximum of 24 hours before plating.

8. FECAL SPECIMENS

Specimen collection and transport

- A small quantity of solid/semisolid stool or one third of the container in case of watery stool is collected in a sterile screw-capped disposable 40 ml container.
- A rectal swab is not recommended as the material obtained is never adequate for all the tests or for inoculating all the media used for culture.
- The sample should be collected preferably prior to initiation of antibiotics in the container directly, taking care not to soil the outside of the container. Samples should not be collected from bedpan.
- The sample should be immediately transported to the laboratory on collection.
- If there is a delay in transporting faecal specimens or if samples need to be sent by post, one of the following transport media may be employed –
  - Phosphate buffered glycerol saline solution
  - Stuart's transport medium
  - Cary and Blair transport medium

Note: *Wasfy et al., study confirms that Cary-Blair medium (CB) is suitable for the preservation of Salmonella and Shigella isolates for more than 2 weeks at 25ºC, 4ºC, or - 70ºC*[10]*. Campylobacter jejuni was not recovered after 2 days of storage in CB at 25ºC when an inoculum of 12 x 10 (8) cells per ml was used.*

SPECIMEN COLLECTION [13]

Types of infections and various specimens collected

Type of infections	Specimens collected
Blood stream infection, sepsis, endocarditis	Paired blood culture specimens Collected aseptically by two - step disinfection of skin; first with alcohol followed by chlorhexidine 8-10 ml of blood (for adults) collected in blood culture bottles
Infectious diseases requiring serology	Blood (2 ml/investigation) Collected by minimal a sepsis (one-step skin disinfection with alcohol) collected in vacutainer
Diarrheal diseases	Stool (mucus flakes), rectal swab
Meningitis	Cerebro-spinal fluid (CSF)
Infections of other sterile body area	Sterile body fluids; e.g. Pleural fluid, synovial fluid, peritoneal fluid
Skin and soft tissue infection	Pus or exudate, wound swabs, aspirates from abscess and tissue bites
Anaerobic culture	Aspirates, tissue specimens, blood and sterile body fluids, bone marrow (swabs, sputum not satisfactory)

Upper respiratory tract infection	Throat swab with membrane over the tonsil, nasopharyngeal swab, per-nasal swab
Lower respiratory tract infection	Sputum, endotracheal aspirate, broncho-alveolar lavage (BAL), protected specimen brush (PSB) and lung biopsy
Pulmonary tuberculosis	• Sputum-early morning and spot • Collected in well- ventilated area • Gastric aspirate for infants
Urinary tract infections	Midstream urine, Suprapubic aspirated urine, Catheterized patient-collected from the catheter tube, not from urobag
Genital specimens	Urethral swab, cervical swab - for urethritis exudate from genital ulcers
Eye infections	Conjunctival swabs, Corneal scrapings, Aqueous or vitreous fluid
Ear infections	Swabs from outer ear, Aspirate from inner ear

General Principles

Following principles should be followed while collecting the specimen -

a) Standard precautions
b) Before starting antibiotics
c) Contamination with indigenous flora should be avoided
d) Swabs-convenient but considered inferior to tissue, aspirate and body fluids
e) Container: sterile, tightly sealed, leak proof, wide-mouth
f) Labelling: All specimens-labelled with name, age, gender, treating physician, diagnosis etc.
g) Rejection: Specimens contaminated or improperly labeled may be rejected
h) Anaerobic culture-proper anaerobic collection containers with media should be used.

Specimen Transport

Most specimens-transport time should not exceed *two hours*. However, there are some exceptions-

a) Immediate transport (< 15 minutes) – CSF and body fluids, ocular specimens, tissue specimens, suprapubic aspirate and bone specimen.
b) Urine (midstream) - added with preservative (boric acid) - transported within 2 hours.
c) Stool culture - transported within 1 hour.
d) Rectal swabs - upto 24 hours is acceptable.
e) For anaerobic culture - Robertson's cooked meat broth or any specialized anaerobic transport system.

Most specimens stored *at room temperature up to 24 hours*. There are some exceptions-

a) Blood cultures - incubated at 37°C immediately upon receipt.
b) Sterile body fluids - immediately plated upon receipt - incubated at 37°C.

Corneal scrapping – plated at bed-side

a) **Stool culture** - stored up to 72 hours at 4°C
b) **Urine** (mid-stream and from catheter), lower respiratory tract specimen, gastric biopsy (for *Helicobacter pylori*) - stored up to 24 hours at 4°C.

"Good *quality specimens are the corner stone for high quality diagnosis*"

REFERENCES

1. Little JR, Murray PR, Traynor PS, Spitznagel E. A randomized trial of povidone-iodine compared with iodine tincture for venipuncture site disinfection: effects on rates of blood culture contamination. The American Journal of Medicine. 1999 Aug; 107(2):119-25.
2. Mimoz O, Karim A, Mercat A, Cosseron M, Falissard B, Parker F, et al., Chlorhexidine compared with povidone iodine as skin preparation before blood culture. A randomized, controlled trial. Annals of Internal Medicine. 1999 Dec7; 131(11): 834-7.
3. Isenberg HD. Clinical microbiology procedures handbook. Washington, D.C: American Society for Microbiology; 2007. p. 3.4.1. - 3.4.1.19.
4. Principles and Procedures for Blood Cultures; Approved Guideline. CLSI document M47 - A. ed. Wayne, PA: Clinical and Laboratory Standards Institute (CLSI), USA; 2007.
5. James PA, Alshafi KM. Clinical value of anaerobic blood culture: a retrospective analysis of positive patient episodes. J Clin Pathol. 2000 Mar; 53(3): 231-3.
6. Cartwright C, Igbaseimokumo U. Lumbar puncture opening pressure is not a reliable measure of intracranial pressure in children. J Child Neurol. 2015 Feb; 30(2):170-3.
7. K. Lily Therese & H. N. Madhavan. Microbiological procedures for diagnosis of ocular infections. Indian Journal of Medical Microbiology (IJMM) http://www.ijmm.org/documents/ocular.pdf.
8. Lauer BA, Masters HB. Toxic effect of calcium alginates swabs on *Neisseria gonorrhoeae*. J Clin Microbiol.1988 Jan; 26(1): 54-6.
9. Swab types: http://www.mwe.co.uk/microbiology-lab-supplies/dry-swabs-cotton-swabs-rayon-swabs-dacron-swabs/.
10. Sampsonas F, Kontoyiannis DP, Dickey BF, Evans SE. Performance of a standardized broncho-alveolar lavage Protocolina comprehensive cancer center: a prospective 2 - year study. Cancer. 2011 Aug1; 117(15): 3424-33.
11. Wasfy M, Oyofo B, Elgindy A, Churilla A. Comparison of preservation media for storage of stool samples. J Clin Microbiol. 1995Aug; 33 (8): 2176-8.
12. UK Standards for Microbiology Investigation of tissues and biopsies from deep seated sites and organs.https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672216/B_17i6.3.pdf.
13. Essential of Medical Microbiology. Apurba S Sastry, Sandhya Bhat. Laboratory diagnosis of bacterial infections. 4th Edition 2023.
14. Collee G, Duguid P, Fraser G, Marmian P, Mackey and Mac Cartney's. Practical Medical Microbiology.14thed. Longman, Singapore: Churchill Livingstone Publishers; 2003.
15. Standard operating procedure of bacteriology. Antimicrobial Resistance Surveillance and Research Network, 2nd Edition, 2019, ICMR.

3. RIMS HOSPITAL ANTIBIOGRAM 2022-23

The isolation distribution of top 10 pathogens isolated in different healthcare is classified as outpatient (from patients attending OPDs), inpatient (from patients admitted in wards other than high dependency areas like ICUs) and ICU (high dependency wards).

Bacteria	Location			
	Total	OPD	Ward	ICU
Escherichia coli	1172	608	473	91
Staphylococcus aureus	470	259	179	32
Klebsiella pneumoniae	545	199	209	137
Enterococcus faecalis	177	46	114	17
Pseudomonas aeruginosa	234	51	103	80
Acinetobacter baumannii	171	17	76	78
Enterococcus spp.	117	28	70	19
Klebsiella oxytoca	141	50	63	28
Enterococcus faecium	90	23	54	13
Escherichia coli Diarrhoeagenic	43	34	9	0

The following information was recorded for each isolate: study number, age, sex, clinical diagnosis, location (OPD/ward/ICU), date of specimen collection, and specimen nature (blood, pus, urine, etc.). For ICU cases, the date of admission and details of antibiotic therapy were also documented.

i. The isolates were identified to the species level using either a conventional biochemical test system or an automated system, following the ICMR SOP.

ii. Susceptibility tests were conducted in accordance with the ICMR SOP.

✓ No. of cultures isolated and cultures for which AST was done:

Month	Total No. of sample received	No. of culture isolated
Jul-22	1221	356
Aug-22	1034	329
Sep-22	1032	404
Oct-22	1055	425
Nov-22	1216	375
Dec-22	1192	342
Jan-23	1222	416
Feb-23	1259	418
Mar-23	1329	402
Apr-23	1135	404
May-23	1156	367
Jun-23	1017	358

Denominator Data:

Following table represents denominator data specimen wise as well as location wise

Data collected for iAMRSN (specimen wise)		
Specimen type	**No. of specimens received for culture**	**No. of Culture Positive**
Blood	1394	143
CSF	61	0
Faeces	371	126
LRT	1909	671
Superficial Infection	1415	1166
Deep Infection	11	3
SS	461	45
Urine	7844	2258
Others	402	194

Data collected for iAMRSN (Location wise)			
Specimen location	**WARD**	**ICU**	**OPD**
No. of specimen received for culture	6163	1350	6355
No. of culture positive isolates	1994	710	1902

AMR data:

- ✓ AMR data of all the clinical isolates obtained in laboratory had been entered manually on monthly basis on the AMR portal website which includes patient's information, hospital information, sample information and Susceptibility test values.
- ✓ Data has been validated by the regional admin.
- ✓ Analysis of the accepted data is done using iAMRSN portal to evaluate isolation rate susceptibility rate, yearly and monthly isolation trends along with resistance trend for RIMS, Hospital, Imphal.
- ✓ Detailed analysis of the data for 2021-2022 is mentioned in this report.

Detailed analysis of results indicating contributions made towards increasing the state of knowledge in the subject.

SUMMARY

The total number of isolates studied from July 2022 to June 2023 was 3524. The distribution of major groups of organisms in different specimens is presented in Table 1.1 and Figure 1.1.

- Members of the Enterobacteriaceae family were the most common organisms in urine (61.6%), followed by cases of Superficial Infection (18.8%), Lower Respiratory Tract (LRT) infections (15.2%), others (2.2%), and blood (1.4%).
- Staphylococci were the predominant isolates in cases of superficial infection (62.9%), urine (16.1%), blood (9.5%), LRT infections (6.8%), and others (3.9%).
- Non-fermenting gram-negative bacilli (NFGNB) were isolated most frequently in cases of LRT infections (37.4%), followed by superficial infections (26.4%), urine (26.4%), blood (4%), others (3.3%), and surgical site (SS) infections (2.6%).
- Enterococci were isolated primarily from urine specimens (77.1%), followed by cases of superficial infection (13.5%), others (2.3%), and SS infections (1.3%).

Isolate	CULTURE POSITIVE																	
	Total		Blood		Urine		LRT		Superficial Infection		Deep Infection		SS		Faeces		Others	
	n=Total		n=Blood		n=Urine		n=LRT		n=SI		n=DI		n=SS		n=Faeces		n=Others	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
No. culture positive	3524 (100)	100	108 (100)	3.06	1789 (100)	50.77	544 (100)	15.44	904 (100)	25.65	2 (100)	0.06	36 (100)	1.02	51 (100)	1.45	90 (100)	2.55
Ward incl HDU	1515 (42.99)	100	54 (50)	3.6	753 (42.09)	49.7	138 (25.37)	9.1	493 (54.54)	32.5	0 (0)	0	24 (66.67)	1.6	10 (19.61)	0.7	43 (47.78)	2.8
OPD	1464 (41.54)	100	18 (16.67)	1.2	849 (47.46)	58	203 (37.32)	13.9	325 (35.95)	22.2	2 (100)	0.1	6 (16.67)	0.4	41 (80.39)	2.8	20 (22.22)	1.4
ICU	545 (15.47)	100	36 (33.33)	6.6	187 (10.45)	34.3	203 (37.32)	37.2	86 (9.51)	15.8	0 (0)	0	6 (16.67)	1.1	0 (0)	0	27 (30)	5
Enterobacteriaceae (except Salmonella)	2098 (59.53)	100	29 (26.85)	1.4	1292 (72.22)	61.6	318 (58.46)	15.2	395 (43.69)	18.8	0 (0)	0	16 (44.44)	0.8	2 (3.92)	0.1	46 (51.11)	2.2
Enterococci	384 (10.9)	100	7 (6.48)	1.8	296 (16.55)	77.1	13 (2.39)	3.4	52 (5.75)	13.5	1 (50)	0.3	6 (16.67)	1.6	0 (0)	0	9 (10)	2.3
Faecal isolates	47 (1.33)	100	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0	47 (92.16)	100	0 (0)	0
Fungi	0 (0)	100	0 (0)	NAN	0 (0)	NAN	0 (0)	NAN	0 (0)	NAN	0 (0)	NAN	0 (0)	NAN	0 (0)	NAN	0 (0)	NAN
NFGNB	425 (12.06)	100	17 (15.74)	4	112 (6.26)	26.4	159 (29.23)	37.4	112 (12.39)	26.4	0 (0)	0	11 (30.56)	2.6	0 (0)	0	14 (15.56)	3.3
Invasive Salmonella	5 (0.14)	100	3 (2.78)	60	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0	2 (3.92)	40	0 (0)	0
Staphylococci	545 (15.47)	100	52 (48.15)	9.5	88 (4.92)	16.1	37 (6.8)	6.8	343 (37.94)	62.9	1 (50)	0.2	3 (8.33)	0.6	0 (0)	0	21 (23.33)	3.9
Streptococcus	20 (0.57)	100	0 (0)	0	1 (0.06)	5	17 (3.13)	85	2 (0.22)	10	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0

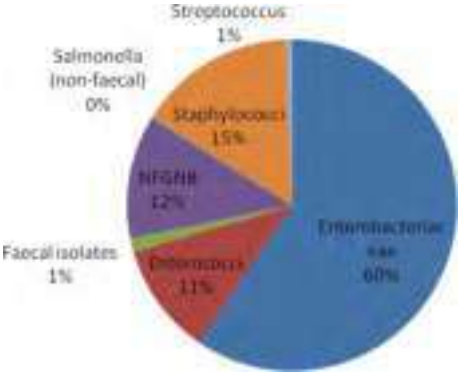
Table : 1.1 Distributions of major group of organisms Note:

1. **Blood includes**: Blood-central catheter, Blood-peripheral and Peripheral catheter-blood.
2. **LRT (Lower Respiratory Tract) includes**: BAL, Sputum, Lung aspirate, endotracheal aspirate (ETA) and Lobectomy tissue (Lung tissue).
3. **Superficial Infection includes**: SST (Skin & Soft Tissue), Pus/exudate, Wound swab, Superficial Biopsy and Superficial Tissue.
4. **Deep Infection includes**: Abscess aspirate, Pus aspirate, Deep Biopsy and Deep Tissue.
5. **SS (Sterile sites) includes**: Fluid from sterile spaces, abdominal fluid, Intercostal tube fluid, pancreatic drain fluid, pericardial fluid, peritoneal fluid and Pleural fluid.

Figure 1.1 Specimen wise distributions of major groups of organisms

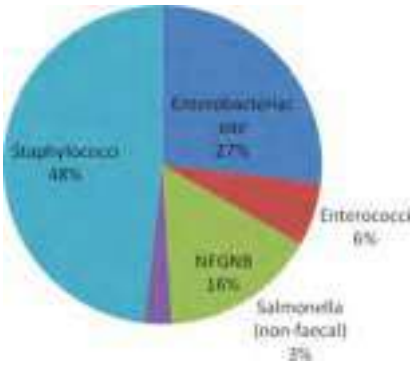
A. All Specimen:

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Enterobacteriaceae	2098	59.5
Enterococci	384	10.9
Faecal isolates	47	1.3
NFGNB	425	12.1
Salmonella (non-faecal)	5	0.1
Staphylococci	545	15.5
Streptococcus	20	0.6
Total	3524	100



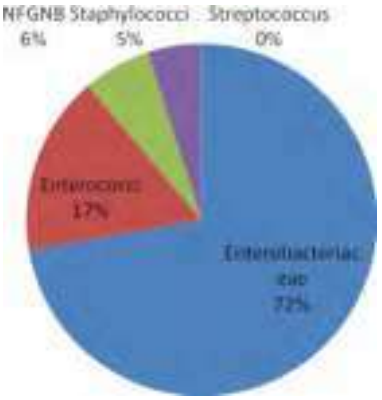
B. Blood:

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Enterobacteriaceae	29	26.9
Enterococci	7	6.5
NFGNB	17	15.7
Salmonella (non-faecal)	3	2.8
Staphylococci	52	48.1
Total	108	100



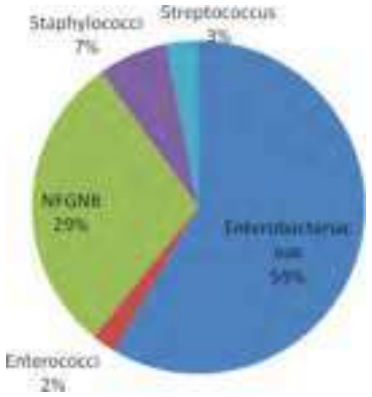
C. Urine:

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Enterobacteriaceae	1292	72.2
Enterococci	296	16.5
NFGNB	112	6.3
Staphylococci	88	4.9
Streptococcus	1	0.1
Total	1789	100



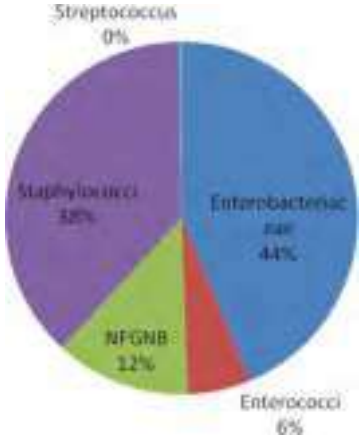
D. LRT :

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Enterobacteriaceae	318	58.5
Enterococci	13	2.4
NFGNB	159	29.2
Staphylococci	37	6.8
Streptococcus	17	3.1
Total	544	100



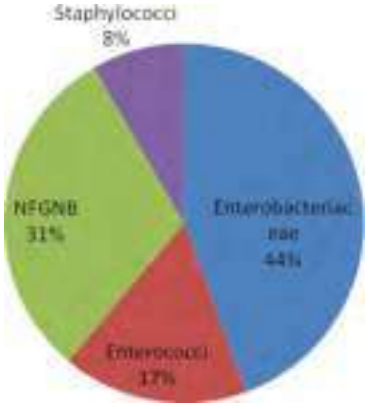
E. Superficial Infection :

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Enterobacteriaceae	395	43.7
Enterococci	52	5.8
NFGNB	112	12.4
Staphylococci	343	37.9
Streptococcus	2	0.2
Total	904	100



F. Sterile Site (SS) :

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Enterobacteriaceae	16	44.4
Enterococci	6	16.7
NFGNB	11	30.6
Staphylococci	3	8.3
Total	36	100



The presented data includes the relative isolation rates of various species obtained from patients in different healthcare units: Outpatient Department (OPD), Wards, and Intensive Care Units (ICUs). The data is provided in Table 1.2

Overall, the most frequently isolated species was Escherichia coli, accounting for 33% of isolates, followed by Klebsiella pneumoniae at 15%, Staphylococcus aureus at 13%, and Pseudomonas aeruginosa at 7%.

In terms of distribution, E. coli, K. pneumoniae, and S. aureus were prevalent in both the OPD and Wards. However, in the ICU, Klebsiella pneumoniae was the predominant isolate.

In summary, the data underscores the varying prevalence of different species in different healthcare settings, with E. coli being the most common overall, and different species predominating in different units.

Table 1.2 Distribution of species of organisms in isolates from OPD, ward and ICU

Bacteria	Location			
	Total	**OPD**	**Ward**	**ICU**
Escherichia coli	1172	608	473	91
Staphylococcus aureus	470	259	179	32
Klebsiella pneumoniae	545	199	209	137
Enterococcus faecalis	177	46	114	17
Pseudomonas aeruginosa	234	51	103	80
Acinetobacter baumannii	171	17	76	78
Enterococcus spp.	117	28	70	19
Klebsiella oxytoca	141	50	63	28
Enterococcus faecium	90	23	54	13
Escherichia coli Diarrhoeagenic	43	34	9	0

Enterobacteriaceae is the predominant group of isolates within Enterobacteriaceae, aside from salmonellae, accounted for the largest proportion (59.53%) overall, as indicated in Table 1.1. The distribution of major species within the Enterobacteriaceae family based on specimen type is provided in Table 1.3 and Figures 1.3a and 1.3b. In general, Escherichia coli emerged as the most frequently encountered species (27.8%), followed by Klebsiella pneumoniae (19.49%) (as detailed in Table 1.3 and Figures 1.3a and 1.3b).

Escherichia coli stood out as the primary isolate from urine samples (64%) and superficial tissue infections (26.7%), demonstrating its prominence in these contexts.

Table 1.3 Specimen wise distribution of major species of family

Isolate	Culture positive																			
	Total n=3324		Blood n=108		Urine n=1789		LRT n=544		Superficial Infection n=894		Deep Infection n=2		CSF n=9		EG n=36		Faeces n=51		Others n=90	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
No. culture positive	3324 (100)	100	108 (100)	3.06	1789 (100)	52.77	504 (100)	15.44	364 (100)	25.83	2 (100)	0.06	0 (100)	0	35 (100)	1.02	51 (100)	1.42	90 (100)	2.33
Escherichia coli	1172 (35.26)	100	16 (14.81)	1.4	889 (49.64)	75.8	67 (13.32)	5.7	181 (20.02)	15.4	0 (0)	0	0 (NAN)	0	9 (25)	0.8	0 (0)	0	11 (12.22)	0.9
Citrobacter +	82 (2.33)	100	2 (1.85)	2.4	37 (2.07)	45.1	17 (3.13)	20.7	23 (2.43)	28.8	0 (0)	0	0 (NAN)	0	0 (0)	0	1 (1.96)	1.2	2 (2.22)	2.7
Klebsiella +	680 (19.52)	100	5 (7.41)	1.3	383 (15.83)	43.1	219 (40.29)	31.8	143 (16.54)	21.1	0 (0)	0	0 (NAN)	0	3 (13.33)	0.7	0 (0)	0	28 (31.11)	4.1
Enterobacter +	44 (1.25)	100	1 (0.93)	2.3	21 (1.17)	47.7	4 (0.74)	9.1	15 (1.89)	34.1	0 (0)	0	0 (NAN)	0	2 (5.56)	4.5	1 (1.96)	2.3	0 (0)	0
Hafnia alvei	0 (0)	100	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0	0 (0)	0	0 (NAN)	0	0 (0)	0	0 (0)	0	0 (0)	0
Serratia marcescens	4 (0.11)	100	1 (0.93)	25	1 (0.06)	25	2 (0.37)	50	0 (0)	0	0 (0)	0	0 (NAN)	0	0 (0)	0	0 (0)	0	0 (0)	0
Proteus +	54 (2.47)	100	0 (0)	0	54 (3.02)	57.4	6 (1.1)	6.4	30 (3.33)	31.9	0 (0)	0	0 (NAN)	0	0 (0)	0	0 (0)	0	4 (4.44)	4.3
Morganella morganii	12 (0.34)	100	0 (0)	0	7 (0.39)	58.3	2 (0.55)	23	2 (0.22)	16.7	0 (0)	0	0 (NAN)	0	0 (0)	0	0 (0)	0	0 (0)	0
Providencia +	2 (0.06)	100	1 (0.93)	50	1 (0.06)	50	0 (0)	0	0 (0)	0	0 (0)	0	0 (NAN)	0	0 (0)	0	0 (0)	0	0 (0)	0

Fig. 1.3a Specimen wise distribution of major species of family Enterobacteriaceae

All Specimen:

Bacteria (Group/Sub group/Species)	Number of isolates (n)	Percent (%)
Citrobacter freundii	27	1.3
Citrobacter koseri	50	2.4
Citrobacter spp.	5	0.2
Enterobacter cloacae	3	0.1
Enterobacter spp.	5	0.2
Escherichia coli	1172	55.9
Klebsiella (Enterobacter) aerogenes	37	1.8
Klebsiella oxytoca	141	6.7
Klebsiella pneumoniae	545	26
Klebsiella spp.	2	0.1
Morganella morganii	12	0.6
Proteus mirabilis	19	0.9
Proteus vulgaris	24	1.1
Providencia rettgeri	1	0
Providencia stuartii	1	0
Serratia marcescens	4	0.2
Total	2099	100

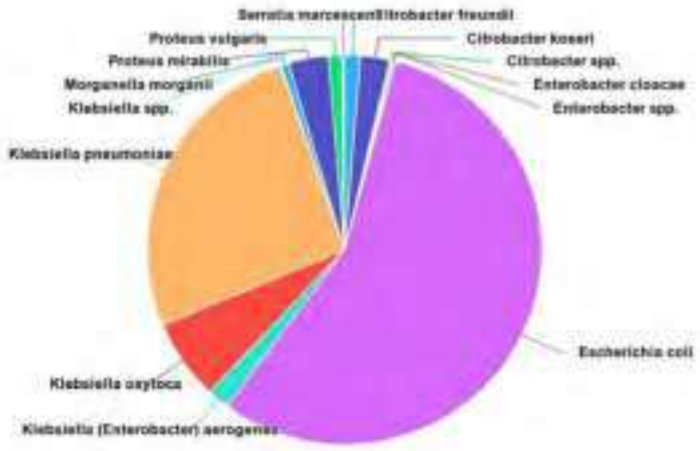
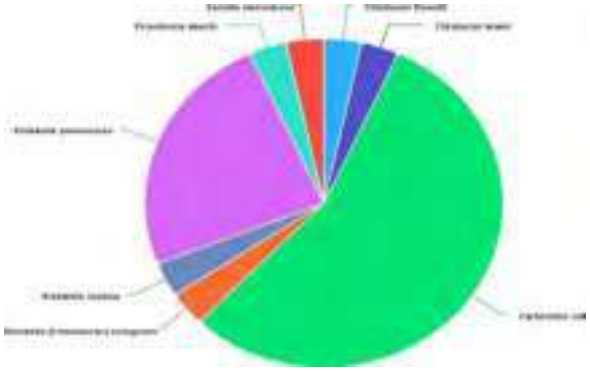
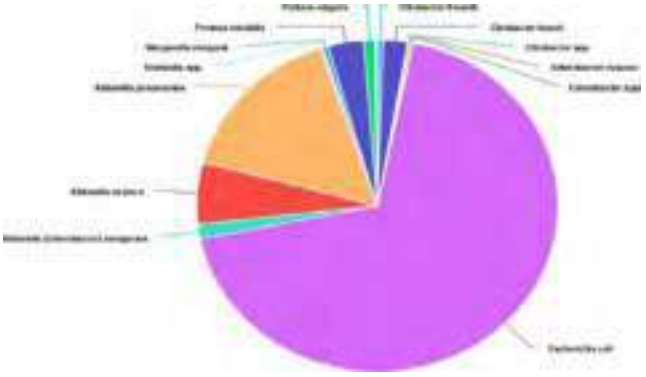


Fig. 1.3b Specimen wise distribution of major species of family Enterobacteriaceae

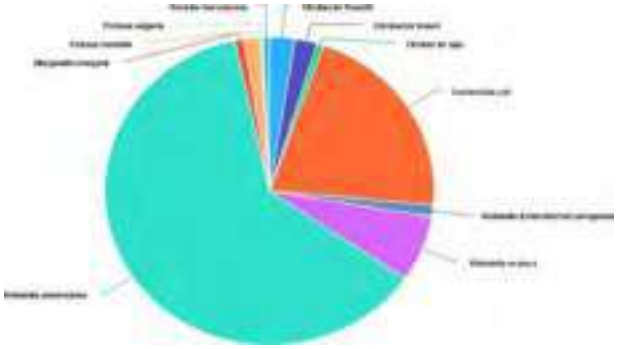
A. Blood:



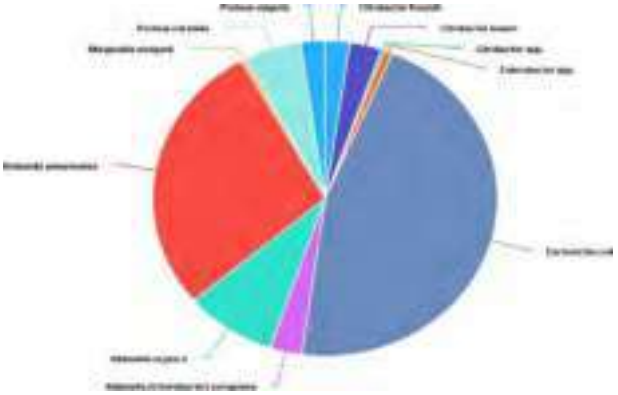
B. Urine



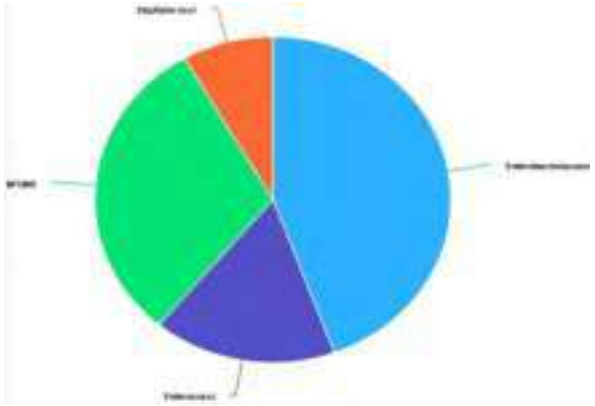
C. LRT:



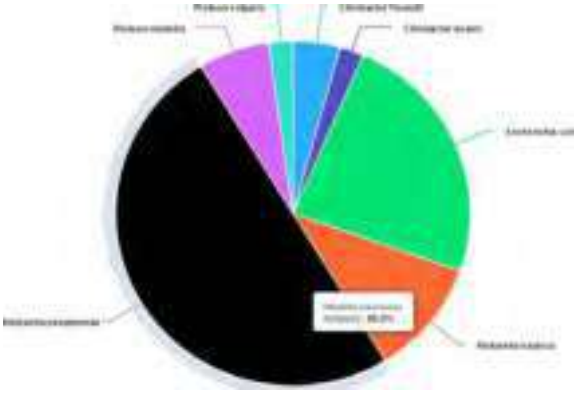
D. Superficial Infection



G. Sterile Site (SS)

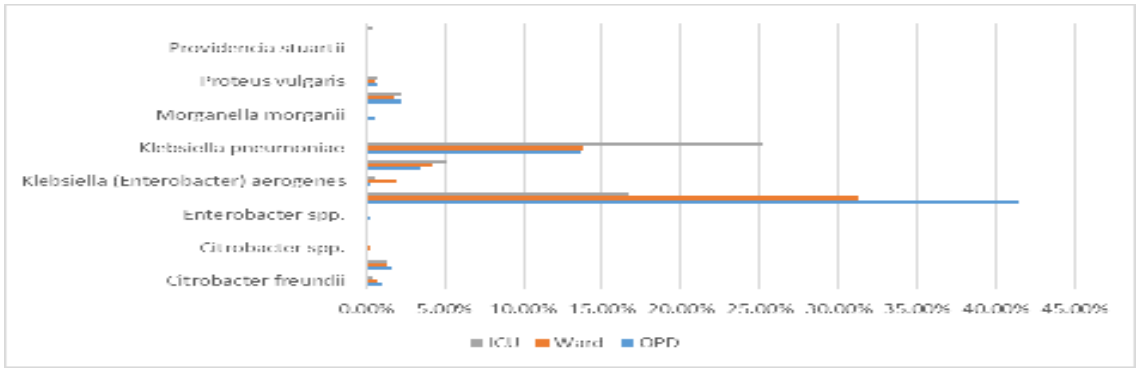


F. Others



Location wise distribution (Table 1.4) showed that, In Wards, OPD & ICU *E.coli* is the predominant species followed by *Klebsiella pneumoniae*.

Table 1.4 Location wise distribution of major species of family Enterobacteriaceae



Staphylococci constituted 15.47% of all isolates (as shown in Table 1.1). Among the Staphylococci, Staphylococcus aureus was the most frequently isolated strain (15.1%), followed by CoNS (2.1%). Staphylococcus aureus was predominantly identified in cases of superficial infections (34.8%), followed by occurrences in blood samples (24.1%). CoNS were primarily isolated from blood samples (24.1%). (as indicated in Table 1.5 and Fig.1.5c)

Staphylococcus aureus stood out as the predominant Staphylococci species among all clinical isolates, both overall and across all hospital locations (as indicated in Table 1.5).

Furthermore, Staphylococcus aureus was more commonly encountered in wards, as well as in the outpatient department (OPD) and intensive care units (ICU) (as depicted in Figure 1.5b).

Table 1.5 Specimen wise distribution of *Stapylococci*

Isolate	Culture positive																			
	Total n=3524		Blood n=108		Urine n=1789		ENT n=544		Superficial infection n=904		Deep infection n=2		CSF n=0		SS n=38		Faeces n=31		Others n=48	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
No. culture positive	3524 (100)	100	108 (100)	3.1	1789 (100)	50.8	544 (100)	15.4	904 (100)	25.7	*2 (-)	0.1	*0 (-)	0	38 (100)	1	31 (100)	1.4	90 (100)	2.6
Staphylococci	545 (15.5)	100	52 (48.1)	9.5	88 (4.9)	16.1	37 (6.8)	6.8	343 (37.9)	62.9	*1 (-)	0.2	*0 (-)	0	3 (8.5)	0.6	0 (0)	0	21 (23.3)	3.9
CoNS	75 (2.1)	100	26 (24.1)	34.7	9 (0.5)	12	10 (1.8)	13.3	28 (3.1)	37.3	*0 (-)	0	*0 (-)	0	1 (2.6)	1.3	0 (0)	0	1 (1.1)	1.3
Staphylococcus aureus	470 (13.3)	100	26 (24.1)	5.5	79 (4.4)	16.8	27 (5)	5.7	315 (34.8)	67	*1 (-)	0.2	*0 (-)	0	2 (5.6)	0.4	0 (0)	0	20 (22.2)	4.3
MSSA	0 (0)	-	0 (0)	-	0 (0)	-	0 (0)	-	0 (0)	-	*0 (-)	-	*0 (-)	-	0 (0)	-	0 (0)	-	0 (0)	-
MRSA	387 (10.4)	100	25 (23.1)	6.5	80 (5.4)	16.3	19 (3.5)	5.2	243 (26.9)	66.2	*1 (-)	0.3	*0 (-)	0	2 (5.6)	0.5	0 (0)	0	17 (18.9)	4.4

Figure 1.5b Location wise distribution of *Stapylococci*

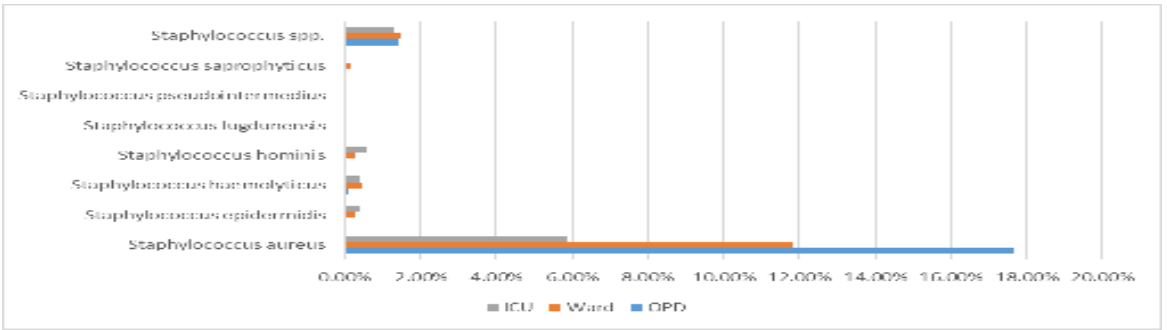
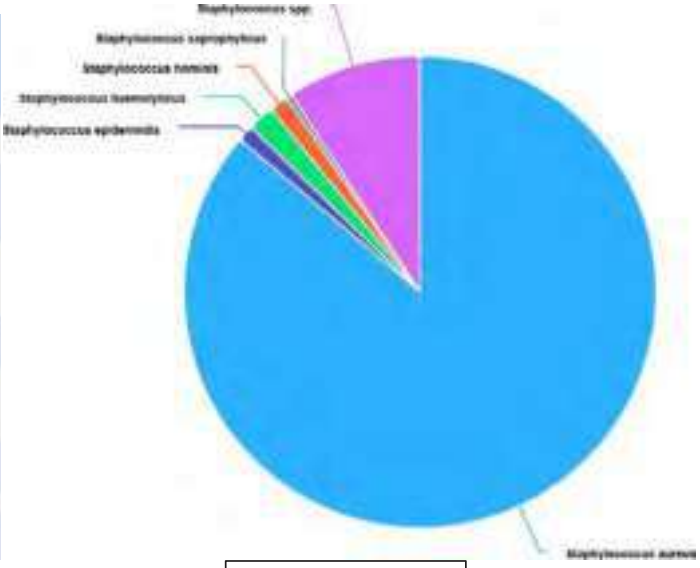


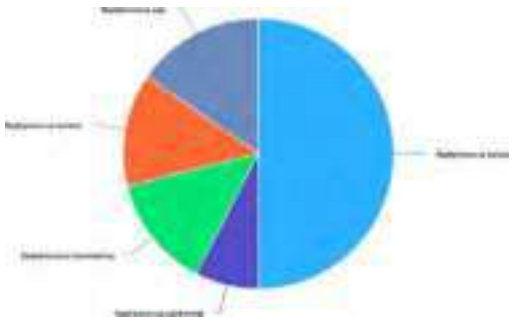
Figure 1.5c Specimen wise distribution of *Stapylococci*

A. All Specimen

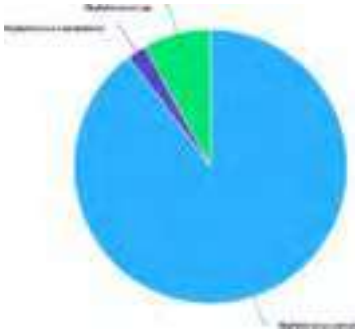
Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Staphylococcus aureus	470	86.2
Staphylococcus epidermidis	6	1.1
Staphylococcus haemolyticus	10	1.8
Staphylococcus hominis	7	1.3
Staphylococcus saprophyticus	2	0.4
Staphylococcus spp.	50	9.2
Total	545	100



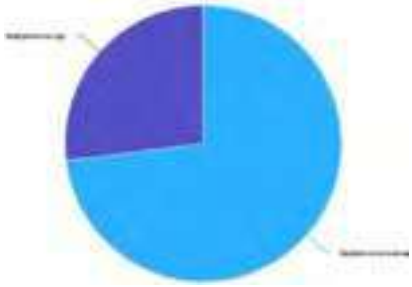
BLOOD



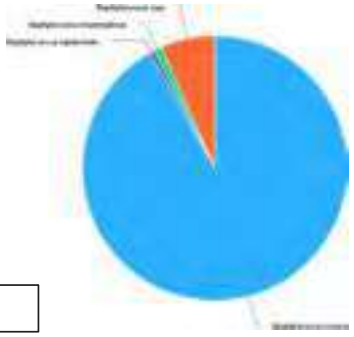
URINE



LRT



SUPERFICIAL INFECTION



OTHERS

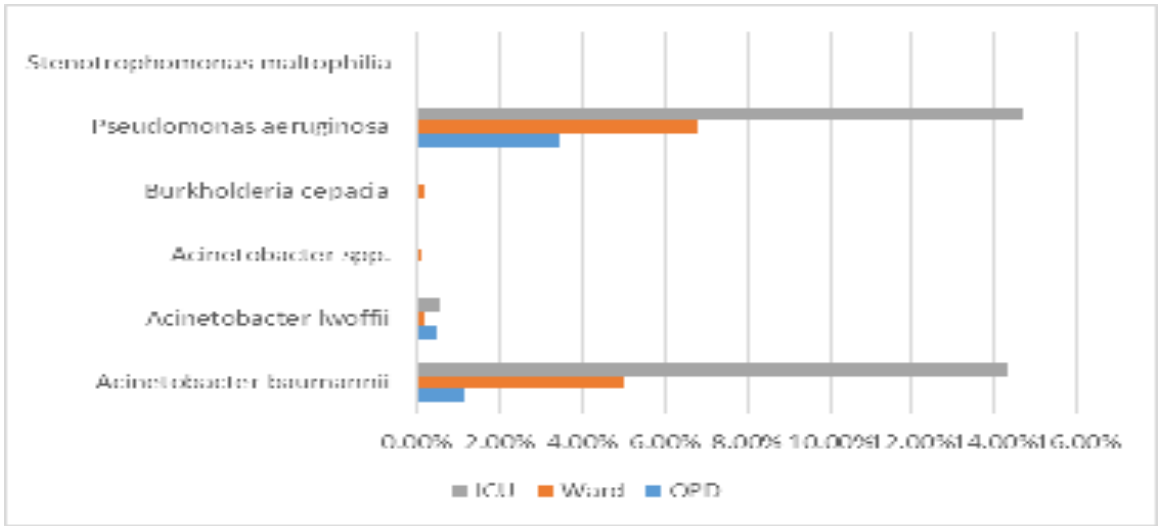
Non-fermenting Gram-negative bacteria (NFGNB) constituted 12.1% of the total isolates, as detailed in Table 1.1. Within the NFGNB category, Pseudomonas aeruginosa emerged as the most prevalent isolate at 6.6%, closely followed by Acinetobacter baumannii at 5.3%. Pseudomonas aeruginosa showcased a significant predominance in cases involving the Lower Respiratory Tract (LRT), accounting for 35.5%, with additional occurrences noted in urine samples (32.1%) and cases of superficial infections (26.1%). On the other hand, Acinetobacter baumannii was predominantly isolated from LRT specimens, constituting 40.6% of such cases as shown in Table 1.6

Pseudomonas aeruginosa held a prominent position as the leading NFGNB species among clinical isolates on a comprehensive level and across all hospital departments, as evidenced by the data presented in Table 1.6.

Moreover, both Pseudomonas aeruginosa and Acinetobacter baumannii exhibited a higher prevalence in Intensive Care Units (ICUs), as depicted in Figure 1.6b. For a thorough breakdown of the distribution of NFGNB specimens, please refer to Table 1.

Table 1.6 Specimen wise distribution of Non-fermenting Gram-negative bacteria.

Figure 1.6b Location wise distribution of Non-fermenting Gram-negative bacteria



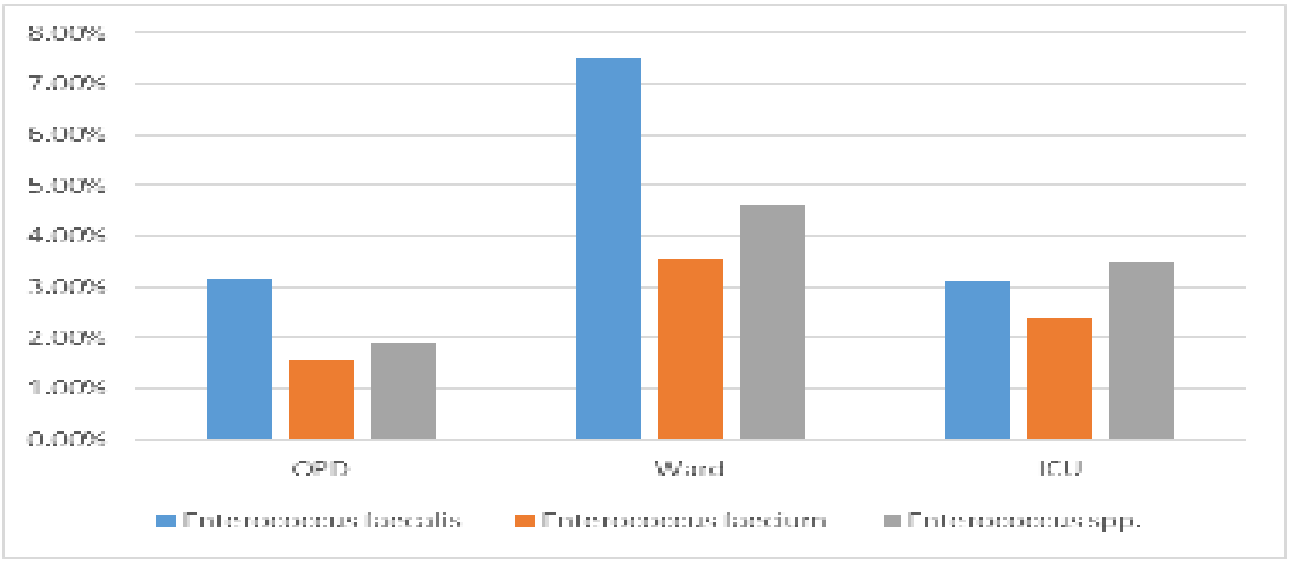
Enterococci constituted 10.9% of the total isolates, as indicated in Table 1.1. Among the specific Enterococcus species, namely E. faecalis and other Enterococcus spp., there was a noticeably higher prevalence in cases of Urine infections, accounting for 80.2% and 77.8% (refer to Table 1.7), respectively. This suggests that these two species were more commonly encountered in cases of urine-related infections

Enterococcus were more common in ward as well as in OPD and ICU (Figure 1.7a)

Table 1.7 Specimen wise distribution of Enterococcus.

Isolate	Culture positive																			
	Total n=3624		Blood n=188		Urine n=1789		LRT n=544		Superficial infection n=804		Deep infection n=12		CSF n=13		SS n=36		Faeces n=61		Others n=60	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
No culture positive	3624 (100)	100	188 (100)	3.1	1789 (100)	50.6	544 (100)	15.4	804 (100)	25.7	12 (-)	0.1	13 (-)	0	36 (100)	1	61 (100)	1.4	60 (100)	2.6
Enterococci	384 (10.9)	100	7 (6.8)	1.8	296 (16.8)	77.1	13 (2.4)	3.4	52 (5.8)	13.5	1 (-)	0.3	0 (-)	0	6 (16.7)	1.8	0 (0)	0	9 (15)	2.3
Enterococcus faecalis	177 (5)	100	2 (1.8)	1.1	142 (7.9)	80.2	6 (1.1)	3.4	21 (2.3)	11.9	0 (-)	0	0 (-)	0	2 (5.6)	1.1	0 (0)	0	4 (4.4)	2.3
Enterococcus faecium	99 (2.8)	100	4 (3.7)	4.4	63 (3.5)	70	2 (0.4)	2.2	16 (1.8)	17.8	1 (-)	1.1	0 (-)	0	3 (8.3)	3.3	0 (0)	0	1 (1.1)	1.1
Enterococcus spp.	117 (3.3)	100	1 (0.9)	0.9	91 (5.1)	77.8	5 (0.9)	4.3	10 (1.7)	12.8	0 (-)	0	0 (-)	0	1 (2.8)	0.9	0 (0)	0	4 (4.4)	3.4

Figure 1.7a Location wise distribution of Enterococcus.



Chapter 2 Enterobacteriaceae

Susceptibility of Enterobacteriaceae to various antibiotics is shown in Table 2.1 Amikacin is most sensitive in 76% & Meropenem in 2nd most sensitive in 70.4%, Cefazolin in least sensitive with only 11.1%.

Table 2.1 Results of susceptibility of Enterobacteriaceae to various antibiotics tested (results in %).

AMA	# Isolates	Amikacin	Cefazolin	Cefotaxime	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Fosfomycin	Imipenem	Levofloxacin	Meropenem	Minocycline	Colistin	Nitrofurantoin	Piperacillin-tazobactam	Trimethoprim-sulfamethoxazole
Escherichia coli	**1172**	88	15	11	12	16	15	72	94	60	24	74	84	100	93	17	46
Citrobacter freundii	**27**	89	0	23	15	35	39	89	100	54	62	92	73	100	67	23	50
Citrobacter koseri	**50**	85	0	15	18	13	24	65	63	56	29	74	91	100	63	9	33
Citrobacter spp.	**5**	60	0	0	0	25	40	60	100	40	40	80	100	100	0	40	0
Klebsiella pneumoniae	**545**	75	23	19	19	25	22	56	78	49	39	60	70	100	60	12	54
Klebsiella oxytoca	**141**	78	1	14	16	15	15	52	67	49	26	53	74	100	68	7	38
Klebsiella spp.	**2**	100	0	0	0	0	0	100	100	100	50	100	0	100	100	100	0
Enterobacter aerogenes	**37**	67	0	12	15	15	36	55	88	42	44	58	93	100	93	12	56
Enterobacter cloacae	**2**	50	0	0	0	0	0	0	50	0	0	0	0	100	100	0	0
Enterobacter spp.	**5**	75	0	0	0	0	0	50	0	50	0	75	100	100	0	0	0
Serratia marcescens	**4**	100	100	0	0	75	75	75	0	25	100	100	100	100	100	0	100
Proteus mirabilis	**70**	85	38	35	31	47	31	79	53	74	47	85	16	-	0	41	35
Proteus vulgaris	**24**	86	0	14	14	8	29	79	38	50	36	86	50	-	0	14	50
Morganella morganii	**12**	80	0	10	20	20	30	80	20	40	40	90	33	-	0	33	60
Providencia rettgeri	**1**	0	0	0	0	0	100	0	100	0	100	0	0	-	0	0	100
Providencia stuartii	**1**	100	0	100	100	100	100	100	0	100	100	100	0	-	0	0	0

Analysis of results:

Summary of results: All isolates from the Enterobacteriaceae family underwent susceptibility testing against amikacin, cefotaxime, ceftazidime, ciprofloxacin, ertapenem, imipenem, meropenem, levofloxacin, and piperacillin-tazobactam, as depicted in Table 2.

The susceptibility of the three major species within the Enterobacteriaceae family namely E. coli, Klebsiella spp, and Proteus species—was analyzed separately based on the specimen type: blood, lower respiratory tract, skin and superficial tissue infections, and urine.

Detailed analysis of data:

The susceptibility of the family Enterobacteriaceae analysed according to the specimen type, blood, urine, lower respiratory tract, superficial infection & sterile site (Table 2.2 - 2.5).

- In specimen blood, E.coli showed 93.3 % susceptible to amikacin followed by Minocycline83.3%
- In specimen urine, E.coli showed 93.8% Susceptible Fosfomycin & K. pneumoniae showed 78.3 % susceptible Fosfomycin. All isolates showed fairly good susceptibility.

- In LRT, K. pneumoniae was more susceptible to Amikacin (79.3%). E.coli were most susceptible to Minocycline followed by carbapenems.
- In Superficial infections, E. coli was more susceptible to amikacin followed by Minocycline. K. pneumoniae showed more susceptible to Minocycline.

Table 2.2 Susceptibility of *Enterobacteriaceae spp*. from Blood

AMA	**no isolates**	Amikacin	Cefotaxime	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Colistin	Imipenem	Levofloxacin	Meropenem	Minocycline	Piperacillin-tazobactam
Escherichia coli	**16**	93.3	6.7	13.3	26.7	26.7	73.3	100	60	33.3	66.7	83.3	6.7
Klebsiella pneumoniae	**7**	57.1	14.3	28.6	16.7	57.1	57.1	100	57.1	57.1	71.4	0	14.3
Citrobacter freundii	**1**	100	0	0	100	100	100	100	100	100	100	0	0
Citrobacter koseri	**1**	100	100	100	100	0	100	100	100	100	100	0	0
Klebsiella oxytoca	**1**	100	0	0	0	0	100	100	100	0	100	0	0
Serratia marcescens	**1**	100	0	0	0	0	0	100	100	100	100	100	0
Providencia stuartii	**1**	100	100	100	100	100	100	-	100	100	100	0	0

Table 2.3 Susceptibility of *Enterobacteriaceae spp*. from Urine

AMA	**No. of isolates**	Amikacin	Cefazolin	Cefotaxime	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Fosfomycin	Colistin	Imipenem	Levofloxacin	Meropenem	Minocycline	Nitrofurantoin	Piperacillin-tazobactam	Trimethoprim- sulfamethoxazole
Escherichia coli	**888**	89	15	12	13	17	15	75	94	100	63	25	77	83	93	17	46
Klebsiella pneumoniae	**203**	74	23	20	25	27	19	62	78	100	53	38	62	61	60	13	54
Klebsiella oxytoca	**78**	84	1	13	17	15	16	51	67	100	45	23	49	75	68	7	38
Proteus mirabilis	**41**	88	38	41	38	52	32	85	53	-	77	47	85	5	0	56	35
Citrobacter koseri	**28**	84	0	5	11	11	21	68	63	100	58	16	79	86	63	11	33
Klebsiella (Enterobacter) aerogenes	**18**	75	0	25	31	25	31	56	88	100	50	40	63	89	93	25	56
Proteus vulgaris	**13**	88	0	13	0	13	38	88	38	-	38	50	75	40	0	0	50
Citrobacter freundii	**7**	100	0	17	17	17	33	100	100	100	67	50	100	50	67	0	50
Morganella morganii	**7**	67	0	17	33	17	17	83	20	-	33	17	83	33	0	20	60
Citrobacter spp.	**2**	50	0	0	0	0	0	50	100	100	0	0	100	0	0	50	0
Klebsiella spp. (others)	**2**	100	0	0	0	0	0	100	100	100	100	50	100	0	100	100	0
Enterobacter cloacae	**2**	50	0	0	0	0	0	0	50	100	0	0	0	0	100	0	0
Serratia marcescens	**1**	100	100	0	0	100	100	100	0	100	0	100	100	100	100	0	100
Providencia rettgeri	**1**	0	0	0	0	0	100	0	100	-	0	100	0	0	0	0	100

Table 2.4 Susceptibility of *Enterobacteriaceae spp*. from LRT

AMA	**No Isolates**	Amikacin	Cefotaxime	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Imipenem	Colistin	Levofloxacin	Meropenem	Minocycline	Piperacillin- tazobactam
Klebsiella pneumoniae	**197**	79.3	21.3	15.2	27.5	25.6	56.1	48.8	100	39	61	75	13.6
Escherichia coli	**67**	78	12	8	16	18	62	58	100	20.4	70	87	20
Klebsiella oxytoca	**22**	70	15	20	20	20	60	45	100	45	60	66.7	15
Citrobacter freundii	**8**	75	12.5	0	25	37.5	87.5	62.5	100	62.5	87.5	83.3	25
Citrobacter koseri	**7**	100	0	0	0	0	75	50	100	25	75	100	0
Proteus mirabilis	**5**	100	0	40	20	20	100	100	-	60	80	50	40
Klebsiella (Enterobacter) aerogenes	**4**	50	0	0	0	25	50	50	100	25	50	100	0
Morganella morganii	**3**	100	0	0	50	100	100	100	-	100	100	0	100
Citrobacter spp.	**2**	50	0	0	50	50	50	50	100	50	50	100	50
Serratia marcescens	**2**	100	0	0	100	100	100	0	100	100	100	100	0
Proteus vulgaris	**1**	0	0	0	0	0	0	0	-	0	0	0	0

Table 2.5 Susceptibility of *Enterobacteriaceae spp*. from Superficial Infection

AMA	Nos of Isolates	Amikacin	Cefotaxime	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Imipenem	Colistin	Levofloxacin	Meropenem	Minocycline	Piperacillin-tazobactam
Escherichia coli	181	84.8	5.3	6.1	7	14.4	59.8	48.5	100	21.5	65.9	87	15.3
Klebsiella pneumoniae	111	68.8	15.1	12.9	20	19.4	46.2	44.1	100	39.8	57	83.3	7.6
Klebsiella oxytoca	34	69	17.2	13.8	14.3	10.3	48.3	58.6	100	20.7	55.2	66.7	3.4
Proteus mirabilis	21	75	31.3	12.5	50	31.3	62.5	62.5	-	43.8	87.5	66.7	18.8
Citrobacter koseri	12	77.8	22.2	33.3	12.5	44.4	44.4	44.4	100	55.6	55.6	100	11.1
Klebsiella (Enterobacter) aerogenes	12	58.3	0	0	8.3	50	50	33.3	100	50	58.3	100	0
Citrobacter freundii	9	100	33.3	33.3	44.4	33.3	88.9	33.3	100	55.6	88.9	100	44.4
Proteus vulgaris	9	100	20	40	0	20	60	60	-	20	100	0	40
Enterobacter spp.	3	66.7	0	0	0	0	33.3	33.3	100	0	66.7	100	0
Morganella morganii	2	100	0	0	0	0	50	0	-	50	100	100	0
Citrobacter spp.	1	100	0	0	0	100	100	100	100	100	100	0	0

The susceptibility pattern of Enterobacteriaceae varies across different locations, with specimens from outpatient departments (OPDs) exhibiting the highest sensitivity to all antibiotics compared to specimens from wards and intensive care units (ICUs)

Table 2.6 Susceptibility of *E. coli* from OPD, ward and ICU

AMA	Total n=1172	OPD n=608	Ward n=473	ICU n=91
Amikacin	87.6	90.8	86.2	73.3
Cefazolin	15.4	18.1	11	14.3
Cefotaxime	10.8	14.3	8.2	1.7
Ceftazidime	11.5	15.3	8.5	1.7
Ceftriaxone	15.6	21.3	10.6	3.4
Ciprofloxacin	15.3	17.3	14.1	8.3
Ertapenem	71.5	84.2	62.4	33.3
Fosfomycin	93.8	94	93.1	96.3
Imipenem	80	89.3	52.5	38.7
Levofloxacin	24	28.9	20.9	5.2
Meropenem	74.4	84.3	66.9	48.7
Minocycline	83.8	87.3	81.9	81.1
Nitrofurantoin	93.3	93.1	94.5	85.7
Piperacillin-tazobactam	19.8	20.7	12.7	10
Trimethoprim-sulfamethoxazole	46.5	51.8	35.9	39.3

Figure 2.6 Susceptibility of *E. coli* from OPD, ward and ICU

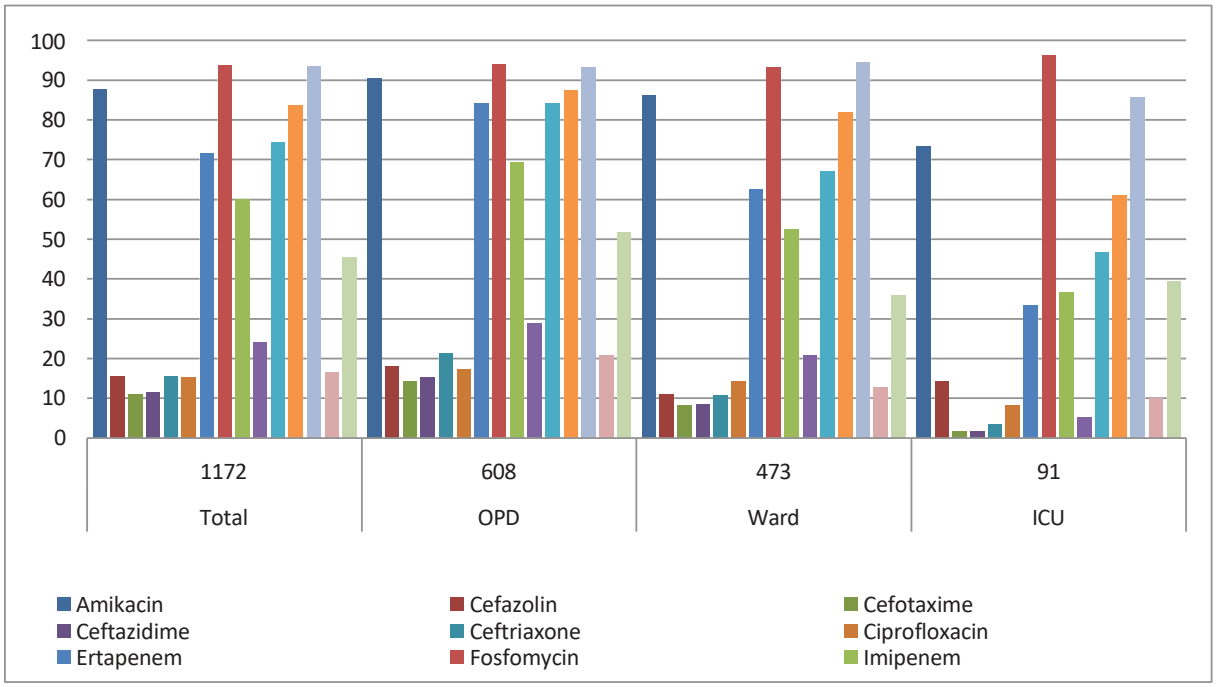


Table 2.7 Susceptibility of *Klebsiella pneumoniae* from OPD, ward and ICU

AMA	Total n=697	OPD n=249	Ward n=286	ICU n=162
Amikacin	75.2	94.4	77.1	46.2
Cefazolin	22.7	37.7	19.1	2.9
Cefotaxime	19.9	34.8	14.3	4.2
Ceftazidime	19.5	33.8	13.8	5
Ceftriaxone	24.5	47.4	17.3	4.3
Ciprofloxacin	21.5	34.2	20	6.7
Ertapenem	56	85.7	52	21.8
Fosfomycin	78.3	88.6	71	73.5
Imipenem	48.8	76.2	44.8	26.1
Levofloxacin	38.6	58.1	36.3	12.7
Meropenem	60.2	87.6	56.3	26.1
Minocycline	69.8	73.8	72.3	62.5
Nitrofurantoin	59.6	73	58	38.2
Piperacillin-tazobactam	11.9	18.2	11.4	4.2
Trimethoprim-sulfamethoxazole	53.9	62.9	55.1	35.3

Figure 2.7 Susceptibility of *Klebsiella pneumoniae* from OPD, ward and ICU (except urine and faeces).

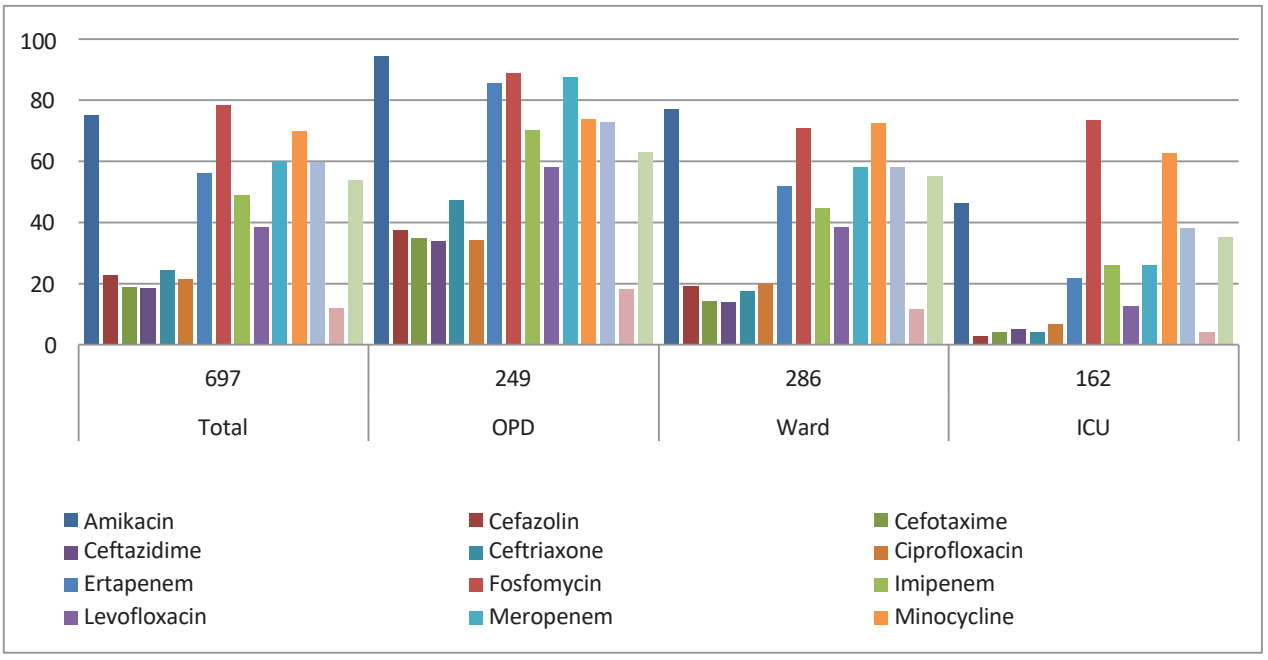


Figure 2.8 Yearly Isolation Trends analysis of Enterobacteriaceae

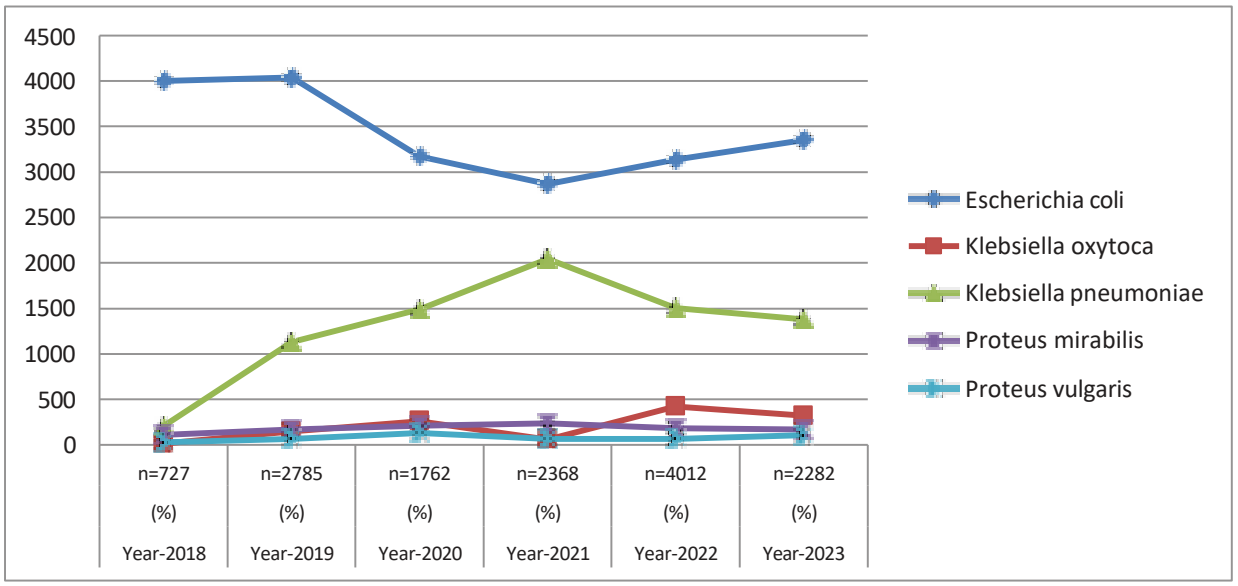
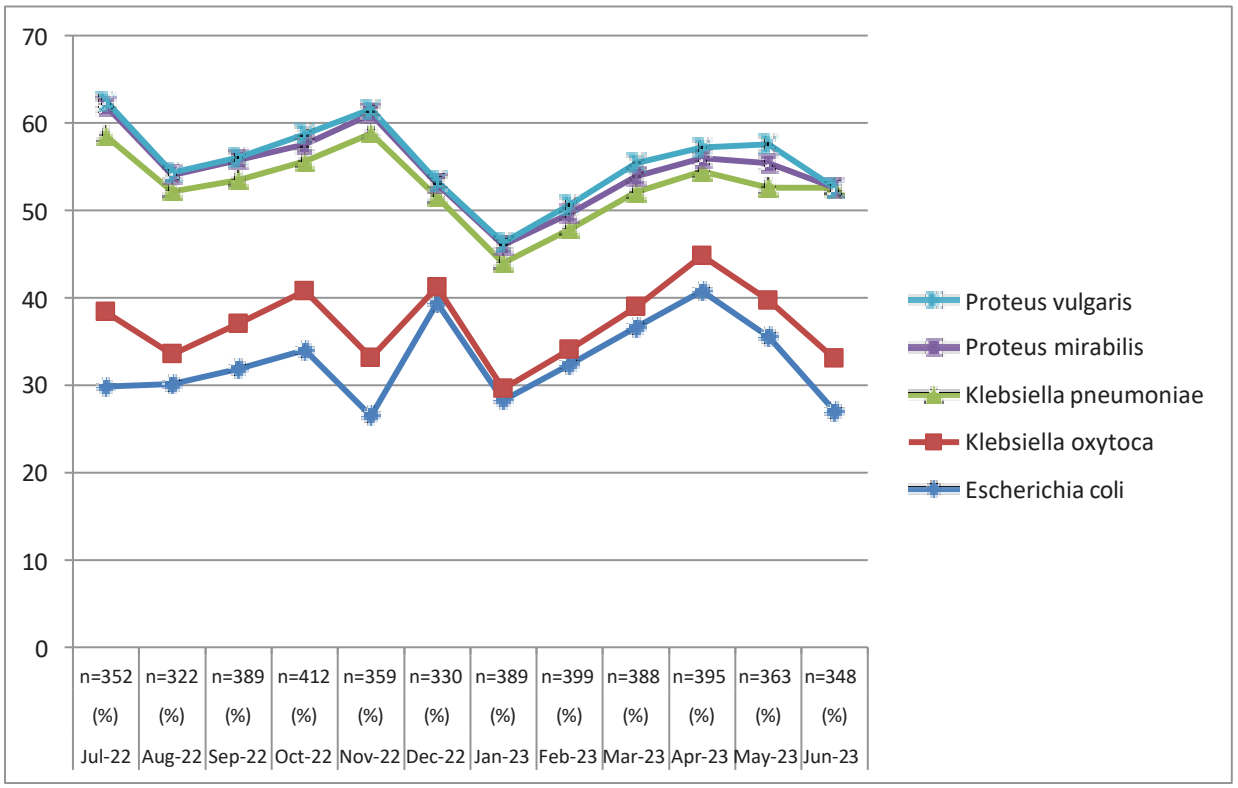


Figure 2.9 Monthly isolation rates Trend analysis of Enterobacteriaceae

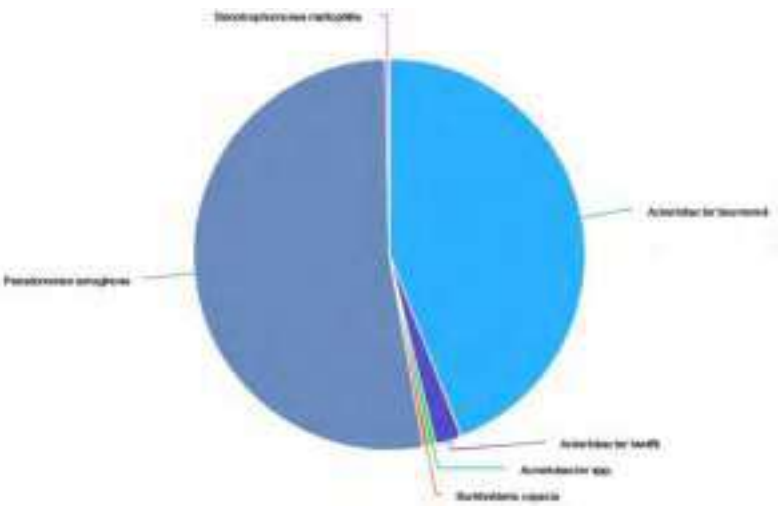


Chapter 3- NFGNB

Pseudomonas sp. & Acinetobacter sp. were the most dominant isolates among NFGNB which account for 52.5%, 44 % followed by Acinetobacter lwoffii (2.2 %) (Figure 3.1)

Figure 3.1: Isolation pattern of NFGNB isolated from all Specimen

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Acinetobacter baumannii	263	44
Acinetobacter lwoffii	13	2.2
Acinetobacter spp.	3	0.5
Burkholderia cepacia	3	0.5
Pseudomonas aeruginosa	314	52.5
Stenotrophomonas maltophilia	2	0.3
Total	598	100



Sample-wise susceptible percentage of *Acinetobacter baumanii*

Susceptible percentages of *Acinetobacter baumannii* isolated from different specimen (except faeces).

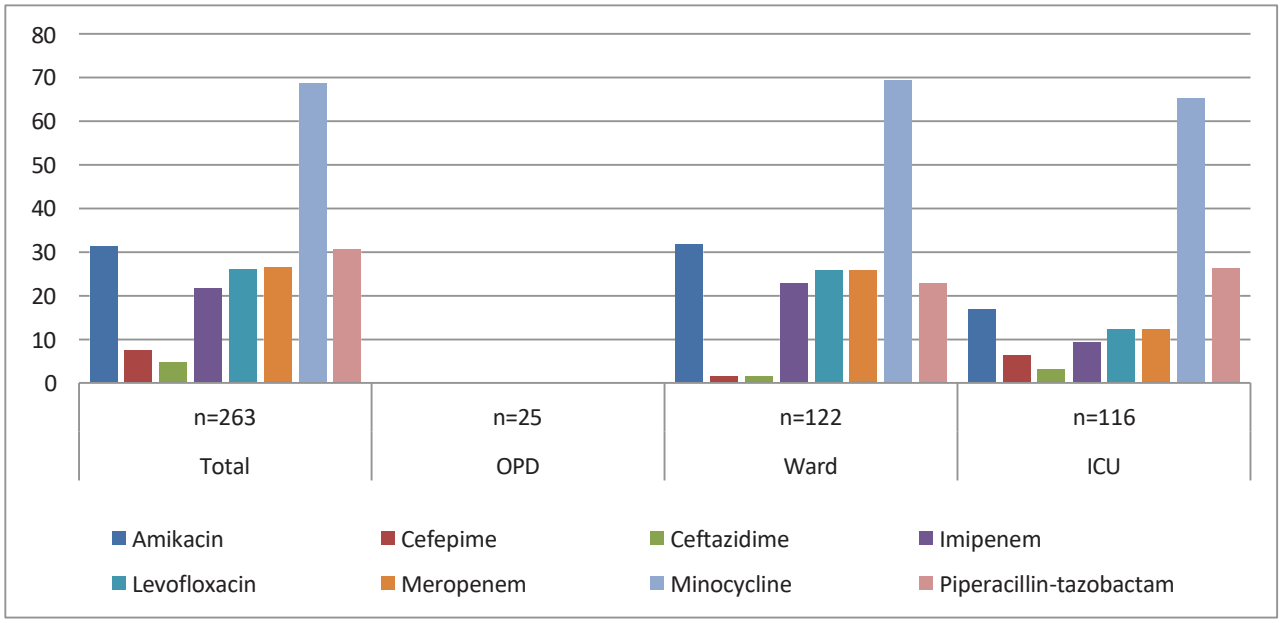
AMA	Blood	LRT	Superficial Infection	Urine
	n=^10	n=59	n=42	n=26
Amikacin	-	22	26.2	46.2
Cefepime	-	3.4	9.5	3.8
Ceftazidime	-	1.7	2.4	3.8
Imipenem	-	16.9	14.3	34.6
Levofloxacin	-	16.9	19	42.3
Meropenem	-	18.6	16.7	42.3
Minocycline	-	68.6	-	-
Piperacillin-tazobactam	-	27.1	19	46.2
Polymixin B	-	-	-	-

Location-wise susceptible percentage of *A. Baumanii* isolated from all samples across OPD, Ward and ICU.

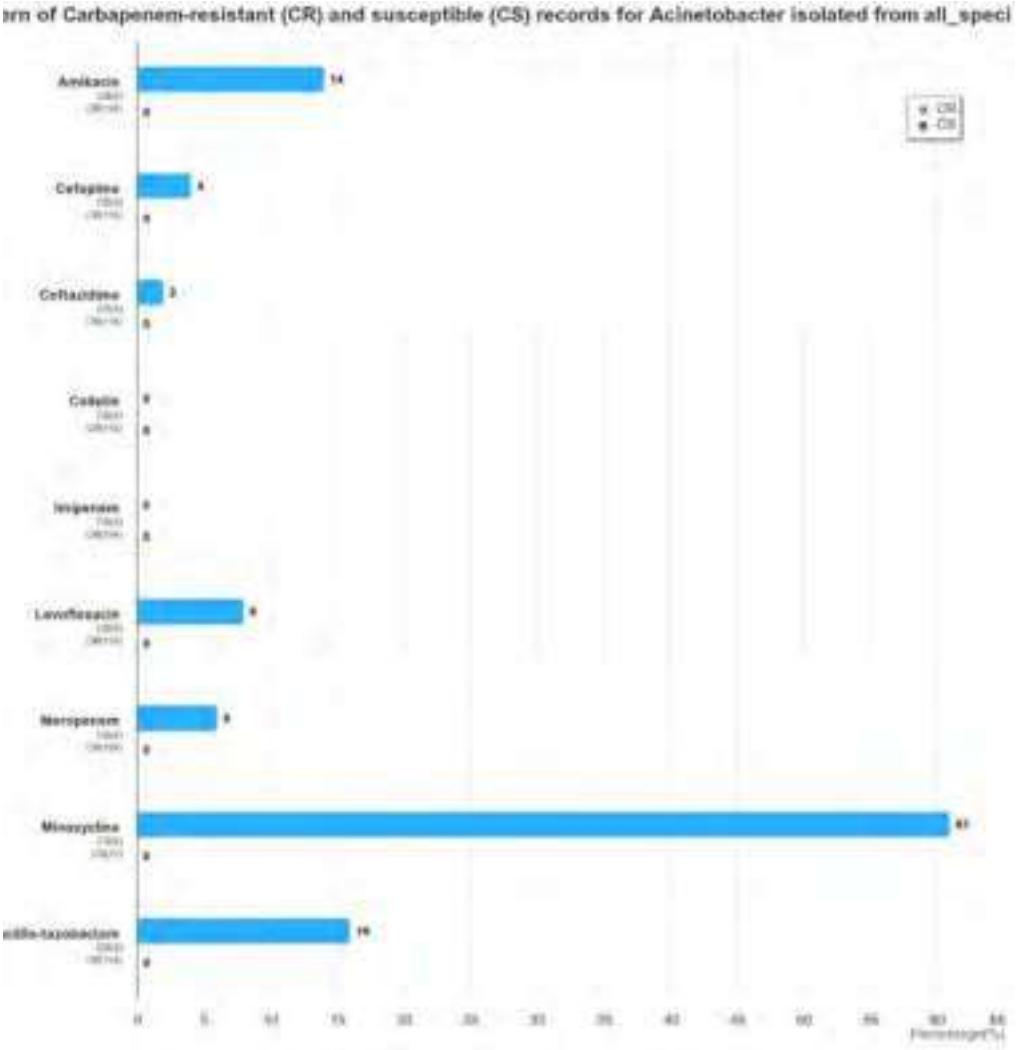
AMA	Total n=263 S %	OPD n=25 S %	Ward n=122 S %	ICU n=116 S %
	S%	S%	S%	S%
Amikacin	31.3	-	31.8	16.9
Cefepime	7.5	-	1.5	6.2
Ceftazidime	4.8	-	1.5	3.1
Imipenem	21.8	-	22.7	9.2
Levofloxacin	25.9	-	25.8	12.3
Meropenem	26.5	-	25.8	12.3
Minocycline	68.8	-	69.4	65.3
Piperacillin-tazobactam	30.6	-	22.7	26.2
Polymixin B	-	-	-	-

Currently, there are 25 samples available for testing Acinetobacter baumannii in the outpatient department (OPD), which is the lowest compared to ward 122 and the intensive care unit (ICU) associated with ward 166

Location-wise susceptible percentage of *A. Baumanii* isolated from all samples across OPD, Ward and ICU



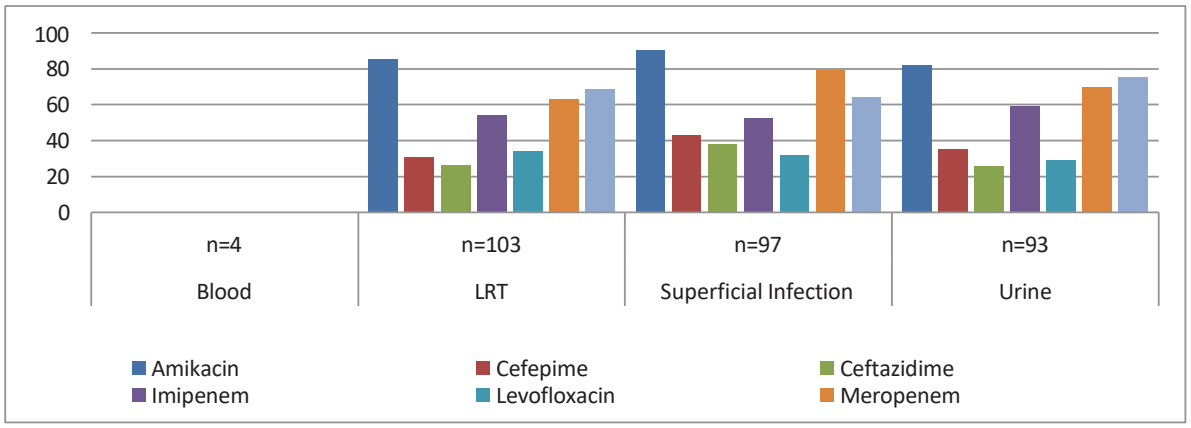
Susceptible pattern of Carbapenem-resistant (CR) and susceptible (CS) records for Acinetobacter isolated from all specimens



Sample-wise susceptible percentage of Pseudomonas aeruginosa

AMA	Blood	LRT	Superficial Infection	Urine
	n=4	**n=103**	**n=97**	**n=93**
Amikacin	-	85.4	90.7	81.7
Cefepime	-	30.7	43.3	35.5
Ceftazidime	-	26.2	38.1	25.8
Imipenem	-	54.4	52.6	59.1
Levofloxacin	-	34.3	32	29
Meropenem	-	63.1	79.4	69.9
Piperacillin-tazobactam	-	68.9	63.9	75.3

Sample-wise susceptible percentage of Pseudomonas aeruginosa

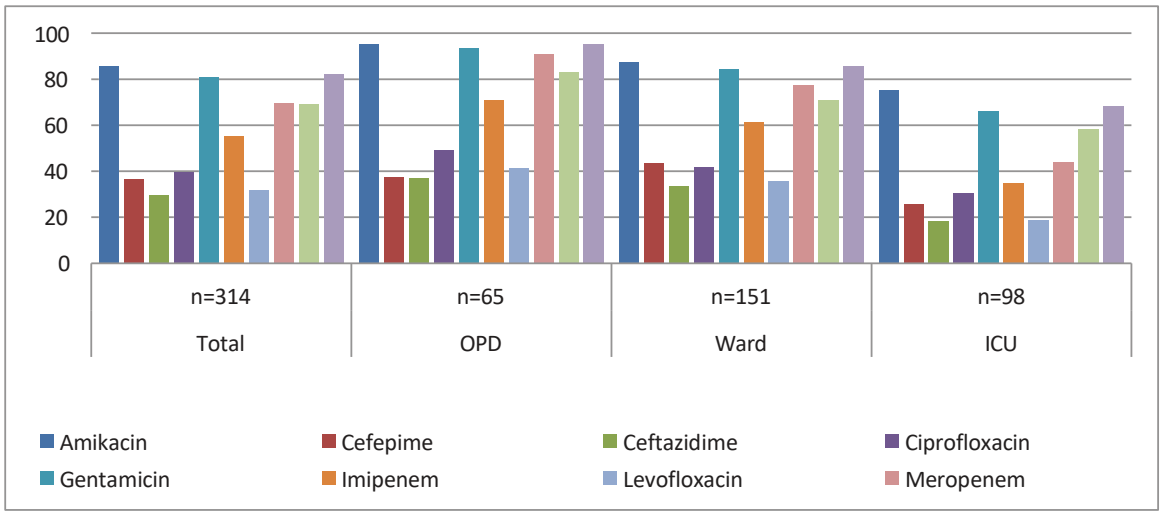


Location-wise susceptible percentage of Pseudomonas aeruginosa

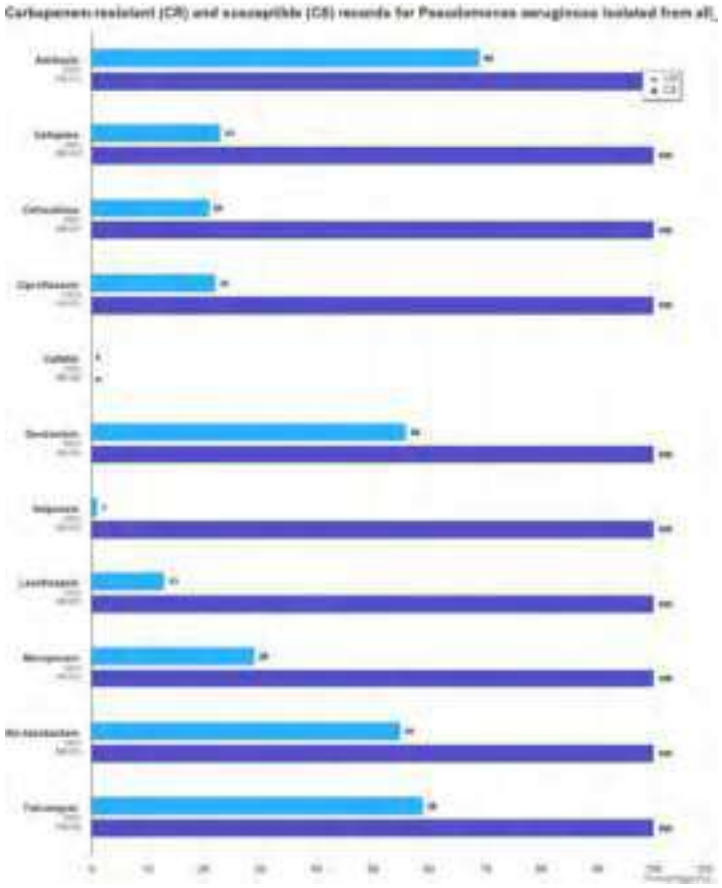
Susceptible pattern of *Pseudomonas aeruginosa* isolated in different health care areas from all specimen (except faeces).

AMA	Total n=314 S %	OPD n=65 S %	Ward n=151 S %	ICU n=98 S %
Amikacin	85.4	95.4	87.4	75.5
Cefepime	36.5	37.5	43.3	25.5
Ceftazidime	29.6	36.9	33.8	18.4
Ciprofloxacin	39.8	49.2	41.7	30.6
Gentamicin	80.7	93.4	84.6	66.3
Imipenem	55.1	70.8	61.6	34.7
Levofloxacin	31.6	41.5	35.8	18.6
Meropenem	69.7	89.8	77.5	43.9
Piperacillin-tazobactam	69.4	83.1	70.9	58.2
Polymixin B	-	-	-	-
Tobramycin	82.1	95.2	85.4	69.1

Location-wise susceptible percentage of Pseudomonas aeruginosa



Carbapenem resistant (cr) and susceptible (cs) records for Pseudomonas aeruginosa isolated from all specimen



Year wise susceptibility trends of ***NFGNB*** from all samples

AMA	Year 2016 (%)	Year 2017 (%)	Year 2018 (%)	Year 2019 (%)	Year 2020 (%)	Year 2021 (%)	Year 2022 (%)	Year 2023 (%)
	n=0	n=0	n=86	n=301	n=264	n=378	n=546	n=378
Amikacin	0	0	91.76	68.47	53.24	62.75	62.45	58.99
Cefepime	0	0	38.16	58.83	28.89	16.29	20.78	27.54
Ceftazidime	0	0	42.31	49.99	35.97	11.97	12.04	21.26
Chloramphenicol	0	0	0	0	0	0	0	0
Ciprofloxacin	0	0	70.03	67.89	54.17	62.89	36.46	40.78
Colistin	0	0	0	95.68	97.71	99.71	0	0
Gentamicin	0	0	78.06	74.23	69.62	81.67	73.02	81.01
Imipenem	0	0	83.36	62.94	34.87	36.89	44.06	35.63
Levofloxacin	0	0	75.32	61.63	48.16	35.47	34.16	26.27
Meropenem	0	0	71.43	71.59	50	50.21	59.91	47.5
Minocycline	0	0	48	91.11	83.33	74.71	77.1	56.36
Piperacillin-tazobactam	0	0	90.71	50	36	23.53	46.77	43.71
Polymixin B	0	0	0	0	0	0	0	0
Ticarcillin-clavulanic acid	0	0	0	0	0	0	0	0
Tobramycin	0	0	71.79	83.54	84.38	83.85	77.04	83.52
Trimethoprim-sulfamethoxazole	0	0	100	0	66.67	81.82	92.31	100

Chapter 4- Staphylococci

A total of 639 Staphylococci samples were isolated during this period, out of which 554 were Staphylococcus aureus, accounting for 86.7% of the total isolates (Figure 4.1).

Figure 4.1 Isolation distribution of *Staphylococcus aureus*, CoNS isolated from all samples.

Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Staphylococcus aureus	554	86.7
Staphylococcus epidermidis	6	0.9
Staphylococcus haemolyticus	11	1.7
Staphylococcus hominis	7	1.1
Staphylococcus saprophyticus	2	0.3
Staphylococcus spp.	59	9.2
Total	639	99.9

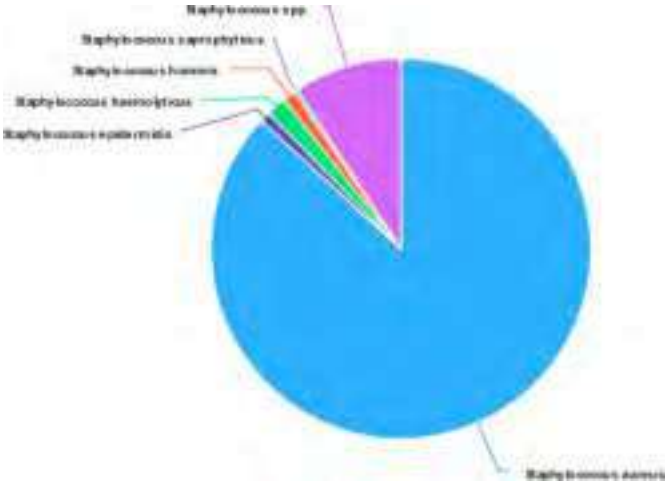


Table 4.1 Percentage Susceptibility of *Staphylococcus aureus*, CoNS, MRSA, MSSA isolated from all samples

AMA	All Specimens			
	Sau n=554	MSSA n=107	MRSA n=447	CoNS n=85
Cefoxitin	19.1	100	0	2.4
Ceftaroline	-	-	-	-
Ciprofloxacin	22	42.1	17.2	25.9
Clindamycin	62	70.8	60	37.6
Daptomycin	-	-	-	-
Erythromycin	10.7	25.5	7.2	5.9
Linezolid	96.4	100	95.5	92.9
Oxacillin	-	-	-	-
Teicoplanin	-	-	-	-
Tetracycline	68.8	80.4	66	50.6
Tigecycline	-	-	-	-
Trimethoprim-sulfamethoxazole	60.3	69.2	58.2	36.5
Vancomycin	100	100	100	98.8

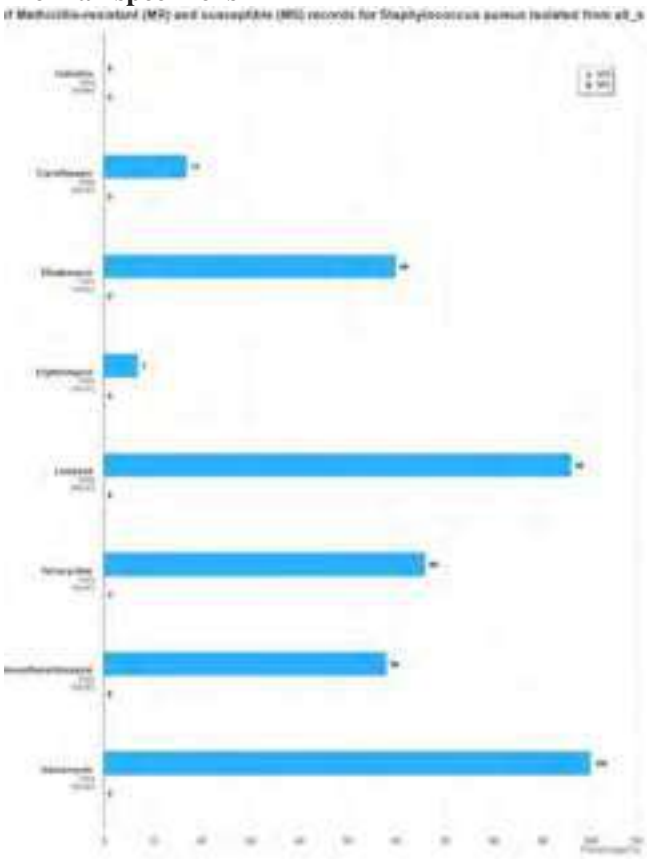
Out of the 554 Staphylococcus aureus isolates, 447 were MRSA. Among the MRSA isolates, Vancomycin exhibited the highest susceptibility (100%), followed by Linezolid (95.5%)

Figure 4.2 Location wise Susceptibility of *Staphylococcus aureus*, CoNS, MRSA, MSSA isolated

Susceptible pattern of Staphylococci isolated in different health care areas from all specimen (except urine and faeces).

	Staphylococcus aureus				MSSA				MRSA				CoNS			
	Total n=468	OPD n=257	Ward n=179	ICU n=32	Total n=	OPD n=	Ward n=	ICU n=	Total n=380	OPD n=196	Ward n=155	ICU n=29	Total n=74	OPD n=16	Ward n=44	ICU n=14
AMA	R%	R%	R%	R%	R%	R%	R%	R%	R%	R%	R%	R%	R%	R%	R%	R%
Cefoxitin	18.5	23.6	12.9	9.4	-	-	-	-	0	0	0	0	2.7	-	4.5	-
Ceftaroline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ciprofloxacin	19.7	21.4	16.2	25	-	-	-	-	15.5	15.8	12.9	27.9	24.3	-	27.3	-
Clindamycin	69.3	73.5	59.8	31.3	-	-	-	-	63.7	73.5	58.1	27.6	37.8	-	38.6	-
Daptomycin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Erythromycin	10.5	12.8	6	0	-	-	-	-	7.6	8.7	7.7	0	5.4	-	6.8	-
Linezolid	95.9	96.5	96.1	90.6	-	-	-	-	95	95.4	95.5	89.7	91.9	-	95.5	-
Oxacillin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Teicoplanin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetracycline	72.9	75.1	67	59.4	-	-	-	-	67.6	71.4	64.5	58.6	59.8	-	43.2	-
Tigecycline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Susceptible pattern of Methicillin resistant (MR) and Susceptible (MS) for Staph. aureus isolated from all specimens



Susceptible percentages of CoNS isolated from all specimen.

AMA	All Specimens	
	Staphylococcus haemolyticus n=10	Staphylococcus spp. n=58
Cefoxitin	-	1.7
Ceftaroline	-	-
Ciprofloxacin	-	30.5
Clindamycin	-	33.9
Daptomycin	-	-
Erythromycin	-	6.8
Linezolid	-	89.8
Oxacillin	-	-
Teicoplanin	-	-
Tetracycline	-	49.2
Trimethoprim-sulfamethoxazole	-	39
Vancomycin	-	100

Year wise susceptibility trends of *Staphylococci* from all samples

AMA	Year-2016 (%)	Year-2017 (%)	Year-2018 (%)	Year-2019 (%)	Year-2020 (%)	Year-2021 (%)	Year-2022 (%)	Year-2023 (%)
	n=0	n=0	n=172	n=539	n=222	n=282	n=561	n=339
Cefoxitin	0	0	34.3	45.54	31.53	22.97	29.08	8.55
Ceftaroline	0	0	0	0	0	0	0	0
Ciprofloxacin	0	0	51.48	44.84	27.65	28.28	27.09	19.17
Clindamycin	0	0	63.37	72.76	77.83	72.76	60.36	60.18
Daptomycin	0	0	0	0	0	0	0	0
Erythromycin	0	0	26.38	22.98	28.18	34.38	15.54	6.85
Linezolid	0	0	92.98	93.13	98.58	99.65	99.82	92.33
Oxacillin	0	0	0	0	0	40	50	0
Teicoplanin	0	0	91.11	92.06	0	100	83.33	0
Tetracycline	0	0	81.21	63.52	81.51	76	66.91	69.03
Tigecycline	0	0	0	0	0	100	58.33	0
Trimethoprim-sulfamethoxazole	0	0	49.7	57.26	68.12	64.23	58.29	56.93
Vancomycin	0	0	0	100	100	98.76	99.82	100

Monthly wise isolation of *Staphylococci* from all samples

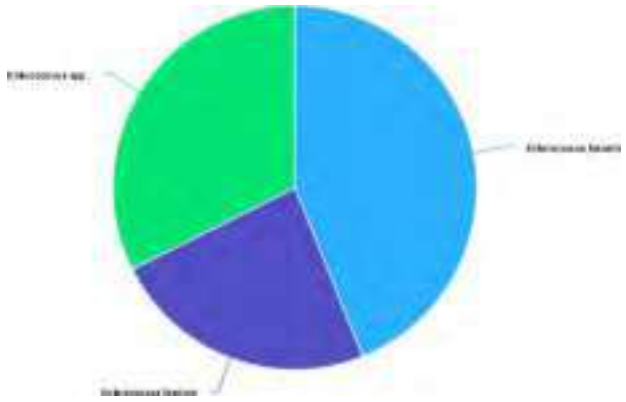
AMA	Jul-2022 (%)	Aug-2022 (%)	Sep-2022 (%)	Oct-2022 (%)	Nov-2022 (%)	Dec-2022 (%)	Jan-2023 (%)	Feb-2023 (%)	Mar-2023 (%)	Apr-2023 (%)	May-2023 (%)	Jun-2023 (%)
	n=32	n=53	n=70	n=59	n=55	n=31	n=81	n=62	n=58	n=52	n=32	n=54
Cefoxitin	41.94	42	31.43	11.86	16.36	19.35	7.41	4.84	27.59	0	3.13	5.56
Ceftaroline	0	0	0	0	0	0	0	0	0	0	0	0
Ciprofloxacin	37.5	22.64	32.86	27.12	23.64	9.68	17.28	24.19	25.86	15.38	9.38	18.52
Clindamycin	56	80.77	48.57	49.15	43.64	83.87	69.14	83.87	44.83	48.38	56.25	57.41
Daptomycin	0	0	0	0	0	0	0	0	0	0	0	0
Erythromycin	9.38	15.09	11.59	10.17	7.27	16.13	18.52	16.13	5.17	0	6.25	0
Linezolid	100	100	100	100	100	100	96.3	95.16	93.1	84.62	75	100
Oxacillin	0	66.67	0	0	0	0	0	0	0	0	0	0
Teicoplanin	66.67	87.5	0	0	0	0	0	0	0	0	0	0
Tetracycline	46.88	77.36	62.86	57.63	56.36	80.65	75.31	64.52	68.97	61.54	81.25	64.81
Tigecycline	33.33	62.5	0	0	0	0	0	0	0	0	0	0
Trimethoprim-sulfamethoxazole	43.75	58.49	58.57	45.76	78.91	64.52	49.38	35.48	68.97	50	75	75.93
Vancomycin	100	98.11	100	100	100	100	100	100	100	100	100	100

Chapter 5 - Enterococci

A total of 472 Enterococci were isolated during the period. Among these, E. faecalis accounted for 43.9%, followed by Enterococcus spp. at 32.4% and E. faecium at 23.7% (Figure 5).

Figure 5 Isolation rate of Enterococci across all samples

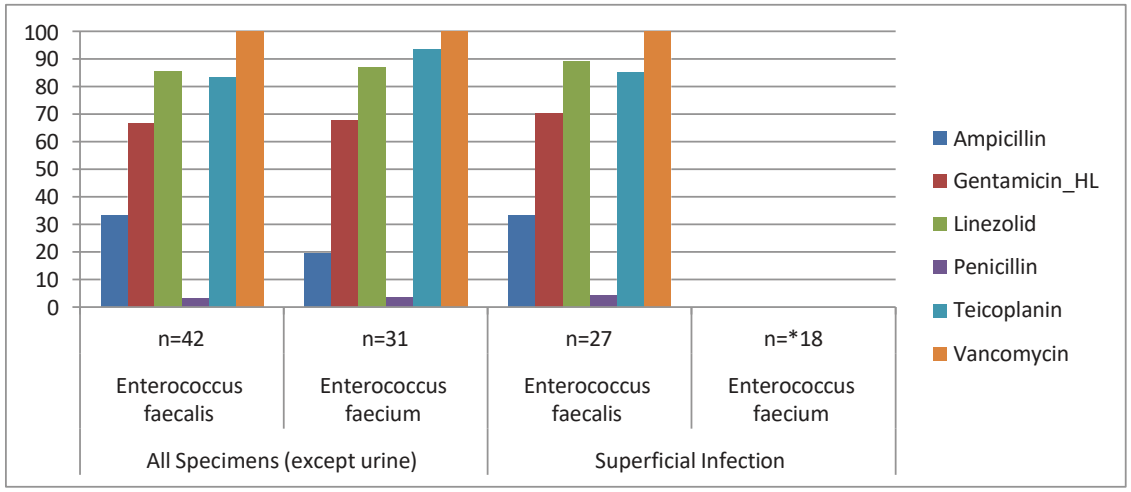
Bacteria (Group/Sub-group/Species)	Number of isolates (n)	Percent (%)
Enterococcus faecalis	207	43.9
Enterococcus faecium	112	23.7
Enterococcus spp.	153	32.4
Total	472	100



Susceptible percentages of Enterococci isolated from different specimen (except urine).

AMA	All Specimens (except urine)		Superficial Infection	
	Enterococcus faecalis n=42	*Enterococcus faecium* n=31	*Enterococcus faecalis* n=27	*Enterococcus faecium* n=^18
Ampicillin	33.3	19.4	33.3	-
Daptomycin	-	-	-	-
Fosfomycin	-	-	-	-
Gentamicin_HL	66.7	67.7	70.4	-
Linezolid	85.7	87.1	88.9	-
Penicillin	3.1	3.6	4.3	-
Teicoplanin	83.3	93.5	85.2	-
Vancomycin	100	100	100	-

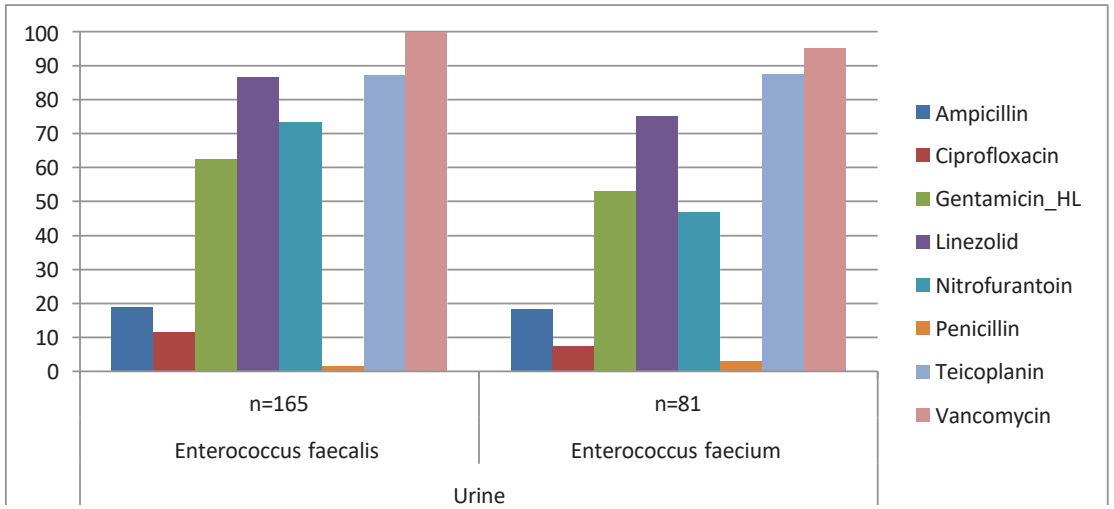
Susceptibility pattern of Enterococci from all samples except urine



Susceptible percentages of Enterococci isolated from urine specimen.

AMA	Urine	
	Enterococcus faecalis n=165	*Enterococcus faecium* n=81
Ampicillin	18.8	18.5
Ciprofloxacin	11.6	7.4
Daptomycin	-	-
Gentamicin_HL	62.4	53.1
Linezolid	86.7	75.3
Nitrofurantoin	73.2	46.9
Penicillin	1.5	2.9
Teicoplanin	87.3	87.5
Vancomycin	100	96.1

Susceptibility pattern of Enterococci from urine



Susceptible pattern of *Enterococci* isolated in different health care areas from all specimen (except faeces).

AMA	*Enterococcus faecalis*				*Enterococcus faecium*			
	Total n=207	OPD n=57	Ward n=129	ICU n=21	Total n=112	OPD n=30	Ward n=67	ICU n=15
	R%	R%	R%	R%	R%	R%	R%	R%
Ampicillin	21.7	31.6	16.3	28.6	18.8	40	11.9	-
Ciprofloxacin	11.6	22.4	6.7	-	7.4	9.1	8.3	-
Daptomycin	-	-	-	-	-	-	-	-
Fosfomycin	61.1	68.8	57.7	-	-	-	-	-
Gentamicin_HL	63.3	76.9	57.4	57.1	57.1	86.7	50.7	-
Linezolid	86.5	88.7	89.1	85.7	78.6	73.3	80.6	-
Nitrofurantoin	73.2	89.8	67.3	-	46.9	54.5	47.9	-
Penicillin	1.8	8	2.7	-	3.1	3.8	3.6	-
Teicoplanin	86.5	78.9	89.1	90.5	89.2	96.7	86.4	-
Vancomycin	100	100	100	100	96.4	96.7	95.5	-

Year wise susceptibility trends of *Enterococci* from all samples

AMA	Year-2016 (%)	Year-2017 (%)	Year-2018 (%)	Year-2019 (%)	Year-2020 (%)	Year-2021 (%)	Year-2022 (%)	Year-2023 (%)
	n=0	n=0	n=41	n=145	n=154	n=254	n=387	n=281
Ampicillin	0	0	35.71	37.88	23.08	22.73	16.84	22.06
Ciprofloxacin	0	0	23.33	36.36	28.57	26.47	13.73	8.1
Daptomycin	0	0	0	0	0	0	0	0
Fosfomycin	0	0	75	96.72	93.69	86.34	70.81	48
Gentamicin_HL	0	0	64.86	52.86	56.67	57.26	64.34	57.3
Linezolid	0	0	65.85	89.58	92	96.97	88.63	76.51
Nitrofurantoin	0	0	64.52	54.17	50.89	67.36	71.13	54.29
Penicillin	0	0	0	0	0	0	0.83	3.56
Teicoplanin	0	0	90.32	90.71	95.27	92.4	86.49	87.54
Vancomycin	0	0	100	93.06	96.69	91.76	92.4	74.27

4. INTERPRETATION OF CULTURE AND SUSCEPTIBILITY REPORTS

Introduction: Culture and susceptibility testing is the cornerstone of a successful antimicrobial stewardship program. Unlike biochemical or haematological assays, the processing, interpretation of the growth and reporting rely on the judgement of the microbiologist. The microbiologist in turn relies on the information provided in the test request form and the quality of the specimen to determine the significance of any growth and make a decision on whether to proceed with susceptibility testing.

Interpretation of culture growth

When an obvious pathogen e.g. *Brucella sp*. or *Salmonella sp*. is isolated in culture, their significance is undisputed. However, problem arises as to the significance of a growth when an organism constituting the normal flora (commensal) or a common environmental contaminant is isolated. The type of specimen also determines the significance of a growth, with growth from a normal sterile site like CSF or other body fluids likely to be significant. Interpretation of blood culture, respiratory specimen and urine culture is discussed below as these specimens are more liable to interpretative errors.

Interpretation of a positive blood culture

Organisms whose growth in blood culture represent true blood stream infection include *Staphylococcus aureus, Streptococcus pneumoniae, Haemophilus influenzae*, members of the order Enterobacterals, *Pseudomonas aeruginosa* and *Candida sp*. In contrast, growth of viridans group of Streptococcus, Coagulase negative Staphylococci and Enterococcus sp. represents true bacteremia only in 38%, 15% and 78% respectively. The non-fermenting Gram negative bacteria including *Acinetobacter sp.* and *Burkholderia sp*. (other than *Burkholderia pseudomallei*) are another group of organisms where the significance of the growth can be hard to predict especially in a hospitalised patient as they are found as common environmental contaminants in the hospital setting. Single culture positive for these organisms usually represent contamination from the skin or the environment. Multiple separate cultures growing the same organism identified to the species level or showing the same susceptibility pattern, are more likely to indicate clinically significant bacteraemia. Growth from a sample collected from a central line may indicate central line colonization alone and should always be paired with a sample drawn from a peripheral venepuncture. When agents associated with bacterial endocarditis is grown, it should be correlated with compatible clinical features.

Interpretation of growth from upper respiratory specimen

Culture of external nares is conducted for the purpose of detection of nasal carriage of methicillin resistant *Staphylococcus aureus* and as such the growth of any other organism including methicillin susceptible strains of *Staphylococcus aureus* is not reported. Group A, C and G beta-haemolytic *Streptococcus, Arcanobacterium haemolyticum, Corynebacterium diphtheriae* and *Neisseria gonorrhoea* are agents implicated in pharyngitis. The growth of *Haemophilus influenzae, Streptococcus pneumoniae* and *Neisseria meningitidis* from a throat swab indicate a carrier state or colonization and need not be treated except in a patient with epiglottitis.

Interpretation of growth from lower respiratory specimen

Lower respiratory specimens, sputum samples in particular, are liable to contamination with oropharyngeal secretions. Detection of possible pathogen in sputum samples grossly contaminated with saliva may merely reflect oropharyngeal flora. A simple examination of the specimen for presence of < 10 squamous epithelial cells per low power field and presence of inflammatory cells and compatible bacterial morphology in Gram-stained smear indicates the isolate to be clinically significant. Another strategy to determine the significance of the growth is to get a simultaneous blood culture drawn. Bacteraemia is observed in 15% of patients with ventilator associated pneumonia (VAP) and blood culture is recommended for all patients suspected of VAP. Growth of same organism in blood and from respiratory specimen confirms the respiratory tract as the source of infection. Semi-quantitative culture of endotracheal aspirates and quantitative culture of broncho-alveolar lavage (BAL) or protected brush specimen (PBS) is recommended for the diagnosis of VAP. It is recommended to withhold antimicrobial for quantitative growth below the threshold level (BAL < 10^4CFU/ml or PBS < 10^3 CFU/ml). Initiation of antimicrobial therapy should be based on clinical criteria alone in a suspected case of VAP, and de-escalated on availability of culture reports.

Interpretation of urine culture

The distal urethra is colonized with different organisms which result in contamination of 5% to as high as 40% of voided urine specimens. The interpretation of urine culture also depends on the type of specimen collected – mid-stream clean catch, catheter, supra-pubic aspirate etc. While the presence of even a single CFU/ml in suprapubic aspirate sample is significant, presence of > 10^5 CFU/ml of possible pathogen is likely to be significant in a mid-stream clean catch specimen. While growth of < 10^3 CFU/ml usually indicate contamination, growth with 10^3-10^5 CFU/ml of possible pathogen has to be correlated with clinical findings to determine the significance of the growth. Foley's catheter tip is not acceptable for culture as they are always contaminated with uretheral flora. Screening for asymptomatic bacteriuria is reserved only in pregnant women and prior to urological procedure, asymptomatic bacteriuria otherwise is not an indication for treatment.

Interpretation of susceptibility report

Antimicrobial panel for testing and reporting is prepared according to the specimen site, the organism isolated and local susceptibility pattern according to Clinical and Laboratory Standards Institute (CLSI) Guidelines. The objective of susceptibility testing is to predict the outcome of treatment with the tested antimicrobials. Interpretative categories are determined by comparing against breakpoints recommended by standard institutions like the CLSI or EUCAST (European Committee on Antimicrobial Susceptibility Testing). A '**susceptible**' category indicates inhibition of the organism at an achievable level of the drug at the site of infection. The infection is likely to respond to treatment with the recommended dose and regimen. A '**resistant**' category indicates the organism is not inhibited at achievable level of the drug and treatment with the agent will likely lead to failure. The '**intermediate**' category indicates a buffer zone for inherent variability in test method. Extreme caution has to be taken in the use of the agent for body compartment infection where drug penetration is restricted even in presence of inflammation e.g., meningitis. A

'**susceptible-dose-dependent (SDD)**' category indicates necessity of giving a higher dose and dosing regimen which will provide higher drug exposure. SDD category is available for the agents cefepime and piperacillin-tazobactam used against infection by organisms belonging to Enterobacterals, and for ceftaroline against *Staphylococcus aureus*. Table 1 give the standard dose for susceptible strains and dose modification for SDD strains for applicable agents according to CLSI guideline.

Table 1: Standard dose for susceptible strains and dose modification for SDD strains

Antimicrobial agent	Susceptible		Susceptible Dose Dependent	
	MIC	Standard dose	MIC	SDD dose
Cefepime	d 2µg/ml	1 g every 12 hours	4 µg/ml	1 g every 8 hourly or 2 g every 12 hourly
			8 µg/ml or zone 19-24 mm*	2 g every 8 hourly
Piperacillin-tazobactam	d 8/4 µg/ml	3.375 – 4 g every 6 hour as 30 min infusion	16/4 µg/ml	4.5 g every 6 hour as a 3-hour infusion or, 4.5 g every 8 hour as a 4-hour infusion
Ceftaroline	d 1 µg/ml	600 mg every 12 hours	2-4 µg/ml	600 mg every 8 hours administered over 2 hours

**Zone diameter cannot be exactly correlated with MIC value. An isolate with zone diameter in SDD zone should be treated as if it might be MIC 8µg/ml.*

Testing of an agent can predict results of closely related agents in the same class as cross-resistance and cross-susceptibility is nearly complete. Laboratories may report results of only one drug in this case. Table 2 give a list of equivalent agents according to CLSI guidelines.

Table 2: List of equivalent agents for testing according to CLSI guideline

Antimicrobial agents	Organism
Cefotaxime or Ceftriaxone	Enterobacterals
Colistin or Polymyxin B	Enterobacterals, *Pseudomonas aeruginaosa, Acinetobacter baumannii* complex
Azithromycin or Clarithromycin or Erythromycin	*Staphylococcus sp.*
The result of Ampicillin susceptibility is used to predict activity of Amoxicillin	*Haemophilus sp.* and Anaerobes

Repeat testing for resistance detection

Repeat testing of subsequent isolates from the same anatomical site is done to detect development of resistance on treatment. The risk of resistance development is higher with longer period of follow-up and some bug-drug combinations are more prone to development of resistance than others. Development of resistance within 3 to 4 days of treatment has been most

notably detected in *Enterobacter sp., Klebsiella aerogenes, Citrobacter* and *Serratia sp.* with third generation cephalosporins, *Pseudomonas aeruginosa* with most antimicrobials and *Staphylococcus sp.* with fluoroquinolones. Prolonged treatment of *Staphylococcus aureus* infection with vancomycin can lead to development of intermediate resistance against vancomycin. Clinical exposure to ceftazidime-avibactam and meropenem-varbobactam for treatment of carbapenem resistant Enterobacterals result in resistance development in approximately 10-20% and 3% of patients respectively. Decision to repeat testing should be determined by clinical judgement and testing is indicated if clinical response is lower than expected under treatment. Susceptibility testing for patients on newer betalactams should be repeated if the patient present with sepsis-like picture suggestive of new or relapsed infection.

Indications for change of therapy

Empiric therapy may need to be changed based on availability of susceptibility testing result. For a patient with uncomplicated cystitis on treatment, if clinical improvement occurs, there is no need to change the antibiotic regimen even when the agent the patient is on shows resistance on testing. However, for all other infections, if the organism is resistant to the empiric antimicrobial agent used, treatment should be changed to another agent showing susceptibility and a full treatment course should be given counting from the day the active agent is started. Considerations on safety cost and availability should be given when choosing an agent when the organism is equally susceptible to more than one antimicrobial agents. De-escalation to oral therapy can be considered when the following criteria are met-

a. Susceptibility to an oral agent is demonstrated
b. The patient is haemodynamically stable
c. Reasonable source control measures have occurred and
d. Concerns about in sufficient intestinal absorption are not present

Use of MIC (minimum inhibitory concentration) data for therapy

In recent years, efforts have been made to incorporate MIC data in choosing appropriate antimicrobial agent especially for treating infections in critical care patients. The aim is to choose the agent with the most favourable pharmacodynamic effect. Breakpoint to MIC quotient (BMQ) is a recent parameter which has come in vogue to determine this effect. BMQ is calculated as the ratio of the susceptibility breakpoint of the drug for the organism group divided by the MIC of the isolate. The BMQ is inversely correlated with the minimum bactericidal concentration, with higher BMQ correlating with more bactericidal effect. The application of this parameter is limited in practice because of the restricted range of drug concentration which is usually tested to give a categorical interpretation.

Very importantly, for an effective antimicrobial management of a patient and by extension, for a successful stewardship program, the importance of communication and co-operation between the treating physician and the clinical microbiologist cannot be emphasised enough. This process should start right from deciding appropriate tests to uncompromised sample collection and continue beyond the dispatch of the culture and susceptibility report.

REFERENCES

1. Murray, P. R., E. J. Baron, J. H. Jorgensen, M. L. Landry and M. A. Pfaller. (2007) Manual of Clinical Microbiology. 9th Edition, American Society for Microbiology, Washington,D.C.
2. Clinical and Laboratory Standards Institute/NCCLS. 2023. M100. Performance standard of antimicrobial Susceptibility Testing. 33rd Edition. Clinical and Laboratory Standards Institute, Wayne,Pa
3. Giuliano C, Patel CR, Kale-Pradhan PB. A Guide to Bacterial Culture Identification And Results Interpretation. P T. 2019 Apr;44(4):192-200. PMID: 30930604; PMCID:PMC6428495.
4. Kirn TJ, Weinstein MP. Update on blood cultures: how to obtain, process, report, and interpret. Clin Microbiol Infect. 2013 Jun;19(6):513-20. doi: 10.1111/1469-0691.12180. Epub 2013 Mar 13. PMID: 23490046.
5. Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, Napolitano LM, O'Grady NP, Bartlett JG, Carratalà J, El Solh AA, Ewig S, Fey PD, File TM Jr, Restrepo MI, Roberts JA, Waterer GW, Cruse P, Knight SL, Brozek JL. Management of Adults With Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clin Infect Dis. 2016 Sep 1;63(5):e61-e111. doi: 10.1093/cid/ciw353. Epub 2016 Jul 14. PMID: 27418577; PMCID: PMC4981759.
6. Tamma PD, Aitken SL, Bonomo RA, Mathers AJ, van Duin D, Clancy CJ. Infectious Diseases Society of America 2023 Guidance on the Treatment of Antimicrobial Resistant Gram-Negative Infections. Clin Infect Dis. 2023 Jul 18:ciad428. doi: 10.1093/cid/ciad428. Epub ahead of print. PMID: 37463564.
7. Sarink MJ, Bode LGM, Croughs P, de Steenwinkel JEM, Verkaik NJ, van Westreenen M, Vogel M, Yusuf E. Less Is More: When to Repeat Antimicrobial Susceptibility Testing. J Clin Microbiol. 2023 Aug 23;61(8):e0046323. doi: 10.1128/jcm.00463-23. Epub 2023 Jul 12. PMID: 37436180; PMCID: PMC10446856.
8. Grillon A, Chabaud A, Zambardi G, Caniaux I, Jehl F. Breakpoint to MIC quotient: A parameter to rapidly evaluate the in vitro bactericidal activity of ² -lactams on Enterobacteriaceae. Int J Antimicrob Agents. 2019 May;53(5):674-677. doi: 10.1016/j.ijantimicag.2019.01.013. Epub 2019 Feb 1. PMID:30716447

5. MANAGEMENT OF SEPSIS

Introduction: International consensus definition of sepsis (SEPSIS-3) largely defines sepsis as Infection causing life-threatening organ dysfunction.

a. **Research criterion**: Sepsis = Acute increase in the Sequential Organ Failure Assessment (SOFA) score of ≥ 2 in the context of infection.

b. **Clinical criterion**: Suspect sepsis if quick Sequential Organ Failure Assessment (qSOFA) score ≥ 2.

c. **Septic shock** = A subset of sepsis with high mortality due to profound circulatory and metabolic abnormalities. Defined as sepsis with persistent hypotension or requiring vasopressors to maintain a MAP ≥ 65 mmHg, and a serum lactate > 2 mmol/L (18 mg/dL) despite adequate volume resuscitation.[1]

Immediate Evaluation and Management

Securing the airway (if indicated) and correcting hypoxemia, and establishing venous access for the early administration of fluids and antibiotics are priorities in the management of patients with sepsis and septic shock

- Stabilize respiration: Supplemental oxygen should be supplied to all patients with sepsis who have indications for oxygenation. Intubation and mechanical ventilation may be required to support the increased work of breathing that frequently accompanies sepsis or for airway protection since encephalopathy and a depressed level of consciousness frequently complicate sepsis.
- Establish venous access: Venous access should be established as soon as possible in patients with suspected sepsis. While peripheral venous or intraosseous access may be sufficient in some patients, particularly for initial resuscitation, the majority will require central venous access at some point during their course. However, the insertion of a central line should not delay the administration of resuscitative fluids and antibiotics.
- Initial investigations: An initial brief history and examination, as well as laboratory, microbiologic (including blood cultures), and imaging studies are often obtained simultaneously while access is being established and the airway stabilized. Quickly obtaining the following is preferable (within 45 minutes of presentation) but should not delay the administration of fluids and antibiotics:
    - Complete blood counts with differential, chemistries, liver function tests, and coagulation studies including D-dimer level. Results from these studies may support the diagnosis, indicate the severity of sepsis, and provide baseline to follow the therapeutic response.
    - Serum lactate – An elevated serum lactate (eg, >2 mmol/L or greater than the laboratory upper limit of normal) may indicate the severity of sepsis.
    - Peripheral blood cultures (aerobic and anaerobic cultures from at least two different sites), urinalysis, and microbiologic cultures from suspected sources

- Arterial blood gas (ABG) analysis – ABGs may reveal acidosis, hypoxemia, or hypercapnia.
- Imaging targeted at the suspected site of infection is warranted.
- Procalcitonin: Particularly those with community acquired pneumonia and respiratory tract infections.[16]

Initial resuscitative therapy

Fluid resuscitation remains an integral part of sepsis management, since it was first employed during the European cholera epidemic as early as 1830. The following years, fluid resuscitation was used to treat hypovolemia and restore tissue perfusion pressure in order to improve oxygen transport to cells. Previous versions of SSC guidelines recommended a quantitative resuscitation protocol, that was based entirely on the early goal-directed therapy (EGDT) study.[2]

Current SSC guidelines recommend the early administration of 30 mL/kg of IV fluids fo sepsis-related hypotension or a lactate ≥ 4mmol/L, within the first 3 hr of resuscitation. Further decision to be taken as per the monitoring finding.

Choice of fluid - Evidence from randomized trials and meta-analyses have found no convincing difference between using albumin solutions and crystalloid solutions (e.g, Ringer's lactate, normal saline) in the treatment of sepsis or septic shock, but they have identified potential harm from using pentastarch or hydroxyethyl starch. There is no role for hypertonic saline.

- **Crystalloid versus albumin**: Among patients with sepsis, several randomized trials and meta-analyses have reported no difference in mortality when albumin was compared with crystalloids, although one meta-analysis suggested benefit in those with septic shock.[5] In the saline versus Albumin Fluid Evaluation (SAFE) trial performed in critically ill patients, there was no benefit to albumin compared with saline even in the subgroup with severe sepsis, who comprised 18 percent of the total group.[4] Among the crystalloids, there are no guidelines to suggest that one form is more beneficial than the other.

Antimicrobial therapy

Rapid antimicrobial therapy is one of the primary aims in the treatment of sepsis, with administration of antibiotics within 1 hour of the onset of symptoms.

Undifferentiated Sepsis

- In cases without a clearly defined source, sepsis coverage in the hospital setting should cover resistant gram-negative bacteria, including Pseudomonas, as well as resistant gram- positive bacteria, including MRSA.
- Resistant gram-negative coverage: Cefepime or Piperacillin–tazobactam or Meropenem or Imipenem–cilastatin.

- Resistant gram-negative coverage for penicillin-allergic patients: Aztreonam or Ciprofloxacin + aminoglycoside.
- Resistant gram-positive coverage: Vancomycin or Linezolid or Daptomycin.

Pulmonary Focus

- As pulmonary infections are among the most common causes of sepsis, coverage for pulmonary sepsis is largely the same as that for undifferentiated sepsis.

Urinary Tract Focus

- Urinary sources are common causes of sepsis, and coverage mimics that of undifferentiated sepsis.

Intraabdominal Focus

- In cases where sepsis is due to an intra abdominal focus of infection, gram-negative and anaerobic organisms are the most common pathogens. Additionally, in patients with a recent history of surgery or upper GI perforation, candidiasis is also a possible cause of sepsis
- Gram-negative + anaerobic coverage: piperacillin–tazobactam, meropenem, imipenem cilastatin, cefepime + metronidazole.
- Candida coverage Micafungin or Caspofungin or Fluconazole.[1]

Monitor response

After fluids and empiric antibiotics have been administered, the therapeutic response should be assessed frequently.

a. Clinical Response: All patients should be followed clinically for improved mean arterial pressure (MAP), urine output, heart rate, respiratory rate, skin color, temperature, pulse oximetry, and mental status. Among these, a MAP ≥ 65 mmHg and urine output ≥ 0.5 mL/kg per hour are common targets used in clinical practice.

b. Hemodynamic: Static or dynamic predictors of fluid responsiveness should be employed in order to determine further fluid management. Guidelines state a preference for dynamic measures since they are more accurate than static measures (eg, CVP) at predicting fluid responsiveness.

- Static: Traditionally, in addition to MAP, the following static CVC measurements were used to determine adequate fluid management:
  - CVP at a target of 8 to 12mmHg
  - $ScvO_2$ ≥ 70 percent.[6]
- Dynamic: Respiratory changes in the vena caval diameter, radial artery pulse pressure, aortic blood flow peak velocity, left ventricular out flow tract velocity-time

integral, and brachial artery blood flow velocity are considered dynamic measures of fluid responsiveness. There is increasing evidence that dynamic measures are more accurate predictors of fluid responsiveness than static measures, as long as the patients are in sinus rhythm and passively ventilated with a sufficient tidal volume.

Patients who fail initial therapy

Patients having persistent hypoperfusion despite adequate fluid resuscitation and antimicrobial treatment should be reassessed for fluid responsiveness adequacy of the antimicrobial regimen and septic focus control. Other options for treatment of persistent hypoperfusion such as the use of vasopressors, glucocorticoids, inotropic therapy, and blood transfusion are to be considered.

a. Vasopressors – Intravenous vasopressors are useful in patients who remain hypotensive despite adequate fluid resuscitation or who develop cardiogenic pulmonary edema. Based upon meta-analyses of small randomized trials and observational studies, a paradigm shift in practice has occurred such that most experts preferto.

- First agent – Data that support norepinephrine as the first-line single agent in septic shock are derived from numerous trials that compared the use of one vasopressor to another.[8]
- Additional agents – The addition of a second or third agent to norepinephrine may be required (eg, epinephrine, dobutamine and vasopressin).[9]

b. Glucocorticoids: For adults with septic shock and an ongoing requirement for vasopressor therapy, IV corticosteroids are suggested.[7] However, the role of steroid is a matter of on going debate.

c. Inotropic therapy: A trial of inotropic therapy may be warranted in patients who fail to respond to adequate fluids and vasopressors, particularly those who also have diminished cardiac output. Dobutamine is a suitable first-choice agent; epinephrine is a suitable alternative.

d. Red blood cell transfusions: Based upon clinical experience, randomized studies, and guidelines on transfusion of blood products in critically ill patients, may be considered blood cell transfusion for patients with a hemoglobin level ≤ 7g/dL.[10]

Patients who respond to therapy

Patients have demonstrated a response to therapy, attention should be directed towards continuing to control the septic focus, and de-escalation of fluids and antibiotics, as appropriate.

a. Identification and control of the septic focus — Further efforts aimed at identifying and controlling the source of infection should be done if the initial evaluation and investigations fail to identify asource.
b. De-escalation fluids — In patients who respond to initial fluid therapy (ie, clinical hemodynamic and laboratory targets are met; usually hours to one to two days), reduce the rate of or stop fluids, wean vasopressor support, and, if necessary, administer diuretics.
c. De-escalation and duration of antibiotics — It is appropriate that de-escalation and duration of antimicrobial agents be assessed daily.[11]
   - **De-escalation** – After culture and susceptibility results return and/or after patients clinically improve, we recommend that antimicrobial therapy be narrowed (typically a few days). When possible, antimicrobial therapy should also be pathogen and susceptibility directed (also known as targeted/definitive therapy).
   - **Duration** – The duration of antibiotics should be individualized. For most patients, the duration of therapy is typically three to eight days.[12] However, longer courses are appropriate in patients who have a slow clinical response, an undrainable focus of infection.[13] Occasionally, shorter courses may be appropriate (eg, patients with pyelonephritis, urinary sepsis, or peritonitis who have rapid resolution of source control).[14]
   - **Role of procalcitonin** – Although many institutions and guidelines support the use of procalcitonin to limit antibiotic (empiric or therapeutic) use in critically ill patients with suspected infection or documented infection, the evidence to support this practice is limited. Several randomized trials and meta-analyses found that using procalcitonin-guided algorithms to guide antimicrobial de-escalation did not result in any mortality benefit.[15]

Conclusion

Sepsis is a life-threatening and time-dependent condition that is still accompanied by an overall poor prognosis. Several reasons may be advocated to explain why sepsis and septic shock challenge emergency physicians in daily practice, including (i) its insidious clinical onset; (ii) misdiagnosis leading to delayed treatment and subsequent worsening of clinical outcomes and quality of life; and finally (iii) multidisciplinary and challenging management with different therapeutic aspects that are still debated, e.g., the time until antimicrobic treatment, adequate fluid resuscitation, early vasopressor administration, and oxygen targets. Nonetheless, a well-orchestrated treatment based on selected antimicrobics, fluids, oxygen, and, if necessary, vasoactive agents can improve patient's outcomes.

REFERENCES

1. Spec A, Escota GV, Chrisler C, Davies B. Comprehensive review of infectiousdiseases.
2. Rivers E, Nguyen B, Havstad S, Ressler J, Muzzin A, Knoblich B, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. New England journal of medicine. 2001 Nov 8;34

3. Moschopoulos CD, Dimopoulou D, Dimopoulou A, Dimopoulou K, Protopapas K, Zavras N, et al. New Insights into the Fluid Management in Patients with Septic Shock. Medicina. 2023 May 29;59(6):1047.
4. SAFE Study Investigators. A comparison of albumin and saline for fluid resuscitation in the intensive care unit. New England Journal of Medicine. 2004 May27;350(22):2247-56.
5. Caironi P, Tognoni G, Masson S, Fumagalli R, Pesenti A, Romero M et al. Albumin replacement in patients with severe sepsis or septic shock. New England Journal of Medicine. 2014 Apr 10;370(15):1412-21.
6. Rivers E, Nguyen B, Havstad S, Ressler J, Muzzin A, Knoblich B, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. New England journal of medicine. 2001 Nov 8;345(19):1368-77.
7. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, et al. Survivingsepsis campaign: international guidelines for management of sepsis and septic shock 2021. Critical care medicine. 2021 Nov1;49(11):e1063-143.
8. Martin C, Papazian L, Perrin G, Saux P, Gouin F. Norepinephrine or dopamine for the treatment of hyperdynamic septic shock?. Chest. 1993 Jun1;103(6):1826-31.
9. Nguyen HB, Lu S, Possagnoli I, Stokes P. Comparative effectiveness of second vasoactive agents in septic shock refractory to norepinephrine. Journal of Intensive Care Medicine. 2017 Aug;32(7):451-9.
10. Hébert PC, Wells G, Blajchman MA, Marshall J, Martin C, Pagliarello G, et al. Transfusion Requirements in Critical Care Investigators for the Canadian Critical Care Trials Group. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. New England Journal of Medicine. 1999 Feb11;340(6):409-17.
11. Weiss CH, Moazed F, McEvoy CA, Singer BD, Szleifer I, Amaral LA, et al. Prompting physicians to address a daily checklist and process of care and clinical outcomes: a single-site study. American journal of respiratory and critical care medicine. 2011 Sep15;184(6):680-6.
12. Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clinical infectious diseases. 2016 Sep1;63(5):e61-111.
13. Liu C, Bayer A, Cosgrove SE, Daum RS, Fridkin SK, Gorwitz RJ, et al. Clinical practice guidelines by the Infectious Diseases Society of America for the treatment of methicillin-resistant Staphylococcus aureus infections in adults and children. Clinical infectious diseases. 2011 Feb 1;52(3):e18-55.
14. Sawyer RG, Claridge JA, Nathens AB, Rotstein OD, Duane TM, Evans HL, et al. Trial of short-course antimicrobial therapy for intraabdominal infection. New England Journal of Medicine. 2015 May21;372(21):1996-2005.
15. Schuetz P, Chiappa V, Briel M, Greenwald JL. Procalcitonin algorithms for antibiotic therapy decisions: a systematic review of randomized controlled trials and recommendations for clinical algorithms. Archives of internal medicine. 2011 Aug8;171(15):1322-31.
16. Schmidt GA, Mandel J, Sexton DJ, Hockberger RS. Evaluation and management of suspected sepsis and septic shock in adults. Uptodate Online.2018:1-29.

6 A. PRESUMPTIVE ANTIBIOTIC THERAPY FOR INFECTIONS IN ENT

Sl no.	Clinical Condition	Antibiotic Choice	Dose	Frequency	Route	Duration
1	● Sinusitis ● Pharyngitis ● Laryngitis ● Tonsillitis ● CSOM ● ASOM ● Otitis Externa	Amoxycillin Clavulanate	625mg	TDS	Oral	7-14 days
		Clarithromycin	500mg	BD	Oral	7-14 days
		Levofloxacin	500mg	OD	Oral	10 days
		Moxifloxacin	400mg	OD	Oral	10 days
		Clindamycin	300mg	BD	Oral	10 days
		Cefuroxime	500mg	BD	Oral	10 days
		Co-trimoxazole	960mg	BD	Oral	10 days
		Inj. Ceftriaxone or any 3rd Generation Cephalosporin	1gm	12 hrly	IV (AST)	5 -7 days
		Inj. Amoxycillin Clavulanate	1.2 gm	8 hrly	IV (AST)	5 -7 days
2	● CSOM With Complications ● Deep Neck Space Infection ● (Ludwig's Angina, ● Parapharyngeal abscess, Retropharyngeal abscess, Peritonsillar abscess,etc) ● Facial/ Orbital Cellulitis ● Malignant Otitis Externa ● Epiglottitis	Inj. Ceftriaxone or any 3rd Generation Cephalosporin	1gm	12 hrly	IV (AST)	5 -7 days
		Inj. Amoxycillin Clavulanate	1.2 gm	8 hrly	IV (AST)	5 -7 days
		Inj. Piperacillin + tazobactam	4.5 gm	8 hrly	IV (AST)	2-3weeks
		Inj Amikacin	250/500 mg	12 hrly	IV	5 days
		Inj. Ciprofloxacin	500 mg	12 hrly	IV	5 days
		Inj. Clindamycin	600 mg	8 hrly	IV	2-3 weeks
		Inj. Metronidazole	500 mg	8 hrly	IV	5 days
		Inj. Meropenem	1 gm	12 hrly	IV	5 days
		Inj. Linezolid	600 mg	12 hrly	IV	10-14
		Inj. Tobramycin	5mg/kg	24 hrly	IV	Up to 5 days after signs of inflammation resolve.

Sl no	Clinical Condition	Antibiotic Choice	Dose	Frequency	Route	Duration
1	● Sinusitis ● Pharyngitis ● Laryngitis ● Tonsillitis ● CSOM ● ASOM ● Otitis Externa	Amoxycillin Clavulanate	625 mg	8 hrs	Oral	7-14 days
		Clarithromycin	500mg	BD	Oral	7-14 days
		Levofloxacin	500mg	OD	Oral	10 days
		Moxifloxacin	400mg	OD	Oral	10 days
		Clindamycin	300mg	BD	Oral	10 days
		Cefuroxime	500mg	BD	Oral	10 days
		Co-trimoxazole	960mg	BD	Oral	10 days
		Inj. Ceftriaxone or any 3rd Generation Cephalosporin	1gm	12 hrly	IV (AST)	5 -7 days
		Inj. Amoxycillin Clavulanate	1.2gm	8 hrly	IV (AST)	5 -7 days
2	● CSOM with complications ● Deep Neck Space Infection ● (Ludwig's Angina ● Parapharyngeal abscess, Retropharyngeal abscess, Peritonsillar abscess,etc) ● Facial/ Orbital Cellulitis ● Malignant Otitis Externa ● Epiglottitis	Inj. Ceftriaxone or any 3rd Generation Cephalosporin	1gm	12 hrly	IV (AST)	2-3 weeks
		Inj. Amoxycillin Clavulanate	1.2gm	8 hrly	IV (AST)	2-3 weeks
		Inj. Piperacillin + tazobactam	4.5gm	8 hrly	IV (AST)	2-3 weeks
		Inj Amikacin	250/500 mg	12 hrly	IV	5 days
		Inj. Ciprofloxacin	400mg	12 hrly	IV	5 days
		Inj. Clindamycin	600mg	8 hrly	IV	2-3 weeks
		Inj. Metronidazole	500 mg	8 hrly	IV	5 days
		Inj. Meropenem	1 gm	12 hrly	IV	5 days
		Inj. Linezolid	600 mg	12 hrly	IV	10-14
		Inj. Tobramycin	5mg/kg	24 hrly	IV	Up to 5 days after signs of inflammation resolve.

REFERENCES

1. Anthony W. Chow, Michael S. Benninger, Itzhak Brook et al., IDSA Clinical practice guideline for acute bacterial Rhinosinusitis in Children and adults, Clinical Infectious Diseases 2012;54(8):e 72-112.
2. ICMR 2019: Treatment Guidelines for Antimicrobial Use in Common Syndromes.
3. IDSA & AAO-HNSF guidelines Macfadyen Ca, Acuin JM, Gamble C Cochrane Database syst Rev. 2006 Jan25;(1)CD005608.

6 B. INFECTIONS IN UROLOGY

Introduction: Urinary tract infections (UTI) are very common and can affect people from all age groups including neonate and geriatric patients. Every year about 150 million people are being diagnosed with urinary tract infection worldwide. Each and every woman has a lifetime risk of developing UTI is 60%; by contrast, men have a lifetime risk of only 13%[1].

Urinary tract Infections can often occur after any diagnostic or therapeutic procedures with symptoms varying from asymptomatic bacteriuria to life threatening urosepsis. Among the patients with nosocomial urinary tract infections (UTIs), almost 80% have a prior history of urologic surgery; endourologic procedures have undergone in 50%, open or laparoscopic surgery in 45%, and prostate biopsies in 5%[2]. Thus, in order to reduce the prevalence of UTIs, preventive measures, such as a strict preoperative evaluation and correct antibiotic prophylaxis should be considered. Proper urine cultures and antibiotics sensitivity testing should be considered before treatment of UTIs. Prudent use of antimicrobial agents, both in prophylaxis and in treatment of established infections should be done. Antibiotic agents should be chosen according to the predominant pathogens at a given site of infection in the hospital environment and local microbiological patterns.

Untreated UTI may progress to sepsis and shock. Urosepsis is one of the most dreadful complications encountered in urological practice owing to its increased morbidity and mortality. Urosepsis is defined as a sepsis caused by UTI; this occurs in 7–25 % of all septic cases[3]. It may be associated with multi-organ dysfunction, hypo-perfusion or hypo-tension, with features consistent with systemic inflammatory response syndrome. Though sepsis is commoner in men than in women, it has been found that urosepsis is commoner in women than in men. While severe sepsis has a reported mortality rate of 20 to 42%, urosepsis may be associated with high mortality rates in special patient groups[4]. Proper patient evaluation before surgery, adequate antibiotic coverage both prophylactic and therapeutic and proper intraoperative and post operative care play a very important role in preventing adverse events related to infection and sepsis. Surgical antimicrobial prophylaxis plays a very important role in reducing the risk of surgical infections.

The principles of treatment of urosepsis involves adequate life-supporting care, appropriate and prompt antimicrobial therapy, adjunctive measures and the optimal management of urinary tract disorders[5]. Source control by decompression of any obstruction and drainage of infected urinary tract is essential[5]. Urologists should work in collaboration with intensive care and infectious diseases specialists for better patient outcomes.

Proper use of prophylactic antibiotics can help in reducing the risk of infections and in order to standardize the administration of antibiotics in various scenarios, both European Association of Urology (EAU) and American Urological Association (AUA) have both published guidelines for best practice in antibiotic prophylaxis in urologic surgery. Proper adherence to the guidelines can help in better patient outcomes and reduction in infections.

Risk factors for infectious complications and need for Antibiotic prophylaxis

There are certain well recognized factors that pose high risk for development of infectious complications after any urological procedure, and require proper prophylactic antibiotic coverage. These high-risk factors can be divided into three different groups e.g related to the patient (immunosuppression, malignancy, advanced age, poor nutrition,prolonged hospitalization), related to the procedure (stone diease management, prosthesis, long duration of surgery) and related to the urinary tract diseases (chronic bacteriuria, urinary diversion, stone diseases, anatomical anomalies). These factors frequently act in an additive manner, compounding their impact. The likelihood of bacterial invasion is also affected by the amount of bacteria at the site of the surgical procedure. All procedures invading the urinary tract are considered"clean–contaminated". The likelihood of bacterial invasion is increased if bacteriuria is present or adequate wound preparation and surgical techniques are not employed[6].

Prevention of infections and sepsis in genitourinary surgical patients

EAU Guidelines on Urological Infections recommends the following basic preventive measures of proven efficacy in any urologic patient undergoing surgery[7] -

- Isolation of all patients infected with Multi resistant organisms to avoid cross-infection.
- Prudent use of antimicrobial agents, both in prophylaxis and in treatment of established infections, to avoid selection of resistant strains.
- Reduction in hospital stay. Early removal of indwelling urethral catheters, as soon as allowed by the patient's condition.
- Nosocomial UTIs are promoted by bladder catheterization as well as by ureteral stenting.
- Antibiotic prophylaxis does not prevent stent colonization, which appears in 100% of patients with a permanent ureteral stent and in 70% of those temporarily stented.
- Use of closed catheter drainage and minimization of breaks in the integrity of the system and use of the least-invasive method to release urinary tract obstruction until the patient is stabilized.
- Attention to simple everyday techniques to ensure a sepsis, including the routine use of disposable gloves, frequent hand disinfection, and infectious disease control measures to prevent cross-infections.
- Thorough history taking, physical examination and identification of all comorbidities and risk factors, proper preoperative evaluation and prophylactic antibiotics can help in minimizing the risk of complications.
- In order to be effective, the antibiotics must be given in proper dose and at specific time. Infusion of the first dose should begin within 60 minutes of the surgical incision (with the exception of 120 minutes for intravenous fluoroquinolones and vancomycin).
- Dosing of the antimicrobial drug must be adjusted to the patient's body weight. Oral administration is as effective as the intravenous route for antibiotics with sufficient bioavailability. Additional doses are required intraoperatively if the procedure extends beyond two half-lives of the initial dose.

Duration of antibiotic prophylaxis

For most endourological procedures single dose prophylaxis or at most antibiotic prophylaxis for 24 hours is required[8]. The placement of prosthetic material, the presence of an existing infection, and the manipulation of an indwelling tube are important circumstances requiring longer duration of antimicrobials[9]. Antibiotic agents should be chosen according to the predominant pathogens at a given site of infection in the hospital environment and local microbiological patterns.

PREOPERATIVE ANTIBIOTICS IN SPECIFIC PROCEDURES

Transurethral surgeries

1. TURP

The AUA guidelines recommend the use of antimicrobial prophylaxis in all patients. The suggested antimicrobial prophylaxis is fluoroquinolone or trimethoprim–sulfamethoxazole as antimicrobial of first choice, and alternatively a first or second generation cephalosporin, aminoglycosides ± ampicillin or amoxicillin/clavulanate, before the start of TURP and until less than 24 hours post operatively[10].

The EAU guidelines recommend a very similar antibiotic regimen in all patients other than those at low risk or with a small prostate[7].

2. TURBT

The AUA guidelines recommend trimethoprim–sulfamethoxazole or fluoroquinolones as the first choice of antimicrobials in all patients undergoing transurethral resection of bladder tumor[9]. The EAU guidelines recommend that antimicrobial prophylaxis for TURBT is unnecessary unless the patient has some risk factors for infectious complications, or a large tumor requiring a prolonged resection time, or a necrotic tumor.[11-13] EAU guidelines recommend Trimethoprim sulphamethoxazole or Cephalosporin group 2 or 3, or Aminopenicillin plus a beta-lactamase inhibitor for antimicrobial prophylaxis for TURBT in high-risk patients[7].

Other transurethral procedures

Other transurethral procedures involving manipulation, like bladder biopsy, laser prostatectomy, and internal urethrotomy, may be similar in terms of tissue trauma, and the AUA guidelines suggest antibiotics prophylaxis for these procedures similar to TURP & TURBT.

Cystoscopy & urethroscopy

AUA guidelines recommend single dose trimethoprim - sulfamethoxazole or Amoxicillin/Clavulanate as choice of antimicrobials for prophylaxis in host related risk factors[10]. While EAU guidelines do not recommend any prophylactic antibiotics for cystourethroscopy[7].

PROCEDURES RELATED TO STONES

Shock -wave lithotripsy

AUA Best Practice Policy guidelines on antibiotic prophylaxis recommends preoperative antibiotic prophylaxis for all patients undergoing SWL[10]. AUA guidelines recommend trimethoprim-sulfamethoxazole or 1st gen. Cephalosporin (Cefazolin) or 2nd gen. Cephalosporin (Cefuroxime) or Aminopenicillin combined with a β-lactamase inhibitor and Metronidazole as the antimicrobial of choice for prophylaxis[10].

EAU recommend against antibiotic prophylaxis prior to SWL in patients without stents or positive urine cultures[7]. Currently, prophylactic antibiotics should be considered only in high-risk patients and SWL should only be performed if the patient's urine is sterile and when there is no distal obstruction.

Ureteroscopy

AUA Best Practice Policy recommends antibiotic prophylaxis with single dose Trimethoprim-sulfamethoxazole or Amoxicillin/clavulanate prior to ureteroscopy for the management of stone diease[10]. The guideline committee states that the potential risk of bacteriuria is 30% and UTI ranges from 4 to 25% without prophylaxis.

Percutaneous renal surgery

Ideally, all patients scheduled for PCNL must have a negative urine culture preoperatively, since stone manipulation or incision therapy in presence of active UTI can be extremely dangerous.

Both EAU and AUA guidelines recommend prophylactic antibiotic therapy for all percutaneous renal surgeries.

First choice prophylactic antibiotics in PCNL include 1st/2nd gen. Cephalosporin or Aminoglycoside and Metronidazole or Aztreonam and Metronidazole or Aminoglycoside and Clindamycin. Dose should be adjusted as per patient's body weight and they should be given for </= 24 hours[10].

Since PCNL can be associated with a pre-existing infection, infectious stone, or manipulation of an indwelling catheter, the subsequent course of antimicrobials is therapeutic rather than prophylactic and might extend beyond 24 hours from the conclusion of the procedure.

Studies suggest that when the preoperative urine culture is negative, a single dose of antibiotics appears to be as effective in preventing postoperative infections as multiple doses irrespective of the type of antibiotic used[17-20].

Trans Rectal Ultrasound guided biopsy of prostate

Adoption of Ciprofloxacin and Fosfomycin antibiotics significantly lowers the rate of prostate needle biopsy urosepsis. Moreover, this regimen is oral, low cost and single dose[18]. In countries where fluroquinolones are allowed as prophylactic antibiotics minimum of a full 1- day administration is recommended. In case of fluroquinolone resistance targeted therapy is recommended fosfomycin is also good as an augmented prophylaxis with fluroquinolone although no established standard combination exists[19].

Open and laparoscopic renal surgeries

- In Clean surgeries (adrenalectomy, lymphadenectomy, retroperitoneal or pelvic). EAU recommends prophylactic antibiotic for all clean cases (single dose of first generation cephalosporins), on the other hand AUA recommends prophylactic antibiotics only for patients with high risk.

- In Clean–contaminated surgeries (pyeloplasty, radical prostatectomy; partial cystectomy) Both EAU and AUA guidelines recommend prophylactic antibiotics for clean contaminated surgeries ($2^{nd}/3^{rd}$ generation cephalosporin or aminoglycoside + metronidazole or aminopenicillin).

- In Contaminated and Dirty surgeries (drainage of perinephric abscess), antimicrobial agents are given with a therapeutic intention rather than prophylactically.

- For perineal surgeries like urethroplasty, the antimicrobials of choice includes Metronidazole 500 mg every 8h IV Plus Ciprofloxacin 400 mg IV every 12h or 750 mg PO x 12 hourly.

Antibiotics use in patients with indwelling catheters, stents, and drainage tubes

Patients with an indwelling catheter, nephrostomy tube, or other stent device should be considered as having bacteriuria and must be treated in advance (between 3 and 7 days prior to the procedure) in order to favor sterile urine at the time of surgery. The patient should be covered well beyond the intervention (7–10 days or longer), depending on the type of operation and patient factors[20]. Asymptomatic bacteriuria (bacterial colonization) is only to be treated prior to surgery or after removal of the drainage tube.

Recommended Antimicrobial Prophylaxis in Genitourinary Surgery & Procedures[7,10]

	Indication		Antibiotic scheme			
Procedure	AGB	EAU	First choice	Alternative	Duration	Remarks
Diagnostic procedures						
Cystography, cystoscopy, ureteroscopy, urodynamics	If risk factors	If risk factors	Fluoroquinolone or 2nd-generation cephalosporin or TMP–SMX	Aminoglycoside + ampicillin or amoxicillin–clavulanate	<24 hours	Warfarin cessation is negative, antimicrobial prophylaxis is not necessary
Prostate biopsy	All	All	Fluoroquinolone or TMP–SMX	Aminoglycoside + metronidazole or clindamycin	<72 hours	
Endourologic surgery and shock-wave lithotripsy						
Shock-wave lithotripsy	All	If risk factors	Fluoroquinolone or TMP–SMX or 2nd/3rd generation cephalosporin	Aminoglycoside + ampicillin or amoxicillin–clavulanate	<24 hours	Patients with ureteral stent, nephrostomy obstruction and infection stone
TURP/TURBT	All	If risk factors	Fluoroquinolone or TMP–SMX or 2nd/3rd generation cephalosporin or aminopenicillin/BLI	Aminoglycoside + ampicillin or 1st-generation cephalosporin or amoxicillin–clavulanate	<24 hours	Consider in large recurrent tumors
Ureteroscopy	All	If risk factors	2nd/3rd generation cephalosporin or TMP–SMX or aminopenicillin/BLI or fluoroquinolone	Aminoglycoside + ampicillin or 1st-generation cephalosporin or amoxicillin–clavulanate	<24 hours	
Percutaneous renal surgery	All	All	2nd/3rd generation cephalosporin or TMP–SMX or aminopenicillin/BLI	Ampicillin/sulbactam or fluoroquinolone or 1st-generation cephalosporin	<24 hours	Length of short course to be determined, intravenous route suggested
Open or laparoscopic surgery						
Clean operations	If risk factors	All	1st-generation cephalosporin	Clindamycin	Single dose	Consider as high-risk and short postoperative catheter treatment
Clean–contaminated opening of urinary tract	All	All	2nd/3rd generation cephalosporin or aminoglycoside + metronidazole or aminopenicillin/BLI	Ampicillin/sulbactam Fluoroquinolone	Single postoperative dose	
Contaminated (involving bowel)	All	All	2nd/3rd generation cephalosporin or aminoglycoside + metronidazole or clindamycin	Ampicillin/sulbactam Ticarcillin/clavulanate Piperacillin/tazobactam Fluoroquinolone	<24 hours	For surgery involving the colon, bowel preparation with oral neomycin plus either erythromycin base or metronidazole can be added
Implanted prosthetic devices	All	All	Aminoglycoside + 1st/2nd generation cephalosporin or vancomycin	Ampicillin/sulbactam Ticarcillin/clavulanate Piperacillin/tazobactam	<24 hours	

TURP, transurethral resection of prostate; TURBT, transurethral resection of bladder tumor; TMP–SMX, trimethoprim–sulfamethoxazole; BLI, β-lactamase inhibitor.

Treatment guidelines for antimicrobial use in common genitourinary infections

1. Asymptomatic bacteriuria in adults

The treatment of ABU should be performed only in cases of proven benefit as it might be protective against superinfecting symptomatic UTI[30,31]. Treatment of asymptomatic bacteriuria is beneficial prior to urological procedures breaching the mucosa and in pregnant women[24-25].

Screening and treatment of ABU is not recommended in patients with ABU who are otherwise healthy, post meno-pausal women, patient dysfunctional and/or reconstructed lower urinary tracts, indwelling catheters or neprostomy or suprapubic tubes and renal transplant patients[23].

2. Uncomplicated cystitis

In female patients of uncomplicated cystitis with mild symptoms, antibiotics may not be required. Treatment regimen for uncomplicated cystitis has been mentioned in the table on Antibiotic use in genitourinary infections.

3. Recurrent UTI

Both continuous and low dose antimicrobial prophylaxis and post coital antimicrobial prophylaxis has been shown to reduce the rate of recurrent UTI.[26-27] Intermittent self-start therapy is effective and safe in women with recurrent UTI. Treatment regimen has been mentioned in the table on Antibiotic use in genitourinary infections.

4. Uncomplicated pyelonephritis

Fluroquinolones and cephalosporins are the only antimicrobials that can be given as oral empirical treatment of uncomplicated pyelonephritis.[28] Intravenous antimicrobial regimen may include a fluoroquinolone, an aminoglycoside or an extended spectrum cephalosporin or penicillin. Carbapenems should only be considered in patients with multidrug resistant organisms. Treatment regimen has been mentioned in the table on Antibiotic use in genitourinary infections.

5. Complicated UTIs

A complicated UTI (cUTI) occurs in an individual in whom factors related to the host (e.g. underlying diabetes or immunosuppression) or specific anatomical or functional abnormalities related to the urinary tract (e.g. obstruction, incomplete voiding due to detrusor muscle dysfunction) are believed to result in an infection that will be more difficult to eradicate than an uncomplicated infection. Treatment regimen has been mentioned in the table on Antibiotic use in genitourinary infections.

6. Catheter associated UTIs

Catheter-associated UTI (CA-UTI) refers to UTIs occurring in a person whose urinary tract is currently catheterised or has been catheterised within the past 48 hours. Catheter-associated asymptomatic bacteriuria should be treated only prior to urinary tract interventions (e.g. transurethral resection of the prostate). Prophylactic antimicrobials should not be used to prevent catheter-associated UTIs. EAU guidelines recommend against antibiotic prophylaxis to prevent clinical UTI after urethral catheter removal or in patients performing intermittent self-catheterisation.

Urosepsis

Urosepsis requires a multi-disciplinary team comprising of urologist, intensive care specialists and infectious disease specialists. Urosepsis treatment requires a combination of treatment including relief of obstruction of urinary tract, adequate life-support care, appropriate antimicrobial therapy and appropriate supportive treatment. Treatment regimen has been mentioned in the table on Antibiotic use in Urosepsis.

Urethritis

Patients diagnosed with severe urethritis should be started with empirical treatment. If the patients' symptoms are mild, delayed treatment guided by the results of NAATs is recommended. All sexual partners at risk should be assessed and treated whilst maintaining patient confidentiality.

In suspected gonococcal urethritis, Gram stain of urethral discharge or a urethral smear must be done preliminarily to diagnose gonococcal urethritis. A validated nucleic acid amplification test (NAAT) on a first-void urine sample or urethral smear prior to empirical treatment should be performed to diagnose chlamydial and gonococcal infections.

Treatment regimen has been mentioned in the table on antibiotic use in genitourinary infections.

Treatment regimen of non gonococcal urethritis has been mentioned in the table on Antibiotic use in genitourinary infections.

Bacterial Prostatitis

In acute bacterial prostatitis**,** parenteral administration of high doses of bactericidal antimicrobials, such as broad-spectrum penicillin, a third-generation cephalosporin or fluoroquinolones, is recommended. Treatment regimen has been mentioned in the table on antibiotic use in genitourinary infections.

In chronic bacterial prostatitis**,** Fluoroquinolones are the first-line drugs for treatment of chronic bacterial prostatitis, doxycycline (100 mg BD for 10 days) or macrolide antibiotics like Azithromycin (500 mg OD for 3 weeks) can also be used.

Acute infective Epididymitis

In young sexually active patients both STIs and Enterobacterales have to be considered as aetiological agents and a negative sexual risk history does not exclude STIs in sexually activemen.

Mid-stream urine and a first voided urine sample for pathogen identification by culture and nucleic acid amplification test should be obtained before treatment.

Treatment regimen has been mentioned in the table on antibiotic use in genitourinary infections.

Fournier's Gangrene

Fournier's gangrene is a rapidly spreading and frequently fatal polymicrobial soft tissue infection of the perineum, peri-anal region, and external genitalia. The treatment for Fournier's gangrene should be started with immediate empirical broad-spectrum antibiotics on presentation, with subsequent refinement according to culture and clinical response. Repeated surgical debridement for Fournier's gangrene should be considered within 24 hrs of presentation.

Treatment regimen has been mentioned in the table on antibiotic use in genitourinary infections.

Antibiotics used in genitourinary infections [7, 10]

Urinary Syndrome	Drug of choice	Alternative Choices	Duration	Comments
Acute cystitis (uncomplicated)	Nitrofurantoin 100 mg PO BD Fosfomycin 3g single dose Pivmecillinam 400 mg TID	Co-trimoxazole Ertapenem Amikacin (can be used in children as well)	Usual treatment is given for 5 days	Dosage adjustment as per eGFR
Recurrent UTIs	Nitrofurantoin 50 mg or 100 mg PO BD	Fosfomycin trometamol 3g every 10 days, Trimethoprim 100 mg once daily	Treatment duration is for 10 days	During pregnancy, Cephalexin 125 mg or 250 mg or cefaclor 250 mg once daily
Acute Pyelonephritis	Piperacillin – tazobactam Ertapenem	Imipenem Meropenem Amikacin (Recommended for children as well)	Treatment is min. of 7 days	Oral antimicrobial regimen for uncomplicated pyelonephritis include Ciprofloxacin

			The total duration of treatment is 14 days in children	500 to 700 mg BD for 7 days or Levofloxacin 750 mg once daily for 5 days
Complicated UTI	Amoxicillin + Aminoglycoside, Second or Third generation cephalosporins iv empirically for systemic symptoms, levofloxacin 750 mg i.v		Treatment is for 5 - 10 days	
Gonococcal urethritis	Ceftriaxone 1 g i.m or i.v with azithromycin 1 g single oral dose should be used as first-line treatment	In case of azithromycin allergy, doxycycline can be used instead in combination with ceftriaxone or cefixime		
Non-gonococcal urethritis	Doxycycline 100 mg twice daily for 7 days	Alternatively, single dose oral azithromycin 500 mg day one and 250 mg days two to four can be used		
U. urealyticum urethritis	Doxycycline 100 mg twice daily for seven days	Azithromycin 1 g single dose		
Urethritis caused by T. vaginalis	Oral metronidazole or tinidazole 2 g single dose			
Acute Bacterial Prostatitis	Ertapenem 1g IV once daily + aminoglycoside	Piperacillin-tazobactam Imipenem Meropenem Trimethoprim-Sulfamethoxazole	Minimum 21 days of antibiotics	Urine and prostatic massage specimen for cultures to be collected before antibiotics
Chronic Bacterial Prostatitis	Fluoroquinolones (levofloxacin, ofloxacin)	Doxycycline 100 mg BD or Macrolide antibiotics like Azithromycin 500 mg OD for 3 weeks	Usual duration of treatment is 10 days	

Epididymo-orchitis (High risk of sexually transmitted)	Ceftriaxone 1g i.m single dose + Doxycycline 200 mg stat, then 100 mg BD for 14 days	Ofloxacin Levofloxacin	Total duration of treatment is 14 days (except for Levofloxacin where it is 10 days)	
Epididymo-orchitis (Low risk of sexually transmitted; likely due to enteric or urinary organisms)	Ofloxacin 200 mg PO BD Levofloxacin 500 mgPO OD		Total duration of treatment is 10 days	
Acute epididymitis in non-sexually active	Fluoroquinolone (levofloxacin 500 mg OD) by mouth once daily for 10 - 14 days	Ofloxacin 200 mg PO BD	Treatment durationis 10 –14 days	
Fournier's Gangrene	Piperacillin-tazobactam (4.5 g every 6-8 h IV) plus Vancomycin (15 mg/kg every 12 h) or Meropenem (1g every 6-8 h IV), Or Gentamicin (5 mg/kg daily)	Combination therapy Cefotaxime (2 g every 6 h IV) plus metronidazole(500mg every 6 h IV) Or Clindamycin (600-900 mg every 8 h IV) can also be used		
Urosepsis	Cefotaxime 2g T.I.D Ceftazidime 1-2g T.I.D Ceftriaxone 1-2g q.d Cefepime 2g B.I.D Piperacillin/tazobactm 4.5g T.I.D Ceftolozane/tazobactam 1.5g T.I.D Ceftazidime/avibactam 2.5 g T.I.D	Gentamicin*5 mg/kg q.d Amikacin*15 mg/kg q.d Ertapenem 1g q.d Imipenem/cilastatin 0.5 g T.I.D Meropenem 1g T.I.D	Treatment duration is 7-10 days	Longer courses are appropriate in patients who have a slow clinical response

REFERENCES

1. R Nalini, J Ezhil Ramya. Recent Sensitivity Pattern of Escherichia Coli in Urinary Tract Infection. RRJMB. 2014; 3(3).
2. Bjerklund Johansen TE et al., Prevalence of hospital acquired urinary tract infections in urology departments. Eur Urol 2007; 51(4): 1100–1111; discussion 1112.
3. Book M et al., [Urosepsis. Current therapy and diagnosis]. Urologe A 2005; 44(4): 413-22 quiz 423-424.
4. Rosser CJ, Bare RL, Meredith JW. Urinary tract infections in the critically ill patient with a urinary catheter. Am J Surg. 1999; 177: 287–90.
5. Dellinger, R.P., *et al*., Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock, 2012. Intensive Care Med, 2013. 39:165. https://pubmed.ncbi.nlm.nih.gov/23361625/.
6. Wagenlehner FM, Weidner W, and Naber KG. Optimal management of urosepsis from the urological perspective. Int J Antimicrob Agents 2007; 30(5): 390–397. DOI: 10.1016/j. ijantimicag. 2007.06.027.
7. Grabe M, Bjerklund-Johansen T, Botto H et al. Guidelines on Urological Infections 2014. European association of urology. http://uroweb.org/guidelines.
8. Deshmukh S et al. Compliance with American Urological Association Guidelines for post percutaneous nephrolithotomy antibiotics does not appear to increase rates of infection. J Urol 2015; 194(4): 992–996. DOI: 10.1016/j.juro.2015.04.097.
9. Mangram AJ et al. Guideline for prevention of surgical site infection 1999; Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol 1999; 20(4): 250–278; quiz 279–280.
10. Wolf JS Jr et al. Best practice policy statement on urologic surgery antimicrobial prophylaxis. J Urol 2008; 179 (4):1379–1390.
11. Delavierre D et al. [The value of antibiotic prophylaxis in transurethral resection of bladder tumors. A propos of 61 cases]. Prog Urol 1993; 3(4): 577–578.
12. Wilson L et al. Is antibiotic prophylaxis required for flexible cystoscopy? A truncated randomized double blind controlled trial. J Endourol 2005; 19(8): 1006–1008.
13. Upton JD and Das S. Prophylactic antibiotics in transurethral resection of bladder tumors: are they necessary? Urology 1986; 27(5): 421–423.
14. Gravas S et al. Postoperative infection rates in low risk patients undergoing percutaneous nephrolithotomy with and without antibiotic prophylaxis: a matched case control study. J Urol 2012; 188 (3): 843–847.
15. Bag S et al. One week of nitrofurantoin before percutaneous nephrolithotomy significantly reduces upper tract infection and urosepsis: a prospective controlled study. Urology 2011; 77 (1): 45–49.
16. Deshmukh S et al. Compliance with American Urological Association Guidelines for post percutaneous nephrolithotomy antibiotics does not appear to increase rates of infection. J Urol 2015; 194 (4): 992–996.
17. Bootsma AM et al. Antibiotic prophylaxis in urologic procedures: a systematic review. Eur Urol 2008; 54 (6):1270–1286.

18. Morin A, Bergevin M, Rivest N, Lapointe SP. Antibiotic prophylaxis for transrectal ultrasound-guided prostate needle biopsy: Compared efficacy of ciprofloxacin vs. the ciprofloxacin/ fosfomycin tromethamine combination. Can Urol Assoc J. 2020 Aug; 14 (8): 267-272. doi: 10.5489/cuaj.6248. PMID: 32209218; PMCID: PMC7402688.
19. Pilatz A, Dimitropoulos K, Veeratterapillay R, Yuan Y, Omar MI, MacLennan S, Cai T, Bruyère F, Bartoletti R, Köves B, Wagenlehner F, Bonkat G, Pradere B. Antibiotic Prophylaxis for the Prevention of Infectious Complications following Prostate Biopsy: A Systematic Review and Meta-Analysis. J Urol. 2020 Aug; 204(2):224-230. doi: 10.1097/JU.0000000000000814. Epub 2020 Feb 27. PMID: 32105195.
20. Niel-Weise BS and van den Broek PJ. Urinary catheter policies for long-term bladder drainage. Cochrane Database Syst Rev, 2005 (1): CD004201.
21. Hansson, S., et al. Untreated asymptomatic bacteriuria in girls: II-Effect of phenoxymethyl penicillin and erythromycin given for inter current infections. BMJ, 1989. 298: 856. https://pubmed.ncbi.nlm.nih.gov/2497823.
22. Cai, T. et al. The role of asymptomatic bacteriuria in young women with recurrent urinary tract infections: To treat or not to treat? Clin Infect Dis, 2012. 55: 771. https://pubmed.ncbi.nlm.nih.gov/22677710/.
23. Asscher, A.W., et al. The clinical significance of asymptomatic bacteriuria in the nonpregnant woman. J Infect Dis, 1969. 120:17. https://pubmed.ncbi.nlm.nih.gov/5803281/.
24. Kazemier, B.M., et al. Maternal and neonatal consequences of treated and untreated asymptomatic bacteriuria in pregnancy: a prospective cohort study with an embedded randomised controlled trial. Lancet Infect Dis, 2015.15: 1324. https://pubmed.ncbi.nlm.nih.gov/26255208/.
25. Grabe, M., *et al*. Controlled trial of a short and a prolonged course with ciprofloxacin in patients undergoing transurethral prostatic surgery. Eur J Clin Microbiol, 1987. 6: 11. https://pubmed.ncbi.nlm.nih.gov/3569248/.
26. Duenas-Garcia, O.F., *et al*. Pharmacological agents to decrease new episodes of recurrent lower urinary tract infections in postmenopausal women. A systematic review. Female Pelvic Med Reconstruct Surg, 2016. 22:63. https://pubmed.ncbi.nlm.nih.gov/26825411/.
27. Nalliah, S., *et al*. The use of chemotherapeutic agents as prophylaxis for recurrent urinary tract infection in healthy nonpregnant women: A network meta-Analysis. Indian J Urol, 2019. 35:147. https://pubmed.ncbi.nlm.nih.gov/31000921/.
28. Aggarwal S et al, Treatment guidelines for antimicrobial use in common syndromes, ICMR, 2019, India, 2nd edition, Chapter 9, Page no. 88, table no. 9.1.

6 C. INFECTIONS IN NEPHROLOGY

Introduction: Urinary tract infections are quite common across all the age groups and sexes. Urinary tract infection may be upper tract infection (Pyelonephritis) or lower tract infection (eg. Cystitis, Prostatitis and Urethritis). Presence of lumber pain, vomiting with high grade fever with chills will indicate upper tract infection.

Except for some categories, every suspected case of urinary tract infection, a urine routine examination and culture-sensitivity should be sent after proper collection. Handling of urine sample is of utmost important to get a proper bacteriological report. It is also very important that we send the sample of urine before starting the antimicrobial therapy and sample should reach laboratory without delay.

Depending on the severity of illness we can start empirical antibiotic before urine culture report is available. Empiric regimes should be modified if needed after the culture and sensitivity report is available and should be continued for the specific duration. Duration of antibiotic therapy will vary depending on the site of infection. In addition to the urine and biochemical examination, imaging modalities like USG or CT-scan may require to see any anatomical and physiological changes in the urinary tract. These imaging may also help us for any intervention like draining of pus collection etc.

As per antibiogram of RIMS (Imphal) 2021-2022, the most common organisms responsible for UTI includes Enterobacteriaceae (68.8%) followed by Enterococci (17.1%). The other organism include NFGNB (9.1%), Staphylococci (4.9%).[1]

The susceptibility of Enterobacteriaceae sps. from urine showed high susceptibility to Fosfomycin, Amikacin, Meropenem, Imipenem, Nitrofurantoin, Ertapenem, Piperacillin-tazobactam TMP-SMX and Levofloxacin, in decreasing order with least sensitivity to cephalosporins.[2]

The susceptibility of Enterococci from urine showed high susceptibility to Teicoplanin, Linezolid, Vancomycin, Fosfomycin, Nitrofurantoin, Gentamicin and Ampicillin in decreasing order.[3]

Thus, based on the above findings, the recommended antibiotic regimen includes:

Conditions	Most common organisms	Empiric regimen	Alternative regimen	Comments
Asymptomatic bacteriuria	Enterobacteriaceae sps.	Nitrofurantoin monohydrate/ macrocrystals 100 mg PO BD for 3-7 days	Amoxycillin-clavulanate 1g PO BD for 3-7 days Cefixime 400 mg PO BD for 3-7 days	Indications- pregnancy, pre-urological procedures, postrenal transplant

Acute uncomplicated cystitis (females)	Enterobacteriaceae, Enterococci	Nitrofuranton monohydrate/ macrocrystals 100 mg PO BD-7days Or Fosfomycin 3g sachet- single dose	Amoxycillin-clavulanate 1g PO BD for 5-7 days Meropenem 1g IV TDS for 5-7 days	To avoid Fluoro-quinolones in view of TB endemic regions
Asymptomatic bacteriuria (2 consecutive urine culture with ≥105 CFU/ml of same organism)	Enterobacteriaceae Enterococci	Nitrofurantoin 100 mg BD for 5 days or Fosfomycin 3gm I dose	TMP-SMX DS 1 tablet BD for5 days or Levofloxacin 500mg OD for 5 days	Treat in Pregnancy, Pre-Urological procedures, Post-Transplant/ Avoid Quinolones in Pregnancy and suspected cases of TB
Acute uncomplicated cystitis (women)	Enterobacteriaceae Enterococci	Nitrofurantoin 100 mg BD for 5 days or Fosfomycin 3gm I Dose or TMP-SMX DS 1 tablet BD for 5 days	Amox-Clav 875 +125 mg BD for 5-7 days or Faropenem 200mg TDS for 5-7 days or Linezolid 600mg BD for 5-7 days Or Minocycline 200 mg stat followed by 100mg BD for 5-7 days	Avoid Quinolones in Pregnancy and suspected cases of TB
Acute uncomplicated cystitis (men)	Enterococci	Nitrofurantoin 100 mg BD for 5 days or TMP-SMX DS 1 tablet BD for 5 days	Amox-Clav 875 +125 mg BD for 5-7 days or Fosfomycin 3gm I dose or Linezolid 600mg BD for 5-7 days	If recurrent, rule out Prostatitis and Bladder outlet obstruction

Recurrent UTIin women (2 or more infections in 6 months or 3 or more infections in 1year)	Enterobacteriaceae Enterococci	Nitrofurantoin 100 mgBD for 5 days or Fosfomycin 3gm IV dose or TMP-SMX DS 1 tablet BD for 5 days or Amox-Clav 875+125 mg BD for 5-7 days	Preventive strategy: avoiding Spermicide, increase Fluid intake, Post Coital antibiotics (Nitrofurantoin 100 mg or TMP- SMX 80/400mg) Antibiotics prophylaxis: TMP-SMX DS OD/ Nitrofurantoin 50-100 mg OD/ Cephalexin 250 mg OD for 3 months and review	Post Menopausal women may consider Intravaginal Estrogen (Estriol) 0.5 mg daily for 2weeks followed by twice weekly
Pregnancy: Asymptomatic Bacteriuria and cystitis	Enterobacteriaceae Enterococci	Nitrofurantoin 100 mg BD for 5-7 days (avoid in 3rd trimester) or Amox-Clav 625 mg TDS for 5-7 days or Cephalexin 500 mg BD for 5-7 days	TMP-SMX DS 1 tablet BD for 3 days (Avoid in 1st trimester and term) Or Cefpodoxime 100 mg BD for 5-7 days	Nitrofuranto in in 3rd trimester increase risk of Haemolytic Anaemia in Newborn/ Untreated Bacteriuria in Pregnancy increase risk of low birthweight, pre-term delivery and perinatal mortality
Pregnancy: Acute pyelonephritis	Enterobacteriaceae Enterococci	Moderately ill: Ceftriaxone 1gm iv OD for 14 days or Cefepime1gm iv BD for 14 days or Aztreonam 1gm iv TDS for 14 days (in Penicillin allergy)	Severely ill: Piperacillin-tazobactam 4.5gm iv TDS for 14 days or Meropenem 500 mg iv TDS for 14 days or Ertapenem 1gm iv OD for 14 days or Based on CS findings	Switch to PO after afebrile for 48 hrs/ Suppressive therapy may be continued in recurrent cases for the duration of pregnancy with nitrofurantoin 50-100 mg OD or Cephalexin 250-500 mg OD

Acute Pyelonephritis	Enterobacteriaceae Enterococci	LOW RISK for Resistance: Levofloxacin 750mg PO OD for 7-14 days/ Ciprofloxacin 500 mgPO BD for 7-14 days/ TMP-SMX DS 1tablet BD for 7-14 days/ Ceftriaxone 1gm iv OD for 10 days/ Piperacillin-Tazobactam 4.5 gm ivTDS for 7-14 days HIGH RISK for Resistance: Meropenem 1gm iv TDS for 7-14 days/ Ertapenem 1gm iv OD for 7-14 days (recent Pseudomonas infection)	Gentamicin 5mg/kg iv OD for 7-14 days or Amikacin 250 mg iv BD for 7-14 day or Teicoplanin 400 mg iv 12 hourly for 3 doses followed by 200mg OD for 14 days or Vancomycin 15mg/kg iv BD for14 days Further Regimen based on CS findings May shift to oral drugs if afebrile for 48 hours	Consider imaging in critical ill, suspected calculi or obstructive uropathy or failure to respond to therapy HIGH RISK: Prior highly resistant bacteria in urine/recent hospitalisation/ obstructive uropathy/ recent Quinolones or Beta-lactams Avoid Aminoglycosides if Renal functionis compromised
Prostatitis	Acute: N. Gonorrhoea/ C. Trachomatis Chronic: Enterobacteriaceae	Acute STD: Ceftriaxone 500 mg im single dose/ Cefixime 400 mg PO single dose followedby Doxy 100mg POBD for 10 days Acute Enterobacteriaceae: Levofloxacin 750 mgPO OD for 14 days Chronic: Ciprofloxacin 500 mgPO BD for 4 weeks/ Levofloxacin 750 mg PO OD for 4 weeks	TMP-SMX DS 1 tablet PO BD for 1-3 months or Fosfomycin 3gm PO OD for 3- 4 months	In Treatment Failure: Consider Infected Prostatic calculi Test for other viral serology (HIV,HEP-B, HEP-C)

Acute complicated UTI: UTI plus other co-morbid conditions that increases severity and risk of failure (diabetes/ pregnancy/ post-transplant/foley in-situ/ obstruction/ CAKUT	Enterobacteriaceae Enterococci	LOW RISK of MDR: Levofloxacin 750mg iv OD/ Ceftriaxone 1gm iv OD/ Cefepime 1 gm iv BD/Pip-Tazo 4.5 gm iv TDS/Gentamicin 5mg/kg iv OD/ Aztreonam 2gm iv TDS for 14 days (Penicillin allergy)	HIGH RISK for MDR: Meropenem 1gm iv TDS/ Ceftazidime-tazobactam 2.25 gm iv TDS for 14 days/ Teicoplanin 400 mg iv 12 hourly for 3 doses followed by 200mg OD for 14 days/ Vancomycin 15mg/kg iv BD for14 days based on CS findings	Due to high incidence of resistance, avoid using Nitrofurantoin/ Fosfomycin/ TMP-SMX Always rule out Urological intervention requirements

REFERENCES

1. Prof. (Dr.) N. Sanjib Singh et al (2021-2022). RIMS Hospital-Antibiogram 2020-2021. Antibiotic policy RIMS Imphal, e2:19**.**
2. Prof. (Dr.) N. Sanjib Singh et al (2021-2022). RIMS Hospital-Antibiogram 2020-2021. Antibiotic policy RIMS Imphal, e2:25.
3. Prof. (Dr.) N. Sanjib Singh et al (2021-2022). RIMS Hospital-Antibiogram 2020-2021. Antibiotic policy RIMS Imphal, e2:36.

6 D. INFECTIONS IN PLASTIC SURGERY

Timing of Antibiotic Prophylaxis

IV administration 30-60 min before surgical incision.[1,2,3,4,5] Preoperative antibiotics are ideally administered at least 5 min before, and within an hour, the insufflations of an extremity tourniquet, to guarantee adequate levels in the desired tissues at the time of incision.

An additional dose is requested when patient experiences a blood loss of 1500 ml (25 ml/kg in children), with a hemodilution > 15 ml/kg or if the procedure's length has doubled the antibiotic half-life (about 3 hours with cefazolin).

Case specific guidelines

1. Breast - Indicate antibiotic use in all types of breast procedures like lumpectomy, breast cancer surgery, reduction mammoplasty and breast augmentation.[6,7] 2 g IV Cefazolin, if allergic 600 mg Clindamycin.

2. Aesthetics - AICPE suggests antibiotic prophylaxis for abdominoplasty, body lift, bottom lift, thigh lift, brachioplasty and lipofilling procedures.[8] For lipofilling, prophylaxis indicated only if a volume of >150 cc of adipose tissue has been suctioned. 2 g IV Cefazolin, 600 mg Clindamycin if allergy.

3. Head and Neck - No antibiotic required for otoplasty and blepharoplasty.[1,6] Antibiotics indicated only in case of wide resections, lymph node dissection and rhinoplasty.[3] 2 g Cefazolin, if allergy 600 mg Clindamycin.

4. Hand - Skin incision, soft tissue excision, suturing, repair of muscle, tendon and fascia, no antibiotic required.[6] Antibiotics are not required in open distal phalanx fracture.[9]

Antibiotic prophylaxis required in patients having soft tissue surgeries lasting longer than 2 hours when surgery involves the bone and implants, in case of debridement of devitalized wound tissue or animal or human bites.

When needing temporary ischemia of a limb, it is necessary to wait at least 5 min after intravenous administering completion to guarantee appropriate drug concentration at the surgical site before starting tourniquet application.[1,3,4,10]

5. Trauma - High grade, open injuries in agricultural environment. Administration of a first-generation cephalosporin (e.g., cefazolin 1-2 g administered intravenously every 8 h until 24 h after wound closure) will provide coverage against gram-positive organisms.

An aminoglycoside (e.g., gentamicin administered intravenously with the dose based on weight) or levofloxacin (500 mg IV administered every 24 h) is added to the regimen to provide coverage against gram-negative organisms. The addition of ampicillin, penicillin, or doxycycline is recommended to address the risk of *Clostridial myonecrosis* in the setting of agricultural injuries. For the patient allergic to penicillin, a combination of vancomycin and a fluoroquinolone provides excellent coverage against gram-positive, gram-negative, and clostridial species.

If trauma occurs from human and animal bites, antibiotic prophylaxis is indicated for any bites injuring the skin with bleeding or involves the hands, feet, skin overlying joints or skin overlying cartilaginous structures.[11] 1g Amoxicillin-clavulanate 3 times per day for 5 days. If allergy, 400 mg Metronidazole or 500 mg Ciprofloxacin or 800+160 mg Cotrimoxazole or 100 mg Doxycycline 2 times per day for 14 days.

6. Hand fractures - Closed fracture requiring osteosynthesis or open middle phalange, proximal phalange, carpal or metacarpal fracture: 2 g Cefazolin or 600 mg Clindamycin, if allergy. No antibiotic prophylaxis for conservative treatment of closed hand fractures or for open distal phalange fracture.[12]

7. Burns - No antibiotic prophylaxis indicated except when mechanical ventilation or skin-grafting procedures are needed.[13,14,15,16,17] Cefazolin 2 g and 1 g every 8 hours upto 7 days.

8. Major Surgery (Microsurgery, Pressure sore, Large flaps) - Cefazolin 2 g 0-30 min before surgery (1 g after every 3 hours of surgery), 1 g every 8 hours after surgery up to 3 days. If allergy, Clindamycin: 600 mg 0-30 min before surgery, 600 mg every 24 hours upto 3 days.[12]

9. Hirudotherapy - 500 mg Ciprofloxacin. If allergy, 80/160 mg of Cotrimoxazole.[12]

10. Non-surgical Procedures - Scar revision, Laser therapy: Generally antibiotics not required; focus on aseptic technique.

11. Non-operative cases -

- Cellulitis (Mild to Moderate): Oral antibiotics like cephalexin or dicloxacillin.
- Cellulitis (Severe or MRSA suspected): Clindamycin or trimethoprim-sulfamethoxazole.

12. Diabetic foot ulcer

- Bases on severity, amoxicillin-clavulanate or ceftriaxone with metronidazole.
- Non-healing wound: Antibiotics not routinely recommended; focus on wound care and local measures.

REFERENCES

1. SICPRE linee guida. [03 March 2020]. https://www.sicpre.it/wp content/uploads/2019/01/Linee-Guida-Antibioticoprofilassi-SICPRE.pdf .
2. FNOPI linee guida. [20 March 2020]. https://www.fnopi.it .
3. JUST Clinic Guidelines. [25 March 2020]. https://www.just.edu.jo/Pages/Default.aspx .
4. SIOT guidelines: Infection prevention in orthopedic surgery. [23 March 2020]. https://siot.it/area-soci/le-linee-guida .
5. ANDO Linee guida antibiotic profilassi perioperatoria nell'adulto. [24 March 2020]. https://www.anmdo.org/category/pubblicazioni/linee-guida.
6. Ariyan S, Martin J, Lal A, Cheng D, Borah GL, Chung KC, Conly J, Havlik R, Lee WPA, McGrath MH, Pribaz J, Young VL. Antibiotic prophylaxis for preventing surgical-site infection in plastic surgery: an evidence-based consensus conference statement from the American Association of Plastic Surgeons. Plast Reconstr Surg. 2015 Jun; 135(6):1723 1739. [PubMed] [Google Scholar].
7. Huang N, Liu M, Yu P, Wu J. Antibiotic prophylaxis in prosthesis-based mammoplasty: a systematic review. Int J Surg. 2015 Mar; 31–7. [PubMed] [Google Scholar].
8. AICPE aggiornamento 2015. https://www.aicpe.org/documenti-riservati-ai-soci .
9. Metcalfe D, Aquilina AL, Hedley HM. Prophylactic antibiotics in open distal phalanx fractures: systematic review and meta-analysis. J Hand Surg Eur Vol. 2016 May;41(4): 423–30. [PubMed] [Google Scholar].
10. Eberlin KR, Ring D. Infection after hand surgery. Hand Clin. 2015 May;31(2):355 60. [PubMed] [Google Scholar].
11. NICE guideline. Human and animal bites: antimicrobial prescribing Draft for consultation. [25 March 2020]. https://www.nice.org.uk/guidance/ng184.
12. Brambullo T, Biffoli B, Scortecci L, Messana F, Vindigni V, Bassetto F. Antibiotic Prophylaxis in Plastic Surgery: From Systematic Review to Operative Algorithm. World J Plast Surg. 2022 Jul;11(2):24-36. doi: 10.52547/wjps.11.2.24. PMID: 36117892; PMCID: PMC9446112.
13. Ramos G, Cornistein W, Cerino GT, Nacif G. Systemic antimicrobial prophylaxis in burn patients: systematic review. J Hosp Infect. 2017 Oct; 97(2):105–114. [PubMed] [Google Scholar]
14. Barajas-Nava LA, López-Alcalde J, Roqué I Figuls M, Solà I, Bonfill Cosp X. Antibiotic prophylaxis for preventing burn wound infection. Cochrane Database Syst Rev. 2013 Jun; (6):CD008738. [PubMed] [Google Scholar].
15. Barajas-Nava LA, López-Alcalde J, Roqué I Figuls M, Solà I, Bonfill Cosp X. Antibiotic prophylaxis for preventing burn wound infection. Cochrane Database Syst Rev. 2013 Jun; (6): CD008738. [PubMed] [Google Scholar].
16. Csenkey A, Jozsa G, Gede N, Pakai E, Tinusz B, Rumbus Z, Lukacs A, Gyongyi Z, Hamar P, Sepp R, Romanovsky AA, Hegyi P, Vajda P, Garami A. Systemic antibiotic prophylaxis does not affect infectious complications in pediatric burn injury: A meta-analysis. PLoS One. 2019 Sep; 14(9): e0223063. [PMC free article] [PubMed] [Google Scholar].
17. Chahed J, Ksia A, Selmi W, Hidouri S, Sahnoun L, Krichene I, Mekki M, Nouri A. Burns injury in children: is antibiotic prophylaxis recommended? Afr J Paediatr Surg. 2014 Oct-Dec;11(4): 323–5. [PubMed] [Google Scholar.

6 E. INFECTIONS IN GASTRO INTESTINAL SURGERY

Introduction: Recent guidelines for gastrointestinal surgery consider the use of antimicrobial prophylaxis to be imperative. Intravenous application of antibiotics is most widely practiced in gastrointestinal surgery to reduce rates of surgical sites infections (SSI).

Wounds are classified as clean-contaminated or contaminated for GI Surgery. The four guiding principles for adequate perioperative antimicrobial prophylaxis are-

a) Usage for procedures where it has been proven to reduce SSI rates.
b) The antimicrobial agent must be safe, inexpensive and have a bactericidal effect for the most probable pathogens of SSI.
c) The timing of initial dose must ensure a bactericidal concentration at the blood and tissue level at the time incision, that is, to be given within 60-30 minutes before the procedure.
d) Therapeutic serum and tissue level to be maintained throughout and a few hours after skin closure. Additional intraoperative dosing if duration of surgery exceeds three times the half- life of antimicrobial agent or in case of excessive blood loss (>1500mL).

Prophylaxis exceeding 24 hours is strongly discouraged as it increases the risk of selection of antimicrobial resistance or Clostridium difficile infections and may lead to toxicity and unnecessary expense. An overview of antimicrobial agents is provided in the following Tables 1 & 2.

The routine use of vancomycin is not recommended during GI Surgery but may be acceptable in case of known colonization with MRSA or when a cluster of SSI caused by MRSA has been detected in an institution. In such cases, a single perioperative dose of vancomycin is to be added to the standard antimicrobial recommended.

Table 1: Recommended doses of antimicrobials used in prophylaxis in GI Surgery

Antimicrobial	Usual dose (adult)	Redosing interval (hrs.)
Intravenous prophylaxis		
Ampicillin-sulbactam	3 g (2g/1g)	2
Cefazolin	2 g	4
Cefoxitin	2 g	2
Cefotetan	2 g	6
Clindamycin	900 mg	6
Metronidazole	500 mg	-
Vancomycin	15 mg/Kg	-
Oral prophylaxis		
Neomycin	1g	-
Erythromycin	1g	-
Metronidazole	1g	-

Table 2: Recommended antimicrobial prophylaxis for GI Surgery

Procedure	Recommended antimicrobials	Alternative antimicrobials
Esophageal surgery	Cefazolin	Vancomycin
Gastroduodenal surgery	Cefazolin	Clindamycin Vancomycin + aminoglycoside
HPB surgery		
Open procedure	Cefazolin	Cefoxitin Cefotetan Ampicillin-sulbactam Clindamycin
Laparoscopic procedure	Cefazolin	Cefoxitin Cefotetan Ampicillin-sulbactam Clindamycin
Appendectomy (without complicated appendicitis)	Cefazolin + metronidazole	Cefoxitin Cefotetan Clindamycin + aminoglycoside
Small intestine surgery		
Not obstructed	Cefazolin	Cefoxitin Cefotetan
Obstructed	Cefazolin + metronidazole	Cefoxitin Cefotetan
Colorectal surgery		
Intravenous prophylaxis	Cefazolin + metronidazole	Cefoxitin Cefotetan Ampicillin-sulbactam Clindamycin Vancomycin + aminoglycoside
Oral prophylaxis	Neomycin + erythromycin base	Neomycin + metronidazole

A recent meta-analysis has shown that for colorectal surgery, the combination of oral and intravenous prophylaxis is superior to intravenous prophylaxis, with RR of SSI of 0.55 (95% CI:0.41-0.74). Oral prophylaxis usually contains neomycin combined with erythromycin or metronidazole, administered 1-2 days before surgery. The use of oral preoperative antimicrobial prophylaxis is invariably combined with mechanical bowel preparation. The role of selective decontamination of the digestive tract (SDD) as a prophylactive measure in GI surgery remain unclear.

Clostridium difficile infection

The risk of clostridium difficile infection (CDI) is increased in patients that have undergone gastrointestinal surgery as well as after administration of antimicrobials. The use of first or third generation cephalosporins is the greatest contributing factor for developing CDI. Antibiotic treatment should be discontinued when diagnosis is confirmed by detection of C. difficile toxins in the faeces. For mild CDI, metronidazole is the treatment of first choice. For severe infection, treatment with vancomycin is indicated.

Empirical or presumptive use of antibiotics in gastrointestinal surgery

Antimicrobial treatment is not always indicated in the treatment of SSIs. Minor superficial infections often respond to drainage of pus by opening the surgical wound. For deeper infections adjunctive antibiotic treatment may be indicated. Optimal empirical therapy needs to be based on the local antibiotic susceptibility pattern of the microorganisms associated with SSIs, which includes gram-negative bacilli and anaerobes in almost all circumstances for patients undergoing gastrointestinal surgery. Empirical therapy may be adapted once the culture results are available. It is essential to obtain cultures from the infected sites whenever possible.

Ventilator-associated pneumonia (VAP)

In patients with early-onset VAP and not likely to harbour MDR organism, empirical therapy may be started with one of the following antibiotics: Fluoroquinolones, Ceftriaxone, Ampicillin-sulbactam or Ertapenem.

In patients of VAP with late-onset or likely to harbour MDR pathogens, initial agents effective against Pseudomonas like Cephalosporins (Cefepime and Ceftazidime), Carbapenems (imipenem and meropenem) or combination of beta-lactam/beta-lactam inhibitors (piperacillin/tazobactam) and an antipseudomonal fluoroquinolone (ciprofloxacin and levofloxacin) or aminoglycoside (amikacin, gentamicin, and tobramycin) and vancomycin or linezolid (if MRSA suspected) may be considered empirically.

Intra-abdominal infections

The world Society of Emergency Surgery in consensus with surgeons, infectious disease specialists, pharmacologists, radiologists, and intensivists have defined the following recommendation for early treatment of intra-abdominal infections.

Table 3: Antimicrobial regime recommended by the World Society of Emergency Surgery (WSES) for community-acquired extrabiliary intra-abdominal infections.

Condition of Pts		Antimicrobial agents	Dosage
Stable patients	No ESBL - associated risk factor	Amoxicillin/clavulanate Ciprofloxacin plus metronidazole	2.2 g q6h 400 mgq8h 500mgq6h
	ESBL-associated risk factor	Ertapenem or Tigecycline	1g q 24 h 100mg LD, then 50 mg q12 h

Critically ill patients	No ESBL- associated risk factor	Piperacillin/tazobactam	9 g LD then 18 g/ day or 4.5g q6h
	ESBL- associated risk factor	Meropenem or imipenem plus fluconazole	500 mg q6h 500 mg q6h 600 mg LD then 400 mg q24 h

Table 4: Antimicrobial regime recommended by WSES for community-acquired biliary intra-abdominal infections.

Condition of Pts		Antimicrobial agents	Dosage
Stable patients	No ESBL-associated risk factor	Amoxicillin/clavulanate Ciprofloxacin plus metronidazole	2.2 g q6h 400 mg q6h 500 mg q6h
	ESBL-associated risk factor	Tigecycline	100 mg LD, then 50mg q12h
Critically ill patients	No ESBL-associated risk factor	Piperacillin/tazobactam	9 g LD then 18g/day or 4.5 g q6h
	ESBL-associated risk factor	Piperacillin plus Tigecycline plus/minus Fluconazole	9 g LD then 18g/day or 4.5 g q6h 100 mg LD then 50 mgq12h 600 mg LD then 400 mg q24h

Table 5: Antimicrobial regime recommended by WSES for hospital-acquired intra-abdominal infections.

Condition of Pt	Antimicrobial agents	Dosage
Stable patients	Piperacillin plus Tigecycline plus Fluconazole	8g LD then 16 g/day or 4g q6h 100 mg LD then 50 mg q12h 600 mg LD then 400 mg q24h
Critically ill patients	Piperacillin plus Tigecycline plus Echinocandin or Meropenem or Imipenem or Doripenem plus Teicoplanin plus Echinocandin	8 g LD then 16 g/day or 4 g q6h 100 mg LD then 50 mg q12h 500 mg q6h 500 mg q6h 500 mg q8h 1.6 g via continuous infusion or 400 mg q6h

REFERENCES

1. Mangram AJ, Horan TC, Pearson ML, William R. Guideline for prevention of surgical site infection. *Bull Am Coll Surg* 2000; 85:23-9.

2. Bratzler DW, Houck PM. Antimicrobial prophylaxis for surgery: An advisory statement from the National Surgical Infection Prevention Project. *Am J Surg*2005;189:395-404.
3. Van Kasteren ME, Gyssens IC, Kullberg BJ,Bruining HA, Stobberingh EE, Goris RJ. Optimising antibiotics policy in the Netherlands. V. SWAB guidelines for perioperative antibiotic prophylaxis. Foundation Antibiotics Policy Team. *Ned TijdschrGeneeskd[Internet]*2000;144:2049-55.
4. Koeng SM, Truwit JD. Ventilator-associated pneumonia: diagnosis,treatment, and prevention. *ClinMicrobiol Rev*. 2006;19(4):637-57
5. Sartelli M, Catena F, Coccolini F, Pinna AD. Antimicrobial management of intra-abdominal infections: Literature's guidelines. *World J Gastroenterol.*2012;18(9):865-871.

6 F. INFECTIONS IN RESPIRATORY TRACT

Lower respiratory tract infections

LRTI includes acute uncomplicated bronchitis/tracheobronchitis, acute exacerbation of COPD and bronchiectasis, community acquired pneumonia, hospital acquired pneumonia, ventilator associated pneumonia, lung abscess and empyema.

Acute uncomplicated bronchitis/tracheobronchitis

Acute uncomplicated bronchitis is defined as a self-limited inflammation of the large airways with a cough (may be dry or productive) lasting up to 6 weeks (without evidence of pneumonia). It is often accompanied by mild constitutional symptoms. Approximately 5% of adults develop acute bronchitis in a given year, resulting in approximately 100 million ambulatory care visits in the United States. Acute bronchitis leads to more inappropriate antibiotic prescribing than any other ARTI syndrome in adults.

Clinicians should not perform testing or initiate antibiotic therapy in patients with bronchitis unless pneumonia is suspected.

Pneumonia

Pneumonia is defined as an infection of the pulmonary parenchyma from the level of the respiratory bronchioles to alveoli. Clinically, pneumonia can be recognized by the presence of a new lung infiltrate coupled with any of the following: new or increased cough, dyspnea, pleuritic chest pain, purulent sputum, confusion, fever, hypoxemia, rales, leukocytosis, or leukopenia.

Pneumonia that occurs in community-dwelling individuals is termed as community-acquired pneumonia (CAP). Hospital acquired pneumonia (HAP) is defined as pneumonia that occurs 48 hrs or more after hospital admission, while ventilator-associated-pneumonia (VAP) is defined as pneumonia occurring 48 hrs or more after endotracheal intubation.

Etiology

Bacterial pneumonia	Non-bacterial pneumonia
Pneumococcal pneumonia - Streptococcus pneumonia	Influenza, Respiratory syncytial virus, Parainfluenza virus, Coronaviruses, Coxsackie virus, Rhinoviruses, etc
Atypical pneumonia - Legionella spp. (legionnaires'), Mycoplasma pneumonia, Chlamydia spp., Coxiella burnetii (Q fever)	Bacteria-like and rickettsia - like pneumonia
Staphylococcal pneumonia - Staphylococcus aureus	Fungal and actinomycotic pneumonia
Gram-negative enteric pneumonia - Klebsiella spp., Pseudomonas aeruginosa, Escherichia coli, Enterobacter spp., Serratia spp.	Viral pneumonia
Haemophilus influenzae pneumonia	

Moraxella catarrhalis pneumonia	Pathogens associated with VAP in hospital ICUs -
Anaerobic pneumonia (mixed flora) Bacteroides spp. Fusobacterium spp. Peptococcus spp. Peptostreptoccus spp.	Staphylococcus aureus, Pseudomonas aeruginosa, Selected Klebsiella species, Enterobacter species, Haemophilus influenza, All Streptococcus species, Escherichia coli, Serratia species, Stenotrophomonas maltophilia Acinetobacter species, Proteus species, Burkholderia cepacia, Others

Lung abscess

A lung abscess is a localized area of destruction of lung parenchyma in which infection by pyogenic organism's results in tissue necrosis and suppuration. Lung abscesses may be single or multiple and they frequently contain air-fluid levels. When multiple and small (< 2 cm in diameter) they are sometimes referred to as necrotizing or suppurative pneumonia, but they are an expression of the same pathological process and the distinction is an arbitrary one.

Causes include anaerobic and aerobic organisms, tuberculosis, non-bacterial organisms including fungi and protozoa, other pathologies such as necrosis in a lung tumour or infection within a lung cyst.

Empyema

Empyema refers to a purulent collection in any body site. It is commonly used to indicate a pleural space infection. It is typically associated with underlying pulmonary parenchymal infection but may also be associated with blood-borne infection, thoracic surgery, trauma, abdominal infection, or neoplasm.

Acute exacerbation of COPD

It is characterized by worsening cough, dyspnoea, and sputum production beyond normal day to day variation. These exacerbations are associated with acute deterioration of lung function during the exacerbation and may also accelerate lung function decline. Increasing dyspnoea accompanied by a change in the quantity or colour of phlegm is usually an indication of bacterial infection and should prompt initiation of antibiotic.

Causes of exacerbation of COPD
Respiratory viral infections-(Rhinovirus, respiratory syncytial virus, influenza, adenovirus and metapneumo virus)
Bacterial infections or superinfections - (Haemophilus influenzae, Moraxella catarrhalis and Streptococcus pneumoniae; gram-negative bacteria)
Severe air pollution (Particulates, sulphur dioxide, ozone and nitrogen dioxide)

Acute exacerbation of bronchiectasis

It is an acute clinical deterioration, requiring a change in therapy, manifesting with at least three of the following symptoms over ≥ 48 hours -

- Cough
- Sputum volume and/or consistency
- Sputum purulence
- Breathlessness and/or exercise intolerance
- Fatigue and/or malaise
- Hemoptysis

Antimicrobial therapy is the mainstay of treatment for exacerbations of bronchiectasis. The bacteriology of bronchiectasis is quite complex. Pseudomonas aeruginosa and Haemophilus influenzae are the most common pathogens (cultured in 35% of patients with bronchiectasis). Others include Staphylococcus aureus, Moraxella catarrhalis, and Streptococcus pneumoniae.

Management guidelines

All patients with CAP should be risk stratified. The scoring system CURB-65 is preferred for its simplicity as it contains only five variables (confusion, blood urea nitrogen > 20 mg/dL, respiratory rate ≥ 30 breaths per minute, systolic blood pressure < 90 mm Hg or diastolic blood pressured ≤ 60 mm Hg, and age ≥ 65 years of age).

Patients with a score of 0 to 2 are classified as low-risk and have 30- day mortality rates less than or equal to 2.1%. The British Thoracic Society recommends CURB-65 due to ease of use.

CURB - 65 divides patients into 3 groups:

Score	Mortality risk	Managed as
0–1	Low risk of 30–day mortality	Out-patient
2	Intermediate risk and	In-patient/Genaral ward
3–5	High risk of 30–day mortality	ICU

The Infectious Diseases Society of America/American Thoracic Society and the British Thoracic Society guidelines suggest that patients with CURB-65 scores of 0–1 are at low risk of death and thus may be managed as outpatients.

For admission in ICU, the 2007 IDSA–ATS major and minor criteria for severe CAP are recommended for use in IDSA–ATS guidelines.

Minor criteria	Major criteria
Respiratory rate ≥ 30 breaths/min	Need for invasive mechanical ventilation
PaO2/FiO2 ≤ 250	Septic shock with need for vasopressors
Multilobar infiltrates	
Confusion/disorientation	
Uraemia (BUN ≥ 20 mg/dL)	
[a]Leukopenia (WBC count < 4,000 cells/mm3)	
Thrombocytopenia (platelet count <100,000 cells/mm3)	
Hypothermia (core temperature < 36° C)	
Hypotension requiring aggressive fluid resuscitation	

- Other minor criteria to consider include hypoglycaemia (in non diabetic patients), acute alcoholism/alcohol withdrawal, hyponatremia, unexplained metabolic acidosis or elevated lactate level, cirrhosis, and asplenia.
- A need for non-invasive ventilation can substitute for a respiratory rate > 30 breaths/min or PaO2 /FiO2 ≤ 250.
- [a]Leukopenia: as a result of infection alone.

Severe pneumonia is defined as the presence of at least one major or three or more minor criteria. (BUN-blood urea nitrogen; PaO2/FiO2 **-** arterial oxygen pressure/ fraction of inspired oxygen).

Empiric Antibiotic Therapy

Group	Antibiotic Regimens
Healthy outpatients without risk factors for MRSA or Pseudomonas aeruginosa [a](Risk factors include: prior respiratory isolation of methicillin-resistant Staphylococcus aureus or Pseudomonas aeruginosa, recent hospitalization with receipt of parenteral antibiotics during the previous ninety days)	Monotherapy with Amoxicillin: Tab. Amoxicillin- clavulanate 625 mg TDS or 1 gm BID for 5 to 7 days Macrolide: Tab. Azithromycin 500 mg OD for 5 days or, Tab. Clarithromycin 500 mg BD for5 days Doxycycline: Tab. Doxycycline 100 mg BID for 5 to 7 days
Outpatients with comorbidities (Notable comorbidities include chronic heart, lung, liver, or renal disease, diabetes mellitus, alcohol use disorder, malignancy, or asplenia)	Combination therapy Amoxicillin/clavulanate or cephalosporin + Macrolide or doxycycline

	[Tab. Amoxicillin-clavulanate 625 mg TDS or 1gm BID for 5 to 7 days/ Tab. Cefuroxime-clavulanate 625 mg 1 tab BID for 5 days/ Tab. Cefpodoxime CV 325 1 tab BID for 5 days + Tab. Azithromycin 500 mg OD for 5 days or, Tab. Clarithromycin 500 mg BD for 5 days or, Tab. Doxycycline 100 mg BID for 5 to 7 days] Monotherapy with a respiratory fluroquinolone [Tab. Levofloxacin 500 mg/750 mg 1 tab OD for 5-7 days or, Tab. Moxifloxacin 400 mg 1 tab BID for 5-7 days]
Inpatients with non-severe CAP without risk factors for MRSA or P. aeruginosa[a]	Combination therapy β-lactam+ macrolide (Inj. Amoxicillin-clavulanate 1.2 g i.v. TDS or, Inj. Ceftriaxone-sulbactum 1.5 g i.v. BID Inj. Cefoperazone-sulbactum 1.5 g i.v. BID + Tab. Azithromycin 500 mg OD for 5 days or, Tab. Clarithromycin 500 mg BD for 5 days or, Tab. Doxycycline 100 mg BID for 5 to 7 days) Monotherapy with Respiratory fluroquinolone (not practised) Combination therapy with β-lactam + doxycycline can be considered if contraindications to both macrolides and fluroquinolones
Severe CAP	Combination therapy with β-lactam/penem + macrolide [Inj. Piperacillin-tazobactam 4.5 g i.v. TDS or, Inj. Meropenem 1 g i.v. TDS + Tab. Azithromycin 500 mg OD for 5 days or, Tab. Clarithromycin 500 mg BD for 5 days] Or β-lactam/penem + respiratory fluoroquinolone [Inj. Piperacillin- tazobactam 4.5 g i.v. TDS or, Inj. Meropenem 1 g i.v. TDS + Inj. Levofloxacin 100 mL or moxifloxacin 100 ml i.v. OD]
Empiric treatment for MRSA	Vancomycin or linezolid
Empiric treatment for P. aeruginosa	Piperacillin-tazobactam, cefepime, ceftazidime, aztreonam, meropenem, or imipenem

Anaerobic coverage

IDSA–ATS guidelines now explicitly recommend against the addition of anaerobic coverage for patients with aspiration pneumonia in the absence of lung abscess or empyema (conditional recommendation, very low quality of evidence).

This recommendation is driven by the changing microbiology of aspiration pneumonia. While historic studies describe high rates of infection with anaerobic pathogens, confirmation of an anaerobic infection is now increasingly uncommon.

But, in cases with suspicion of aspiration pneumonia (according to clinical history) and cases of lung abscess/empyema, Inj. Metronidazole 400 mg 100 ml i.v. TDS/ inj. Ornidazole 100 ml i.v. BID.

Based on culture and sensitivity reports, higher antibiotics are prescribed.

Imipenem-Cilastatin	i.v. 500 mg QID
Colistin	i.v. Loading dose = 300 mg CBA followed by 150 mg CBA BID Begin maintenance dose 12 hours after the loading dose [Colistin base activity 1 mg (CBA) is equivalent to 30,000 units colistimethate sodium] Nebulisation 150 mg CBA TDS delivered over 60 minutes
Tigecycline	i.v. - initial dose - 50 mg 2 vials as a single dose - maintenance dose - 50 mg 1 vial BID - infuse over 30 to 60 minutes
Teicoplanin	i.v. -initial dose - 6 mg/kg 12 hrly for 3 doses -maintenance dose - 6 mg/kg OD -Give as infusion over 30 minutes or bolus over 3-5mins

Empiric treatment of lung abscess/empyema

Lung abscess/ empyema	Inj. Piperacillin - tazobactam 4.5 g i.v. TDS or, Inj. Meropenem 1 g i.v. TDS + Inj. Levofloxacin 100 ml or moxifloxacin 100 ml i.v. OD + Inj. Metronidazole 400 mg i.v. TDS or, Inj. Ornidazole 500 mg i.v. BID

Antibiotic treatment of COPD exacerbations

First Line

- Amoxicillin 500-875 mg PO TID
- Doxycycline 100 mg PO BID
- Azithromycin 500 mg, then 250 mg PO OD x 4d

Alternatives

- Amoxicillin/clavulanate 875 mg PO BID
- Clarithromycin 500 mg PO BID
- Second-generation cephalosporins

Previous antibiotics or known gram-negative pathogens

- Levofloxacin 500-750 mg PO OD x 7d
- Ciprofloxacin 500 mg PO BID x7d

Prevention of pulmonary exacerbations in non-cystic fibrosis bronchiectasis cases (3 or more exacerbations requiring antibiotic therapy per year)

Azithromycin PO, 500 mg 3 times weekly for 6 months

Pulmonary exacerbations in non-cystic fibrosis bronchiectasis cases (3 or more exacerbations requiring antibiotic therapy per year)

For acute exacerbations-beta-lactam (if there is no previous positive microbiology) or antipseudomonal cephalosporin + aminoglycoside i.e. Inj. Amoxicillin-clavulanate 1.2 g i.v. TDS or, Inj. Cefoperazone-sulbactum 1.5 g i.v. BID + Nebulisation with Tobramycin 80 mg BID (Doxycycline for those with penicillin allergy)

Fig. 1 Empiric treatment of non-ventilator hospital-associated pneumonia in adults with normal kidney function

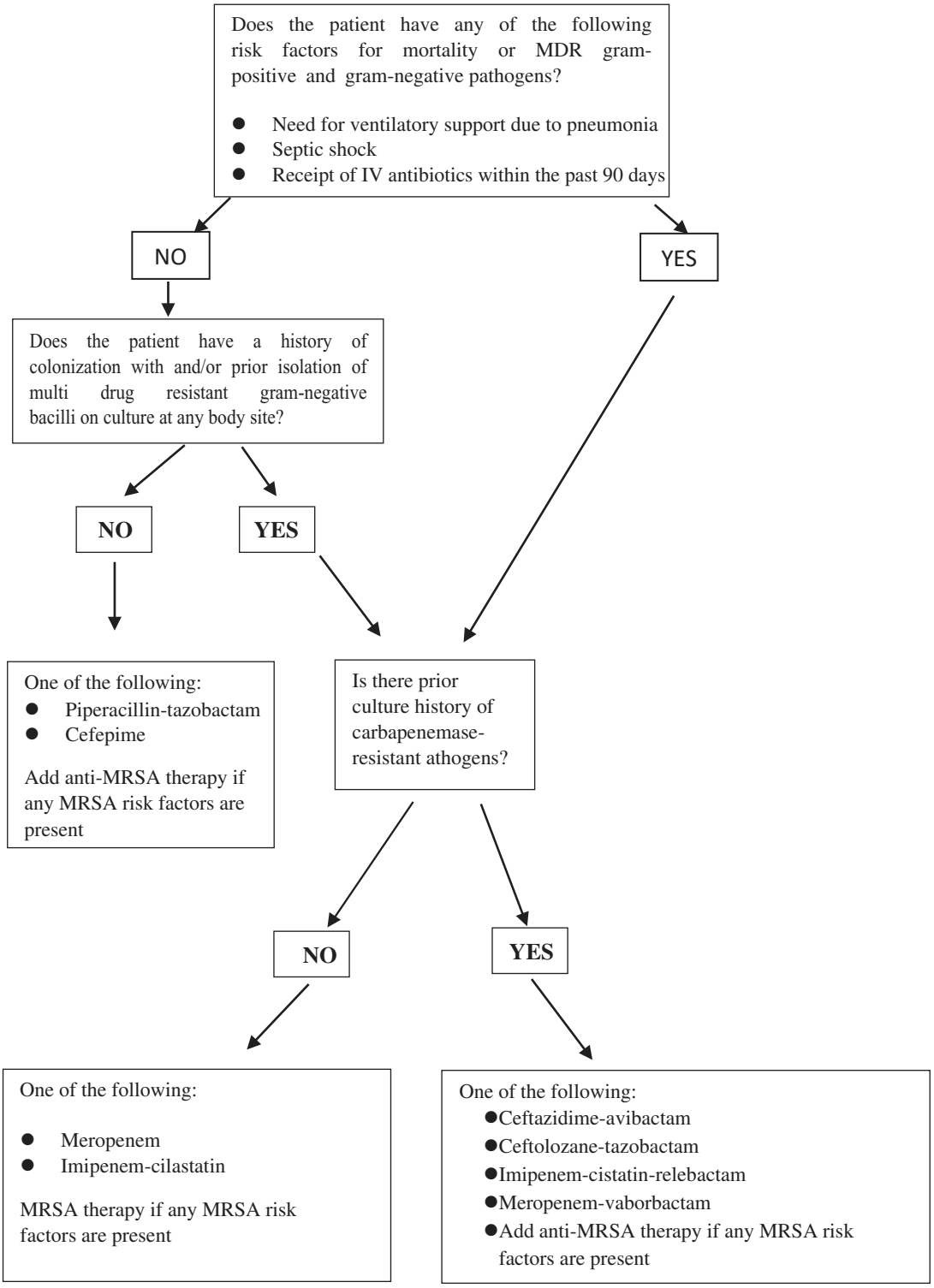
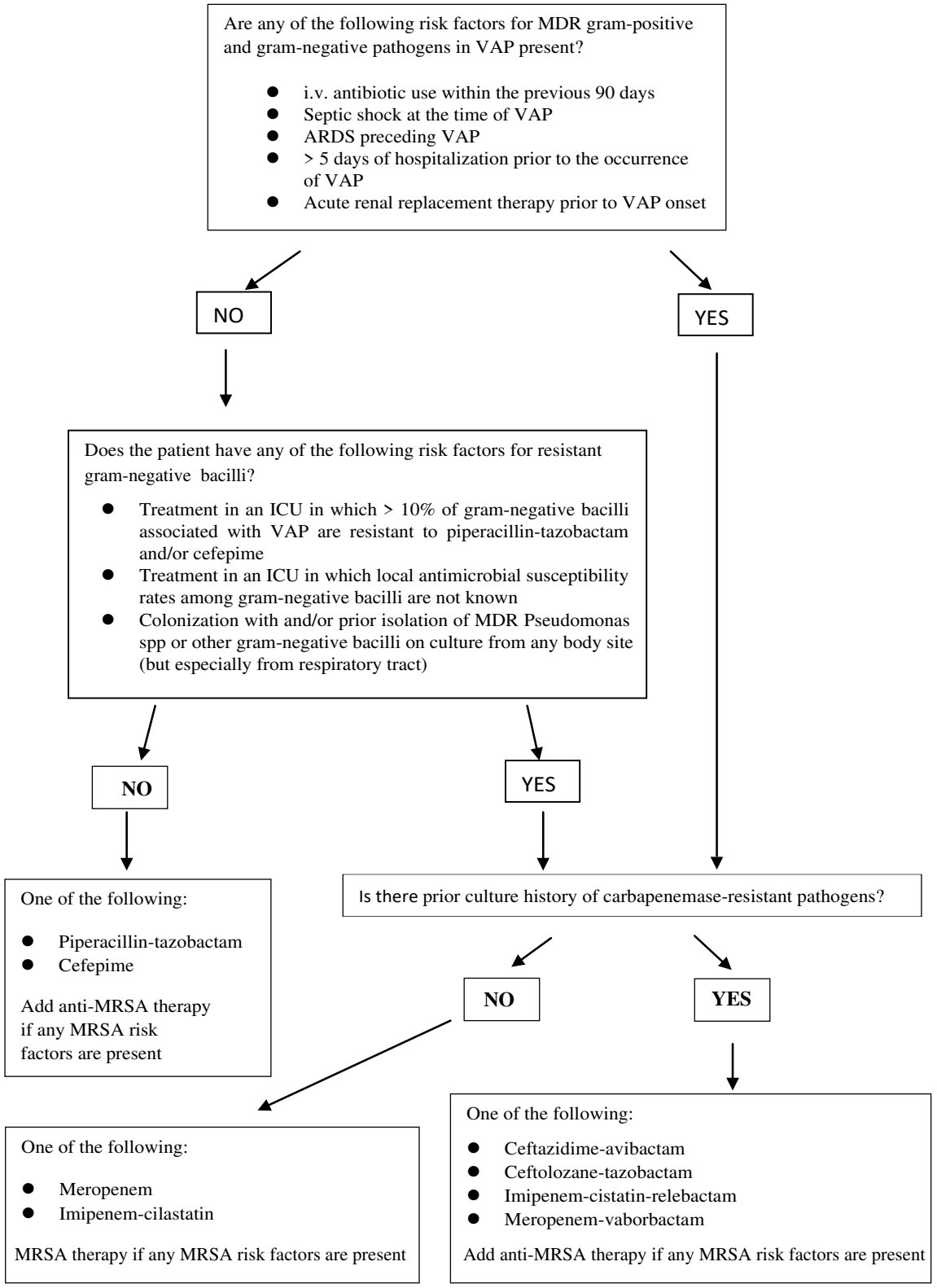


Fig. 2 Empiric treatment of ventilator-associated pneumonia (VAP) in adults with normal kidney functions



REFERENCES

1. Harris AM, Hicks LA, Qaseem A, High Value Care Task Force of the American College of Physicians and for the Centers for Disease Control and Prevention*. Appropriate antibiotic use for acute respiratory tract infection in adults: advice for high-value care from the American College of Physicians and the Centers for Disease Control and Prevention. Ann Intern Med. 2016 Mar 15;164(6):425-34.
2. Kasper D, Fauci A, Hauser S, Longo D, Jameson J, Loscalzo J. Harrison's principles of internal medicine, 19ed. New York, USA: Mcgraw-hill;2015.
3. Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J, Crothers K et al. Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019 Oct 1;200(7):e45-67.
4. Barker AF. Bronchiectasis. N Engl J Med. 2002 May 2;346(18):1383-93.
5. Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clin Infect Dis. 2016 Sept1;63(5):e61-111.
6. Mandell LA, Wunderink RG, Anzueto A, Bartlett JG, Campbell GD, Dean NC et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. Clin Infect Dis. 2007 Mar 1;44(Supplement_2):S27-72.
7. Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J,Crothers K et al. Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019 Oct 1;200(7):e45-67.
8. Weiner-Lastinger LM, Abner S, Edwards JR, Kallen AJ, Karlsson M, Magill SS et al. Antimicrobial-resistant pathogens associated with adult healthcare-associated infections: summary of data reported to the National Healthcare Safety Network, 2015–2017. Infect Control & Hosp Epidemiol. 2020 Jan;41(1):1-8.
9. Tassi GF, Marchetti GP, Pinelli V, Chiari S. Practical management of pleural empyema. Monaldi Archives for Chest Disease.2010;73(3).
10. Grippi MA, Antin-Ozerkis DE, Dela Cruz CS, Kotloff RM, Kotton CN, Pack AI. Fishman's pulmonary diseases and disorders. 6th ed. New York: McGraw Hill Professional; 2002.
11. Seaton A, Seaton D, Leitch GA. Crofton and Douglas's respiratory diseases. 5th ed. Oxford: Oxford University Press; 2008.

6 G. INFECTIONS IN CARDIOLOGY

Coronary stent infections

Owing to extreme rarity of cases, no management strategy has been defined.[1] S. aureus is the predominant pathogen, and device removal appears necessary. Antimicrobial therapy that is based on pathogen identification and susceptibility results should be administered for approximately 6 weeks.

Left ventricular assist device (LVAD) infections

Antimicrobial therapy is the main stay of management, often for prolonged periods on a recurrent basis. Practice of antibiotics prophylaxis at times of LVAD placement is universal. Multiple (up to five) antimicrobials, typically including some combinations of vancomycin, rifampicin, cefepime, ciprofloxacin and fluconazole for at least 24 hours is used.

Cardiovascular implantable electronic device (CIED) infections

Duration of antimicrobial therapy is based on clinical syndromes of CIED infection and the identified pathology. Fig.1. shows a management algorithm in case of patients with CIED infection[2].

Preoperative administration of an anti staphylococcal antibiotic given intravenously 30 to 60 minutes before device placement or revision is effective in reduction of CIED infection[3].

Bacterial myocarditis

Blood stream bacterial infection can result in metastatic foci in myocardium. For some infection like diphtheria, Whipple disease, and Lyme carditis appropriate antibiotic must be given.

Bacterial pericarditis

Bacterial pericarditis is a medical emergency and prompts closed therapeutic pericardiocentesis, or surgical drainage should be performed. Broad-spectrum antibiotic should be started prompt and modified according to sensitivity results[4].

Bacterial infections of aorta

Infected aortic aneurysms (more infrarenal), infected prosthetic aortic grafts, although rare are commonly caused by Staphylococcus aureus and Salmonella species. Treatment includes prolonged antibiotic therapy along with surgical management.

Rheumatic fever

Primary prevention of initial attack and secondary prevention of recurrent attacks will both necessitate antibiotics.

Table 1: Drug Regimen of Choice for the Primary Prevention of Rheumatic Fever[5]

Antibiotic	Administration	Dose
Benzathinebenzyl penicillin	Single IM injection	1.2 million unit; 50% if <30 kg
Phenoxymethyl penicillin (PenicillinVK)	PO for 10 days	250-500 mg TID for 10 days
Erythomycinethyl succinate	PO for 10 days	Varies with the formulation

Table 2: Drug Regimen of Choice for the Secondary Prevention of Rheumatic Fever[5]

Antibiotic	Mode of Administration	Dose
Benzathinebenzyl penicillin	Single intramuscular injection every 3- 4weeks	For adults and children ≥ 30 kg in weight: 1,200,000 units For children <30 kg in weight: 600,000 units
Penicillin V	Oral	250 mg twice daily
Sulfonamide (e.g., sulfadiazine, sulfadoxine, sulfisoxazole)	Oral	For adults and children ≥ 30 kg in weight: 1 g daily For children <30 kg in weight: 500 mg daily
Erythromycin	Oral	250 mg twice daily

Table 3: Duration of Secondary Prophylaxis for Rheumatic Fever[5]

Category of Patient	Duration of Prophylaxis
Patient without proven carditis	For 5 years after the last attack or until 18 years of age (whichever is longer)
Patient with carditis (mild mitral regurgitation or healed carditis)	For 10 years after the last attack or at least until 25 years of age (whichever is longer)
More severe valvular disease	Life-long
After valve surgery	Life-long

ANTIBIOTIC PROPHYLACTIC REGIMENS FOR ENDOCARDITIS

Guidelines AHA Guidelines

The American Heart Association (AHA) Guidelines for Prevention of Infective Endocarditis were updated in 2007 and included numerous changes from the previous 1997 version. The guidelines were approved by the Council on Scientific Affairs of the American Dental Association has approved the guidelines as it relates to dentistry. Additionally, the guideline is endorsed by the Infectious Diseases Society of America and by the Pediatric Infectious Diseases Society[6].

Major changes in the updated AHA guidelines include:

- Only an extremely small number of cases of infective endocarditis (IE) might be prevented by antibiotic prophylaxis for dental procedures even if such prophylactic therapy were100% effective
- IE prophylaxis for dental procedures should be recommended only for patients with underlying cardiac conditions associated with the highest risk of adverse outcome from IE
- For patients with these underlying cardiac conditions, prophylaxis is recommended for all dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa
- Prophylaxis is not recommended based solely on an increased lifetime risk of acquisition of infective endocarditis
- Administration of antibiotics solely to prevent endocarditis is not recommended for patients who undergo a genito urinary or gastro intestinal tract procedure

The antibiotic prophylactic regimens recommended by the AHA are only for patients with underlying cardiac conditions associated with the highest risk of adverse outcome from infective endocarditis[6].

High-risk cardiac conditions

Antibiotic prophylaxis is indicated for the following high-risk cardiac conditions-

- Prosthetic cardiac valve
- History of infective endocarditis
- Congenital heart disease(CHD)(except for the conditions listed, antibiotic prophylaxis is no longer recommended for any other form of CHD):
  (1) unrepaired cyanotic CHD, including palliative shunts and conduits;
  (2) completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure; and
  (3) repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibits endothelialization)
- Cardiac transplantation recipients with cardiac valvular disease

Dental Procedures

For patients with high cardiac risk, antibiotic prophylaxis is recommended for all dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa.

The following dental procedures do not require endocarditis prophylaxis-

- Routine anesthetic injections through non infected tissue
- Taking dental radiographs

- Placement of removable prosthodontic or orthodontic appliances
- Adjustment of orthodontic appliances
- Placement of orthodontic brackets
- Shedding of deciduous teeth
- Bleeding from trauma to the lips or oral mucosa

Respiratory Tract, Infected Skin, Skin Structures, or Musculo skeletal Tissue Procedures

Antibiotic prophylaxis is recommended for invasive respiratory tract procedures that involve incision or biopsy of the respiratory mucosa (eg, tonsillectomy, adenoidectomy). Antibiotic prophylaxis is **not** recommended for bronchoscopy unless the procedure involves incision of the respiratory tract mucosa. For invasive respiratory tract procedures to treat an established infection (eg, drainage of abscess, empyema), administer an antibiotic that is active against *Streptococcus viridans*.

Patients with high cardiac risk who undergo a surgical procedure that involves infected skin, skin structure, or musculo skeletal tissue should receive an agent active against staphylococci and beta-hemolytic streptococci (eg, Anti staphylococcal penicillin, cephalosporin).

If the causative organism of respiratory, skin, skin structure, or musculoskeletal infection is known or suspected to be *Staphylococcus aureus*, administer an anti staphylococcal penicillin or cephalosporin, or vancomycin (if patient is unable to tolerate beta-lactam antibiotics). Vancomycin is recommended for known or suspected methicillin-resistant strains of *S. aureus*.

Antibiotic Prophylaxis Regimens

The most common cause of endocarditis for dental, oral, respiratory tract, or esophageal procedures is *S. viridans* (alpha-hemolytic streptococci). Antibiotic regimens for endocarditis prophylaxis are directed toward *S. viridans,* and the recommended standard prophylactic regimen is a single dose of oral amoxicillin. Amoxicillin, ampicillin, and penicillin V are equally effective in vitro against alpha-hemolytic streptococci; however, amoxicillin is preferred because of superior gastrointestinal absorption that provides higher and more sustained serumlevels.

All doses shown below are administered once as a single dose 30-60 min before the procedure.

Standard general prophylaxis

Amoxicillin
Adult dose: 2 g PO
Pediatric dose: 50 mg/kg PO; not to exceed 2 g/dose

Unable to take oral medication

Ampicillin
Adult dose: 2 g IV/IM
Pediatric dose: 50 mg/kg IV/IM; not to exceed 2 g/dose

Allergic to penicillin

Clindamycin
Adult dose: 600 mg PO
Pediatric dose: 20 mg/kg PO; not to exceed 600 mg/dose

Allergic to penicillin

Cephalexin or other first- or second-generation oral cephalosporin in equivalent dose (do not use cephalosporins in patients with a history of immediate-type hypersensitivity penicillin allergy, such as urticaria, angioedema, anaphylaxis)

Adult dose: 2 g PO
Pediatric dose: 50 mg/kg PO; not to exceed 2 g/dose

Azithromycin or clarithromycin
Adult dose: 500 mg PO
Pediatric dose: 15 mg/kg PO; not to exceed 500 mg/dose

Allergic to penicillin and unable to take oral medication

Clindamycin
Adult dose: 600 mg IV
Pediatric dose: 20 mg/kg IV; not to exceed 600mg/dose

Cefazolin or ceftriaxone (do not use cephalosporins in patients with a history of immediate-type hypersensitivity penicillin allergy, such as urticaria, angioedema, anaphylaxis)

Adult dose: 1 g IV/IM
Pediatric dose: 50 mg/kg IV/IM; not to exceed 1 g/dose

Antimicrobial Therapy for Infective Endocarditis (IE)

Antimicrobial treatment should be prolonged (often weeks), high dose, parenteral and cidal and bacterial antibiotic sensitivity specific. Initial empiric antibiotic treatment results in many IE with blood-culture negative presentation. Initial empiric antibiotic therapy should cover *Staphylococcus aureus* and Streptococcus. A combination of β-lactamase resistant pericillin or vancomycin for penicillin allergic patients and gentamicin is often used. Oral rifampin is added for staphylocacal infection of prosthetic materials[7].

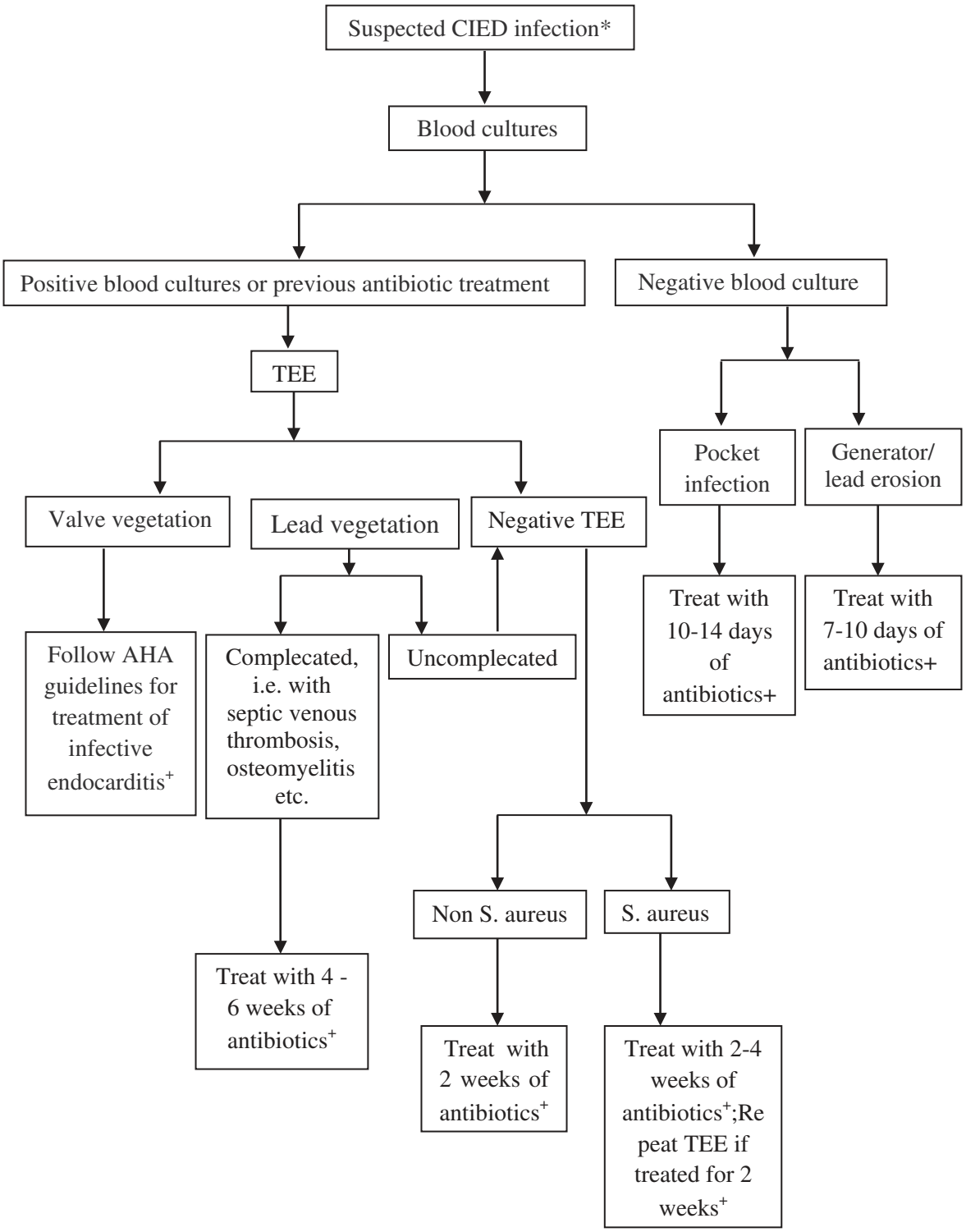


Fig 1. Approach to management of adults with CIED infection + Duration of antibiotic should be counted from the day of device explantation

REFERENCES

1. Baddown LM, Bettann MA. Bolger AF, el al : Non valuable cardiovascular device related infections Circulation 108 : 2018,2003.
2. Nienaber JJ. Kusne S. Riaz t, et al. Clinical manifestations and management of left ventricular assist device-associated infection. Clin Infect Dis 57: 1438,2013.
3. De Oliveira JC, Martinelli M, Nishioka SA, et al. Efficacy of antibiotic prophylaxis before the implantation of pacemakers and cardioverter-defibrillators: results of a large propective, randomized, double blind, placebo controlled trial. ClincarrrhythmElectrophysiol 2:29,2009.
4. Seferovic PM, Ristic AD, Maksimovie R, et al: Pericardial symdromes: an update after the ESC guidelines 2004. Heart Fail Rev 18: 255,2013
5. WHO Technical Report Series No. 923. Rheumatic Fever and Rheumatic Heart Disease: Report of a WHO Expert Panel, Geneva 29 October-1 November 2001. Geneva, WHO2004.
6. Wilson M, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis. Recommendation by the American Heart Association. Circulation 116:1736,2007.
7. Baddour LM, Wilson WR, Bayer AS, et al. Infective endocarditis in adults: Diagnosis, antimicrobiological therapy, and management of complication: A scientific statement for healthcare professionals from the American Heart association. Circulation 2015oct 13; 132 (15)1435-1486.

6 H. INFECTIONS IN GENERAL SURGERY

Introduction: The world health organization (WHO) has developed, through an international consensus statement, a surgical safety checklist aimed to improved the safety of patients undergoing surgical procedures, since safety measures are often not adequately implemented, even in referral centres[1].

Surgical infection remains an issue, being the third most frequent cause of nosocomial infection and affecting 14-16% of hospitalized patients. In surgical patients, postoperative wound infection is the most common cause of nosocomial infection, accounting for 77% of deaths. Patients who develop infection double the chance of dying compared to patients who undergo the same procedures without infection.[2]

The introduction of antibiotics for prophylaxis and for treatment, together with advances in anaesthesia and critical care medicine, has made possible surgery that would not previously have been considered. Faecal peritonitis is no longer inevitably fatal, and incisions made in the presence of such contamination can heal primarily without infection in 80–90 per cent of patients with appropriate antibiotic therapy. Surgical site infection in patients who have contaminated wounds, who are immunosuppressed or undergoing prosthetic surgery, is now the exception rather than the rule since the introduction of prophylactic antibiotics. The evidence for this is of the highest level. The value of prophylactic antibiotics in clean, non-prosthetic surgery remains controversial, although SSI rates after such surgery is high when judged by close, unbiased, post-discharge surveillance, using strict definitions[3].

It is estimated that about 60% of these SSIs can be avoided through the application of prevention measures recommended by clinical guidelines and protocols[4,5], when correctly performed[6]. However, adherence to these prevention protocols is often inadequate in up to 66.3% of cases[7]. In this respect, a systematic review has shown that the inadequate indication of antimicrobials ranges from 2.3 to 100%[8]. There is an association between the risk of SSI and failure to comply with the protocols in relation to the selection and timing of administration of the antimicrobial[9]. This non-adherence is also a cause of underdose (11.7%) and overdose (14.6%) in antibiotic therapy[10]. The excessive and inappropriate use of antimicrobials promotes the development of adaptive mechanisms of resistance in microorganisms[11], showing a positive association between the consumption of antimicrobials and the development of antimicrobial resistance[12]. Thus, it is essential to adopt complementary strategies (antimicrobial stewardship) to promote adherence to surgical antibiotic prophylaxis protocols. Antimicrobial stewardship (AMS) is defined by the Infectious Diseases Society of America and Society for Healthcare Epidemiology of America (IDSA/SHEA) as an activity that includes the selection, dose, route and duration of appropriate antimicrobial therapy.[14–18] Its main objective is to optimize clinical outcomes, minimizing the unwanted consequences of the use of antimicrobials, including toxicity, the selection of pathogenic organisms (such as Clostridium difficile) and the emergence of resistance.[15]

Preoperative dose timing

There is a delay before host defences can become mobilized after a breach in an epithelial surface, whether caused by trauma or surgery. The acute inflammatory, humoral and cellular defences take up to 4 hours to be mobilised. This is called the 'decisive period', and it is the time when the invading bacteria may become established in the tissues. Strategies aimed at preventing infection from taking a hold become ineffective after this time period. It is therefore logical that prophylactic antibiotics should be given to cover this period and that they could be decisive in preventing an infection from developing. The tissue levels of antibiotics should be above the minimum inhibitory concentration (MIC 90) for the pathogens likely to be encountered.[19]

The optimal time for administration of preoperative doses is within 60 min before surgical incision. This is a more-specific time frame than the previously recommended time, which was ''at induction of anesthesia.'' Some agents, such as fluoroquinolones and vancomycin, require administration over one to two hours; therefore, the administration of these agents should begin within 120 min before surgical incision.

Selection, dosing and redosing

Information is included regarding the approach to weight-based dosing in obese patients and the need for repeat doses during prolonged procedures.[20-2] Obesity has been linked to an increased risk for SSI. The pharmacokinetics of drugs may be altered in obese patients, so dosage adjustments based on body weight may be warranted in these patients. For all patients, intraoperative redosing is needed to ensure adequate serum and tissue concentrations of the antimicrobial if the duration of the procedure exceeds two half-lives of the drug or there is excessive blood loss during the procedure (Table 1). Recommendations for selection of antimicrobial agents for specific surgical procedures are provided in Table 1.

Duration of prophylaxis

New recommendations for a shortened postoperative course of antimicrobials involving a single dose or continuation for less than 24 hours are provided. Further clarity on the lack of need for postoperative antimicrobial prophylaxis based on the presence of indwelling drains and intravascular catheters is included.

Drug administration

The preferred route of administration varies with the type of procedure, but for a majority of procedures, i.v. administration is ideal because it produces rapid, reliable, and predictable serum and tissue concentrations.

Biliary tract procedure

Biliary tract procedures include cholecystectomy, exploration of the common bile duct, and choledochoenterostomy. These guidelines pertain only to patients undergoing biliary tract procedures with no evidence of acute biliary tract infection and to patients with community-acquired acute cholecystitis of mild-to-moderate severity. Patients receiving therapeutic antimicrobials for an infection before surgery should be given additional antimicrobial prophylaxis before surgery. The overall reported rate of postoperative infection in open biliary tract procedures with antimicrobial prophylaxis is 1–19%.[26–34] Infection rates after laparoscopic cholecystectomy range from 0% to approximately 4% in patients without antimicrobial prophylaxis[31,35–43] and from 0 % to 7% with prophylaxis.[26,27–46]

Organisms

The organisms most commonly associated with infection after biliary tract procedures include E. coli, Klebsiella species, and enterococci; less frequently, other gram-negative organisms, streptococci, and staphylococci are isolated.[28,29,35,38,39,42,44] Anaerobes are occasionally reported, most commonly Clostridium species. Recent studies have documented increasing antimicrobial resistance in the causative pathogens in biliary tract infections and other intra-abdominal infections, with up to 40 % of E. coli isolates resistant to ampicillin–sulbactam and fluoroquinolones [47-49]. Due to this increasing resistance of E. coli to fluoroquinolones and ampicillin–sulbactam, local population susceptibility profiles should be reviewed to determine the optimal antimicrobials for SSI prevention in biliary tract procedures.

Regional Institute of Medical Sciences Hospital, Imphal annual report on Surveillance of Drug Resistant in Manipur by the Dept of Microbiology from July 22 to June 23 (in local population) found E. coli was the most common top 10 pathogens isolated during this period with highest susceptibility to amikacin (81.85%) from superficial infection.

The majority of studies of antimicrobial prophylaxis for laparoscopic cholecystectomy were underpowered and varied in control groups used (placebo, active, or no treatment) and follow-up (from 30 to 60 days). The most common antibiotic used was cephalosporin.

Recommendation

A single dose of cefazolin/ceftriaxone/amikacin should be administered in patients undergoing open biliary tract procedures (Table 1). Antimicrobial prophylaxis is not necessary in low-risk patients undergoing elective laparoscopic cholecystectomies. Antimicrobial prophylaxis is recommended in patients undergoing laparoscopic cholecystectomy who have an increased risk of infectious complications. Risk factors include performance of emergency procedures, diabetes, anticipated procedure duration exceeding 120 min, risk of intraoperative gallbladder rupture, age of > 70 years, open cholecystectomy, risk of conversion of laparoscopic to open cholecystectomy, ASA classification of more than 3, episode of biliary colic within 30 days before the procedure, reintervention in less than a month for noninfectious

Complications of prior biliary operation, acute cholecystitis, anticipated bile spillage, jaundice, pregnancy, nonfunctioning gallbladder, and immunosuppression. Because some of these risk factors cannot be determined before the surgical intervention, it may be reasonable to give a single dose of antimicrobial prophylaxis to all patients undergoing laparoscopic cholecystectomy.

Appendectomy procedure

Cases of appendicitis can be described as complicated or uncomplicated on the basis of the pathology. Patients with uncomplicated appendicitis have an acutely inflamed appendix. Complicated appendicitis includes perforated or gangrenous appendicitis, including peritonitis or abscess formation. All patients with suspected clinical diagnosis of appendicitis, even those with an uncomplicated case, should receive appropriate preoperative i.v antimicrobials for SSI prevention.

SSI has been reported in 9-30 % of patients with uncomplicated appendicitis who do not receive prophylactic antimicrobials, though some reports suggest lower complication rates in children with uncomplicated appendicitis.[50-56]

Organisms

The most common microorganisms isolated from SSIs after appendectomy are anaerobic and aerobic gram-negative enteric organisms. Bacteroides fragilis is the most commonly cultured anaerobe, and E. coli is the most frequent aerobe with similar report from Regional Institute of Medical Sciences Hospital, Imphal annual report on Surveillance of Drug Resistant in Manipur by the Dept of Microbiology from from july 22 to june 23, being the most common top 10 pathogens isolated during this period with highest susceptibility to amikacin (81.85%) from superficial infection, indicating that the bowel flora constitute a major source for pathogens.[57-59] Aerobic and anaerobic streptococci, Staphylococcus species, and Enterococcus species also have been reported. Pseudomonas aeruginosa has been reported infrequently.

Choice of agent

An appropriate choice for SSI prophylaxis in uncomplicated appendicitis would be any single agent or combination of agents that provides adequate gram-negative and anaerobic coverage. The second-generation cephalosporins with anaerobic activity and a first-generation cephalosporin plus metronidazole are the recommended agents.

Recommendations

For uncomplicated appendicitis, the recommended regimen is a single dose of a cephalosporin with anaerobic activity (cefoxitin or cefotetan) or a single dose of a first-generation cephalosporin (cefazolin)/amikacin plus metronidazole (Table 1). For β-lactam-

allergic patients, alternative regimens include (1) clindamycin plus gentamicin, aztreonam, or a fluoroquinolone and (2) metronidazole plus gentamicin or fluoroquinolone (ciprofloxacin or levofloxacin).

Small intestine procedure

Small intestine procedures, or small bowel surgery as defined by National healthcare safety network, NHSN include incision or resection of the small intestine, including enterectomy with or without intestinal anastomosis or enterostomy, intestinal bypass, and strictureoplasty.

Organisms

The most common microorganisms isolated from SSIs after small bowel surgery are aerobic gram-negative enteric organisms. Among the species isolated from patients with SSI after small intestine surgery are gram-negative bacilli of gastrointestinal enteric origin (aerobic and anaerobic) and gram positive species, such as streptococci, staphylococci, and enterococci, which is consistent with similar studies.[60] Escherichia coli is the most frequently identified aerobe, indicating that the bowel flora constitute a major source of pathogens.

Regional Institute of Medical Sciences Hospital, Imphal annual report on Surveillance of Drug Resistant in Manipur by the Dept of Microbiology from july '22 to June '23 reported similar findings that E coli was the most common pathogens isolated during this period with highest susceptibility to amikacin (81.85%) from superficial infection.

Recommendations

For small bowel surgery without obstruction, the recommended regimen is a first-generation cephalosporin (cefazolin)/amikacin (Table 1). For small bowel surgery with intestinal obstruction, the recommended regimen is a cephalosporin with anaerobic activity (cefoxitin or cefotetan) or the combination of a first-generation cephalosporin (cefazolin) plus metronidazole or amikacin plus mitronidazole. For β-lactam allergic patients, alternative regimens include (1) clindamycin plus gentamicin, aztreonam, or a fluoroquinolone and (2) metronidazole plus gentamicin or a fluoroquinolone (ciprofloxacin or levofloxacin).

Hernia repair procedure (hernioplasty and herniorrhaphy)

All patients who undergo hernioplasty (prosthetic mesh repair of hernia) or herniorrhaphy (suture repair of hernia) should receive appropriate preoperative i.v. antimicrobials for SSI prevention. The risk of SSIs is higher in hernioplasty compared with herniorrhaphy.[61]

A Cochrane meta-analysis of 17 randomized trials (n = 7,843; 11 hernioplasty trials, 6 herniorrhaphy trials) in elective open inguinal hernia repair reported SSI rates of 3.1% versus 4.5% in the antimicrobial prophylaxis and control groups, respectively (OR, 0.64; 95% CI,

0.50–0.82).[62] The subgroup of patients with herniorrhaphy had SSI rates of 3.5% and 4.9% in the prophylaxis and control groups, respectively (OR, 0.71; 95% CI, 0.51–1.00). The subgroup of patients with hernioplasty had SSI rates of 2.4% and 4.2% in the prophylaxis and control groups, respectively (OR, 0.56; 95% CI, 0.38–0.81).

Organisms

The most common microorganisms isolated from SSIs after herniorrhaphy and hernioplasty are aerobic gram-positive organisms. Aerobic streptococci, Staphylococcus species, and Enterococcus species are common, and MRSA is commonly found in prosthetic mesh infections.[41]

According to our Institute Regional Institute of Medical Sciences Hospital, Imphalannual report on Surveillance of Drug Resistant in Manipur by the Dept of Microbiology from July 22 to june 23 (in admitted ward patients) staphylococcus and enterococcus spp were 3rd and 7th most common isolated pathogen amongst the top 10 pathogen and also found that out of the 554 Staphylococcus aureus isolates, 447 were MRSA. Amongst this MRSA isolates, Vancomycin exhibited the highest susceptibility (100%), followed by Linezolid (95.5%)

Choice of agent - A first-generation cephalosporin is the recommended agent on the basis of cost and tolerability and vancomycin on MRSA positive patient.

Duration - Based on the evidence to date, a single preoperative dose of antimicrobial isrecommended in hernioplasty and herniorrhaphy, with redosing if the procedure duration exceeds the recommended redosing interval from the time of initiation of the preoperative dose or if there is prolonged or excessive bleeding.

Recommendations

For hernioplasty and herniorrhaphy, the recommended regimen is a single dose of a firstgeneration cephalosporin (cefazolin) (Table 1). For patients known to be colonized with MRSA, it is reasonable to add a single preoperative dose of vancomycin to the recommended agent. For β-lactam-allergic patients, alternative regimens include clindamycin and vancomycin.

Colorectal procedure - Infectious complication rates range from 30% to 60% without antimicrobial prophylaxis[57,63] and are < 10% with appropriate antimicrobial prophylaxis.

Organisms

The infecting organisms in colorectal procedures are derived from the bowel lumen, where there are high concentrations of organisms. Bacteroides fragilis and other obligate anaerobes are the most frequently isolated organisms from the bowel, with concentrations 1,000–10,000 times higher than those of aerobes. Escherichia coli is the most common aerobe. Bacteriodes fragilis and Escherichia coli comprise approximately 20–30% of the fecal mass. They are the most frequently isolated pathogens from infected surgical sites after colon procedures.

Recommendations

A single dose of second-generation cephalosporin with both aerobic and anaerobic activities (cefoxitin or cefotetan) or cefazolin plus metronidazole is recommended for colon procedures (Table 1). The oral antimicrobial should be given as three doses over approximately 10 hours the afternoon and evening before the operation and after the mechanical bowel preparation.

Table1: Recommended surgical antibiotic prophylaxis for common surgical procedures in RIMS, Imphal

Types of procedures	Recommended prophylaxis	Dosing	Redosing
Biliary tract procedures	Amikacin Cephalosporin (ceftriaxone/ cefazolin)	15 mg/kg 1-2 g 1-2g, 3g for pts weighing ≥ 120 kg	NA NA 4 hourly
Appendectomy	Amikacin + Metronidazole Cephalosporins (ceftriaxone / cefazolin) + Metronidazole	15 mg/kg + 500 mg 1-2 g 500 mg	NA NA NA
Hernioplasty/Herniorahphy	Cephalosporins (ceftriaxone/cefazolin) Vancomycin (for MRSA)	1-2 g 15 mg/kg	NA NA
Small intestinal procedures (luminal/extraluminal)	Cephalosporins (ceftriaxone/cefazolin) + Metronidazole	1-2 g 500 mg	NA NA
Coloretal procedures	Cephalosporins(ceftriaxone) + Metronidazole Oral antibiotics- Metronidazole, Neomycin	1-2 g 500 mg 1gm 1gm	NA NA NA NA

NA: Recommended redosing intervals marked as ‘‘not applicable’’ (NA) are based on typical case length; for unusually long procedures, redosing may be needed. Redosing in the operating room is recommended at an interval of approximately two times the half-life of the agent in patients with normal renal function or if there is excessive intraoperative bleeding.

Topical administration of irrigations, pastes, and washes

Limited high-quality data are available regarding the use of antimicrobial irrigations, pastes, and washes that are administered topically. Studies published in the early 1980s demonstrated that prophylactic topical administration of antimicrobials in the surgical incision during various non-ophthalmic procedures is superior to placebo but not superior to parenteral administration, and topical administration does not increase the efficacy of parenteral antimicrobials when used in combination for prophylaxis.[64-67] Additional high quality data on the safety and efficacy of topical antimicrobial administration as an adjunct to i.v. administration are needed to determine the role of topical antimicrobial prophylaxis.

Conclusion

The evidence regarding recommendation for the administration of antibiotic prophylaxis for surgical procedures with the local hospital resistant trends and policies are enormously important in preventing SSI. The uses of antibiotics after surgery to prevent SSI are not encouraged. Gaps in the current research evidence on surgical antibiotic prophylaxis need to be addressed in order to strengthen the evidence and provide adequate clinical recommendations.

REFERENCES

1. Guidelines for safe surgery 2009: safe surgery saves lives. Available at: http://whqlibdoc.who.int/who.int/publications/2009/9789241598552_eng.pdf[accessedon14.10.14].
2. WHO Mendes FF, Carneiro AF. Infeccao no paciente cirurgico: como podemos contribuir para a prevencao? In: Salman FC, Diego LAS, Silva JH, Moraes JMS, Carneiro AF, editors. Qualidade e Seguranca em Anestesiologia. Rio de Janeiro: ociedade Brasileira de Anestesiologia; 2012. p. 143-62.
3. Bailey 26th chapter 5 p-51.
4. Anvisa. Criterios Diagnosticos de Infeccao Relacionada a Assistencia a Saude. 1 ed. Brasilia, DF: Agencia Nacional de Vigilancia Sanitaria; 2013. https:// bvsms. saude. gov. br/ bvs/ publicacoes/ crite rios_ diagn ostic os_ infec coes_ assis tencia_ saude. Pdf Accessed 9 July 2021.
5. Umscheid CA, Mitchell MD, Doshi JA, et al. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. Infect Control Hosp Epidemiol. 2011;32:101–14.
6. Allen J, David M, Veerman JL. Systematic review of the costeffectiveness of preoperative antibiotic prophylaxis in reducing surgical-site infection. BJS Open. 2018;2:81–98.
7. Lim MK, Lai PS, Ponnampalavanar SS, et al. Antibiotics in surgical wards: use or misuse? A newly industrialized country's perspective. J Infect Dev Ctries. 2015;9:1264–71.
8. Gouvea M, Novaes C, Pereira DM, et al. Adherence to guidelines for surgical antibiotic prophylaxis: a review. Braz J Infect Dis. 2015;19:517–24.
9. Bull AL, Worth LJ, Spelman T, et al. Antibiotic prescribing practices for prevention of surgical site infections in Australia: increased uptake of national guidelines after surveillance and reporting and impact on infection rates. Surg Infect (Larchmt). 2017;18:834–40.
10. EmyInumaru F, Silva ASE, Soares AdS, et al. Profile and appropriate use ofantibiotics among children in a general hospital in Southern Brazil. Rev Paul Pediatr. 2019;37:27–33.

11. Schmitt C, Lacerda RA, Padoveze MC, et al. Applying validated quality indicators to surgical antibiotic prophylaxis in a Brazilian hospital: learning what should be learned. Am J Infect Control. 2012;40:960–2.
12. Hwang AY, Gums JG. The emergence and evolution of antimicrobial resistance: impact on a global scale. Bioorg Med Chem. 2016;24:6440–5.
13. Bell BG, Schellevis F, Stobberingh E, et al. A systematic review and meta-analysis of the effects of antibiotic consumption on antibiotic resistance. BMC Infect Dis. 2014;14:1–25.
14. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an antibiotic stewardship program: guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect Dis. 2016;62:e51-77.
15. Dellit TH, Owens RC, McGowan JE, et al. Infectious DiseasesSociety of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. Clin Infect Dis. 2007;44:159–77.
16. Hughes SJ, Moore LS.Antimicrobial stewardship. Br J Hosp Med (Lond). 2019;80:C42–5.
17. Policy statement on antimicrobial stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS). Infect Control Hosp Epidemiol. 2012;33:322–7
18. Rodriguez-Bano J, Pano-Pardo JR, Alvarez-Rocha L, et al. [Programs for optimizing the use of antibiotics (PROA) in Spanish hospitals: GEIH-SEIMC, SEFH and SEMPSPH consensus document]. Enferm Infecc Microbiol Clin. 2012;30:22.e1-22.e3.
19. Bailey 26 th edi chapter5 p-53
20. Edmiston CE, Krepel C, Kelly H et al. Perioperative antibiotic prophylaxis in the gastric bypass patient: do we achieve therapeutic levels? Surgery 2004; 136:738–747.
21. Claforan(cefotaxime sodium) for injection package insert.Bridgewater, NJ: Sanofi Aventis; 2009 Jul. 22.Pappas PG, Silveira FP. Candida in solid organ transplant recipients. Am J Transplant 2009;9(suppl4):S173–179.
23. Zelenitsky SA, Silverman RE, Duckworth H et al. A prospective, randomized, double-blind study of single high dose versus multiple standard dose gentamicin both in combination with metronidazole for colorectal surgical prophylaxis. J Hosp Infect 2000; 46:135–140.
24. Zelenitsky SA, Ariano RE, Harding GK et al. Antibiotic pharmacodynamics in surgical prophylaxis: an association between intraoperative antibiotic concentrations and efficacy. Antimicrob Agents Chemother 2002; 46:3026–3030.
25. Rybak MJ, Lomaestro BM, Rotschafer JC et al. Vancomycin therapeutic guidelines: a summary of consensus recommendations from the Infectious Diseases Society ofAmerica, the American Society of Health-System Pharmacists, and the Society of Infectious Diseases Pharmacists. Clin Infect Dis 2009; 49:325–327.
26. Varela JE, Wilson SE, Nguyen NT. Laparoscopic surgery significantly reduces surgical-site infections compared with open surgery. Surg Endosc 2010; 24:270–276.
27. Meijer WS, Schmitz PI, Jeekel J. Meta-analysis of randomized, controlled clinical trials of antibiotic prophylaxis in biliary tract surgery. Br J Surg 1990; 77:282–290.
28. Den Hoed PT, Boelhouwer RU, Veen HF et al. Infections and bacteriological data after laparoscopic and open gallbladder surgery. J Hosp Infect 1998; 39:27–37.
29. Dervisoglou A, Tsiodras S, Kanellakopoulou K et al. The value of chemoprophylaxis against Enterococcus species in elective cholecystectomy: a randomized study of cefuroxime vs ampicillin/sulbactam. Arch Surg 2006; 141:1162–1167.
30. Cainzos M, Sayek I, Wacha H et al. Septic complications after biliary tract stone surgery: a review and report of the European Prospective Study. Hepatogastroenterology1997; 44:959–967.

31. Lippert H, Gastinger J. Antimicrobial prophylaxis in laparoscopic and conventional cholecystectomy. Chemotherapy 1998;44:355–363.
32. Siddiqui K, Khan AF. Comparison of frequency of wound infection: open vs laparoscopic cholecystectomy. J Ayub Med Coll Abbottabad 2006; 18:21–24.
33. Romy S, Eisenring MC, Bettschart V et al. Laparoscope use and surgical site infections in digestive surgery. Ann Surg 2008; 247:627–632.
34. Rotermann M. Infection after cholecystectomy, hysterectomy or appendectomy. Health Rep 2004; 15:11–23.
35. Chang WT, Lee KT, Chuang SC et al. The impact of prophylactic antibiotics on postoperative infection complication in elective laparoscopic cholecystectomy: a prospective randomized study. Am J Surg 2006;191:721–725.
36. Zhou H, Zhang J, Wang Q et al. Meta-analysis: antibiotic prophylaxis in elective laparoscopic cholecystectomy. Aliment Pharmacol Ther 2009; 29:1086–1095.
37. Dobay KJ, Freier DT, Albear P. The absent role of prophylactic antibiotics in low-risk patients undergoing laparoscopic cholecystectomy. Am Surg 1999; 65:226–228.
38. Higgins A, London J, Charland S et al. Prophylactic antibiotics for elective laparoscopic cholecystectomy: are they necessary? Arch Surg 1999; 134:611–614.
39. Tocchi A, Lepre L, Costa G et al. The need for antibiotic prophylaxis in elective laparoscopic cholecystectomy: a prospective randomized study. Arch Surg 2000; 135: 67–70.
40. Guzma´n-Valdivia G. Routine administration of antibiotics to patients suffering accidental gallbladder perforationperforation during laparoscopic cholecystectomy is not necessary. Surg Laparosc Endosc Percutan Tech 2008; 18: 547–550.
41. Harling R, Moorjani N, Perry C et al. A prospective, randomized trial of prophylactic antibiotics versus bag extraction in the prophylaxis of wound infection in laparoscopic cholecystectomy. Ann R Coll Surg Engl 2000; 82:408–410.
42. Illig KA, Schmidt E, Cavanaugh J et al. Are prophylactic antibiotics required for elective laparoscopic cholecystectomy? J Am Coll Surg 1997; 184:353–356.
43. Zurbuchen U, Ritz JP, Lehmann KS et al. Oral vs intravenous antibiotic prophylaxis in elective laparoscopic cholecystectomy—an exploratory trial. Langenbecks Arch Surg 2008; 393:479–485.
44. Al-Abassi AA, Farghaly MM, Ahmed HL et al. Infection after laparoscopic cholecystectomy: effect of infected bileand infected gallbladder wall. Eur J Surg 2001; 167:268–273.
45. Farello GA, Cerofolini A. Antimicrobial prophylaxis with ceftriaxone in laparoscopic cholecystectomy: a 7-year clinical experience involving 3,603 patients. J Chemother 2000; 12(suppl 3):17–22.
46. McGuckin M, Shea JA, Schwartz JS. Infection and antimicrobial use in laparoscopic cholecystectomy. Infect Control Hosp Epidemiol 1999; 20:624–626
47. Montravers P, Lepape A, Dubreuil L et al. Clinical and microbiological profiles of community-acquired and nosocomial intra-abdominal infections: results of the French prospective, observational EBIIA study. J Antimicrob Chemother 2009; 63:785–794.
48. Baquero F, Hsueh PR, Paterson DL et al. In vitro susceptibilities of aerobic and facultatively anaerobic gramnegative bacilli isolated from patients with intra-abdominal infections worldwide: 2005 results from Study for Monitoring Antimicrobial Resistance Trends (SMART). Surg Infect 2009;10:99–104.
49. Chow JW, Satishchandran V, Snyder TA et al. In vitro susceptibilities of aerobic and facultative gram-negative bacilli isolated from patients with intra-abdominal infections worldwide: the 2002 Study for Monitoring Antimicrobial Resistance Trends (SMART). Surg Infect 2005; 6:439–448.
50. Edwards JR, Peterson KD, Mu Y et al. National Healthcare Safety Network (NHSN) report: data summary for 2006 through 2008. Am J Infect Control 2009; 37:783–805

51. Ahmed ME, Ibrahim SZ, Arabi YE et al. Metronidazole prophylaxis in acute mural appendicitis: failure of a single intra-operative infusion to reduce wound infection. J Hosp Infect 1987; 10:260–264.
52. Donovan IA, Ellis D, Gatehouse D et al. One-dose antibiotic prophylaxis against wound infection after appendectomy: a randomized trial of clindamycin, cefazolin sodium and a placebo. Br J Surg 1979;66:193–196.
53. Gilmore OJ, Martin TD. Aetiology and prevention of wound infection in appendectomy. Br J Surg 1974;62:567–572.
54. Keiser TA, Mackenzie RL, Feld LN. Prophylactic metronidazole in appendectomy: a double-blind controlled trial. Surgery 1983;93:201–203.
55. Winslow RE, Rem D, Harley JW. Acute nonperforating appendicitis: efficacy of brief antibiotic prophylaxis. Arch Surg 1983;118:651–655.
56. Tonz M, Schmid P, Kaiser G. Antibiotic prophylaxis for appendectomy in children: critical appraisal. World J Surg 2000;24:995–998.
57. Gorbach SL, Condon RE, Conte JE Jr et al. Evaluation of new anti-infective drugs for surgical prophylaxis. Clin Infect Dis 1992; 15(suppl1):S313–S338.
58. Stone HH. Bacterial flora of appendicitis in children. J Pediatr Surg 1976;11:37–42.
59. Keighley MR. Infection: prophylaxis. Br Med Bull 1988;44:374–402
60. Schnuriger B, Inaba K, Eberle BM et al. Microbiological profile and antimicrobial susceptibility in surgical site infections following hollow viscus injury. J Gastrointest Surg 2010;14:1304–1310.
61. Den Hartog D, Dur AH, Tuinebreijer WE et al. Open surgical procedures for incisional hernias. Cochrane Database Syst Rev 2008;3:CD006438.
62. Sanchez-Manuel FJ, Lozano-Garcı´a J, Seco-Gil JL. Antibiotic prophylaxis for hernia repair. Cochrane Database Syst Rev 2012;2:CD003769
63. Burton RC. Postoperative wound infection in colon and rectal surgery. Br J Surg 1973;60:363–368.
64. Hares MM, Hegarty MA, Warlow J et al. A controlled trial to compare systemic and intra-incisional cefuroxime prophylaxis in high risk gastric surgery. Br J Surg 1981; 68:276–280.
65. Moesgaard F, Lykkegaard Nielsen M. Failure of topically applied antibiotics, added to systemic prophylaxis, to reduce perineal wound infection in abdominoperineal excision of the rectum. Acta Chir Scand 1988;154:589–592.
66. Pitt HA, Postier RG, Gadacz TR et al. The role of topical antibiotics in ‘‘high-risk’’ biliary surgery. Surgery 1982;91:518–524.
67. Pitt HA, Postier RG, Mcgowan WA et al. Prophylactic antibiotics in vascular surgery. Topical, systemic, or both. Ann Surg 1980;192:356–364.

6 I. INFECTIONS IN RADIATION ONCOLOGY

Introduction: Patients who undergo cytotoxic chemotherapy, hematopoietic stem cell transplant and those receiving radiation therapy to high volume of functioning bone marrow are at increased risk of neutropenia due to myelosuppression. Moreover, radiation therapy and chemotherapy induced mucositis increases the risk of invasive infection due to seeding of blood stream from endogenous flora in gastrointestinal tract. Patients with underlying malignancy also has increased risk of infection in biliary tract, bronchial, gastrointestinal tract or urinary system because of tumour induced obstruction. The risk is particularly high during the period of neutropenia. Prevention and appropriate management of febrile neutropenia (FN) is important because the rate of major complications (eg, hypotension, acute renal, respiratory, or heart failure) in the context of FN is approximately 25% to 30% and mortality up to 11%. In the setting of severe sepsis or septic shock, the hospital mortality rate may be as high as 50%. Antimicrobial prophylaxis can decrease the risk of infection. However because of drug related adverse effect as well as concern about antimicrobial resistance and cost calls for proper weighing of benefit and harm.

Antimicrobial prophylaxis

American Society of Clinical Oncology/Infectious Disease Society (IDSA) recommendation -

- Risk of febrile neutropenia should be systematically assessed, with consideration of patient-related, cancer-related, and treatment-related factors.
- Antibiotic prophylaxis with a fluoroquinolone is recommended for patients who are at high risk for febrile neutropenia or profound, protracted neutropenia (eg, most patients with acute myeloid leukemia/myelodysplastic syndromes or hematopoietic stem-cell transplantation [HSCT] treated with myeloablative conditioning regimens).
- Antibiotic prophylaxis is not routinely recommended for patients with solid tumors.
- Antifungal prophylaxis with an oral triazole or parenteral echinocandin is recommended for patients who are at risk for profound, protracted neutropenia, such as most patients with acute myeloid leukemia/myelodysplastic syndromes or HSCT. Antifungal prophylaxis is not routinely recommended for patientswith solid tumors.
- Prophylaxis (eg, with trimethoprim-sulfamethoxazole [TMP- SMX]) is recommended for patients receiving chemotherapy regimens associated with > 3.5% risk for Pneumocystis jirovecii pneumonia (eg, those with ≥ 20 mg prednisone equivalents daily for ≥ 1 month or those receiving purine analogs).
- Herpes simplex virus–seropositive patients undergoing allogeneic HSCT or leukemia induction therapy should receive prophylaxis with a nucleoside analog (eg, acyclovir).
- Treatment with a nucleoside reverse transcription inhibitor (eg, entecavir or tenofovir) is recommended for patients who areat high risk of hepatitis B virus reactivation.
- Yearly influenza vaccination with inactivated vaccine is recommended for all patients receiving chemotherapy for malignancy and all family and household contacts and health care providers.

- The Expert Panel also supports other vaccination recommendations for immunosuppressed adult oncology patients that are contained in the IDSA guideline for vaccination of the immunosuppressed host.

Risk stratification

Risk stratification is required to determine the management of patients with fever and neutropenia, including the route of antibiotic therapy (oral vs. IV), its duration, and the choice of inpatient or outpatient care. Widely accepted indications of high risk include either or both of the following -

- Chemotherapy-related neutropenia that is expected to be prolonged (duration > 7 days) and profound (absolute neutrophil count [ANC] < 100cells/µL
- Significant medical co-morbid conditions (eg, hypotension, pneumonia, new-onset abdominal pain, neurologic changes)

NCCN guidelines recommend outpatient treatment of febrile neutropenic patients whose initial risk evaluation indicates low risk, based on the following -

- No high-risk features
- Outpatient status at time of development of fever
- Anticipated short duration of severe neutropenia (d 100 cells/mcLfor < 7d)
- Good performance status (ECOG 0-1)
- No liver or kidney insufficiency
- MASCC (Multinational Association for supportive Care in Cancer) score of ≥ 21 or CISNE (Clinical Index of Stable Febrile Neutropenia) score of < 3

The NCCN recommends hospitalization for patients with any of the following high-risk factors -

- MASCC score < 21 or CISNE score ≥ 3
- Inpatient status at time of development of fever
- Significant medical comorbidity or clinically unstable
- Allogeneic HSCT
- Anticipated prolonged severe neutropenia: d 100 cells/µL and ≥ 7d
- Liver insufficiency (5 times upper limit of normal for aminotransferases)
- Kidney insufficiency (creatinine clearance < 30mL/min)
- Uncontrolled or progressive cancer
- Pneumonia or other complex infections at clinical presentation
- Use of certain immune and/or targeted treatments
- Mucositis grade 3-4

Treatment of febrile neutropenia

The ASCO/IDSA guideline recommendations for outpatient management of fever and neutropenia in adult cancer patients are asfollows [2] -

- In the absence of an alternative explanation, clinicians should assume that fever in a patient with neutropenia from cancer therapy is the result of an infection.
- Fever in neutropenic patients is defined as a single oral temperature of ≥ 38.3°C (101°F) or a temperature of ≥ 38.0°C(100.4°F) sustained over 1hour.
- Patients who present with febrile neutropenia within 65 weeks after receiving chemotherapy should be assessed within 15 minutes after triage.

Initial assessment

Recommended tests and procedures for the initial assessment include the following-

- Complete blood cell count (CBC) with differential, hemoglobin,and platelet count
- Serum creatinine and blood urea nitrogen (BUN)
- Electrolyte levels
- Serum lactate
- Liver function tests (total bilirubin, alkaline phosphatase, transaminases)
- At least two sets of blood cultures, with samples taken from different sites Cultures from suspected infection sites (eg, urine, lower respiratory tract, CSF, stool, wounds)
- Chest imaging study for patients with clinical manifestations of lower respiratory tract infection
- Patients with a flu like illness in the setting of seasonal community-acquired respiratory illnesses should have a nasopharyngeal swab obtained for detection of influenza. In some of these cases (eg, patients with hematologic malignancy and HSCT, strong consideration should be given to obtaining expanded viral panels for detection of additional respiratory viruses: influenza virus, parainfluenza virus, adenovirus, coronavirus, respiratory syncytial virus, human metapneumovirus, enteroviruses, and rhinovirus.

Antibiotic agents

In all patients presenting with neutropenic fever, empiric initial broad spectrum antibacterial therapy should be initiated immediately after blood cultures have been obtained and before any other investigations have been completed. Initial regime selection should be guided by the patient's history, allergies, symptoms, signs, recent antimicrobial agent use and culture data and awareness of the susceptibility patterns of nosocomial pathogens.

NCCN guidelines recommend basing antibiotic therapy on the following -

- Infection risk assessment
- Broad-spectrum coverage including antipseudomonal activity
- Colonization with or prior infection with multidrug-resistant organisms
- Site of infection

- Local antibiotic susceptibility patterns
- Organ dysfunction/drug allergy
- Previous antibiotic therapy

For oral antibiotic therapy in low-risk patients (outpatients and select inpatients) who have not received prior quinolone prophylaxis, the NCCN recommends the following -

- Ciprofloxacin (500–750 mg PO every 12 hours or 400 mg IV every 8–12 hour) plus amoxicillin/clavulanate (category 1)
- Levofloxacin (500–750 mg PO or IV daily)
- Moxifloxacin (400 mg PO or IV daily) (category 1), if Pseudomonas coverage is not required

For IV antibiotic therapy, both ASCO/IDSA and NCCN guidelines recommend monotherapy with an antipseudomonal β-lactam agent, such as the following -

- Cefepime (2 g IV every 8 hours)
- Meropenem (1–2 g IV every 8 hours or 500 mg IV every 6 hours)
- Imipenem-cilastatin (500 mg IV every 6 hours)
- Piperacillin-tazobactam (3.375 g IV every 6 hours (mild- moderate infections) or 4.5 g IV every 6 hours (severe infections including fever and neutropenia).

The NCCN also includes ceftazidime as a category 2B recommendation. Other antimicrobials (eg, aminoglycosides, fluoroquinolones, vancomycin) may be added for management of complications (eg, hypotension, pneumonia) or if antimicrobial resistance is suspected orproven.

The NCCN guidelines provide specific recommendations for evaluation andtreatment modification based on infection site and findings. For example, patients presenting with diarrhea who are found to have Clostridioides difficile infection should receive vancomycin or fidaxomicin.

Patients should be observed for ≥ 4 hours before discharge. Patients with febrile neutropenia who are at low risk of medical complications, in whom fever is responding to inpatient IV empirical antibiotic treatment, and who remain clinically stable, are considered eligible for transition to an outpatient regimen.

Patients who are undergoing outpatient management should be evaluated for admission to the hospital if any of the following occur -

- Failure to defervesce after 2 to 3 days of an initial, empirical, broad-spectrum antibiotic regimen
- Fever recurrence after a period of defervescence
- New signs or symptoms of infection
- Use of oral medications is no longer possible or tolerable

- Change in the empirical regimen or an additional antimicrobial drug becomes necessary
- Microbiologic tests identify species not susceptible to the initial regimen.

REFERENCES

1. Alexandre Chan. Antimicrobial Agents in Neutropenic Cancer Patients: Recommendations. https://emedicine.medscape.com/article/2500036- overview (accessed on 07-02-2024,07:04).
2. Randy A. Taplitz, Erin B et al. Antimicrobial Prophylaxis for Adult Patients with Cancer Related Immunosuppression: ASCO and IDSA Clinical Practice Guideline Update. Journal of oncology practice, Oct., 2018; vol. 36 (issue 30):3043-3054.
3. Randy A. Taplitz, Erin B. Kennedy, and Christopher R. Flowers. Antimicrobial Prophylaxis for Adult Patients with Cancer Related Immunosuppression: ASCO and IDSA Clinical Practice Guideline Update summary. Journal of oncology practice, Nov 2018; vol. 14 (issue 11):692-695.
4. Prevention and treatment of cancer-related infections. NCCN Clinical practice guidelines in oncology (NCCN Guidelines). National comprehensive cancer network. version 2.2023-Dec 5,2023 (accessed on 24.1.24 at 12:34:45 am atwww.nccn.org.

7. GUIDELINES FOR ANTIBIOTIC USE IN PAEDIATRICS

Introduction: Specific antibiotic therapy is usually decided after a specific microbiologic diagnosis, with the isolation of the pathogenic organism and aided by subsequent antimicrobial susceptibility testing. But in most cases, antibiotic therapy is started in pediatric patients empirically as they are too sick at presentation, proper culture samples are difficult to be obtained or most of the cultures have a low yield. Empirical antibiotic therapy is also favored in the care of the febrile or sick-appearing neonates. There are important factors influencing the decision to initiate - empirical use of antibacterial agents in infants and children – age, environment, underlying diseases, co-morbid conditions, immunologic and vaccination status.

Early onset sepsis (EOS) occurring in neonates (< 72 hours post natal age) are related to various maternal factors whereas late onset neonatal (>72 hours post natal age) sepsis (LOS) largely result from environmental causes. The most common microbial causes of EOS include group B Streptococcus (GBS), Escherichia coli, viridans streptococci, Enterococcus, and a variety of Enterobacteriaceae such as Klebsiella and Haemophilus spp. Coagulase-negative staphylococci, methicillin-sensitive and methicillin-resistant Staphylococcus aureus, β-lactam-resistant gram-negative organisms, and Candida spp are implicated in LOScases.

In the older age group of children - *Mycoplasma, Chlamydia, Legionella* are frequently found. Unlike adult patients, likelihood of systemic spread leading to severe sepsis should always be considered in children. While initiating empirical antibiotic therapy, due considerations should also be made for the locally prevailing organisms and relevant resistance patterns. In the present times, antibiotic resistance has emerged as a huge problem –due to rampant and sometimes unnecessary antibiotic prescription along with use in other non-human sectors. It would be prudent to use the culture identified antibiotic with the narrowest antimicrobial spectrum via the best possible route and for the specified duration. A stringent and dedicated culture directed antibiotic policy should be the ideal approach for rationale antibiotic therapy inchildren.

NEONATAL INFECTIONS

Disease/ Condition	Antibiotics		Dose	Dosing interval and route		Duration
				0-14 days of life	>14 days of life	
Septicemia or, Pneumonia	1st line	Cefotaxime *and*	If baby's weight a) <1200 g: 100 mg/kg/day b)1200-2000 g: 100-150 mg/kg/day c) >2000 g: 200 mg/kg/day	12 hrly IV	8-12 hrly IV	7-10 days*
		Amikacin	15 mg/kg/dose	24 hrly IV	24 hrly IV	7-10 days*

	2nd line	Piperacillin-tazobactam# *and*	100 mg/kg/dose	12 hrly IV	8 hrly IV	7-10 days*
		Netilmicin	5-7.5 mg/kg/day If age <1 week: 3 mg/kg q 12 hr	12 hrly IV	12 hrly IV	7-10 days*
for culture positive sepsis, duration will be 14 days ***# start as 1st line if umbilical sepsis or pustule***						
Meningitis	1st line	Cefotaxime and	50 mg/kg/dose	8 hrly IV	6 hrly IV	3 weeks*
		Amikacin	15 mg/kg/dose	24 hrly IV	24 hrly IV	3 weeks*
	2nd line	Meropenem	40 mg/kg/dose	8 hrly IV	8 hrly IV	3 weeks*
		Amikacin	15 mg/kg/dose	24 hrly IV	24 hrly IV	3 weeks*
** for complicated meningitis like ventriculitis and brain abscess duration will be 4-6 weeks*						
Systemic fungal infections#	1st line	Fluconazole	12 mg/kg/day loading dose, followed by 6-12 mg/kg/day maintenance dose	48 - 72 hrly IV	24 hrly IV	28 days
	2nd line	Liposomal Amphotericin B, *or*	3-5 mg/kg/24 hr	24 hrly IV	24 hrly IV	28 days
		Amphotericin B Lipid Complex, *or*	2.5-5 mg/kg/24 hr	24 hrly IV	24 hrly IV	
		Amphotericin B (conventional)*	0.5-1 mg/kg/24 hr	24 - 48 hrly IV	24 - 48 hrly IV	
#Duration of antifungal therapy will be 14 days after documented clearance of candida species (not the prefixed duration) – typically 14-21 days **Once daily dosing: 0.5-1 mg/kg/24hr* *Every-other-day dosing: 1.5 mg/kg/dose every other day*						

PAEDIATRIC INFECTIONS

Central Nervous System

Condition/ Disease	Antibiotic		Dose	Dosing interval	Duration
Acute bacterial meningitis	1st line	Ceftriaxone, or	50 mg/kg/dose	12 hrly IV	10-14 days*
		Cefotaxime, and	75 mg/kg/dose	8-12 hrly IV	10-14 days*
		Vancomycin	15 mg/kg/dose	6 hrly IV	10-14 days*
	2nd line	Meropenem, or	40 mg/kg/dose	8 hrly IV	10-14 days*
		Cefipime, and	50 mg/kg/dose	8 hrly IV	10-14 days*
		Vancomycin	15 mg/kg/dose	6 hrly IV	10-14 days*

In case of suspected rickettsial infection, add	Azithromycin (< 8 yrs)		10 mg/kg/day	24 hrly IV or PO	5 days
	Doxycycline (> 8 yrs)		2.2 mg/kg/dose (max.100 mg)	12 hrly IV or PO	7-10 days
**if organism is specified duration will be as follows* *N. meningitidis 5-7 days* *H. influenzae 7-10 days* *S. pneumoniae 10-14 days* *Gram negative bacillary and pseudomonal meningitis 21-28 days*					
CSF shunt	1st line	Ceftriaxone, or	50 mg/kg/dose	12 hrly IV	2-3 weeks
		Cefotaxime, and	75 mg/kg/dose	8-12 hrly IV	
		Vancomycin	15 mg/kg/dose	6 hrly IV	
	2nd line	Meropenem, or	40 mg/kg/dose	8 hrly IV	2-3 weeks
		Cefipime, and	50 mg/kg/dose	8 hrly IV	
		Vancomycin	15 mg/kg/dose	6 hrly IV	
Brain Abscess	1st line	Ceftriaxone, or	50 mg/kg/dose	12 hrly IV	3-6 weeks*
		Cefotaxime, and	75 mg/kg/dose	8-12 hrly IV	
		Vancomycin, and	15 mg/kg/dose	6 hrly IV	
		Metronidazole	10 mg/kg/dose	8 hrly IV	
	2nd line	Meropenem, or	40 mg/kg/dose	8 hrly IV	
		Cefipime, and	50 mg/kg/dose	8 hrly IV	
		Vancomycin, and	15 mg/kg/dose	6 hrly IV	
		Metronidazole	10 mg/kg/dose	8 hrly IV	
**duration depends on involvement of surgery in brain abscess*					
Post neurosurgery	1st line	Vancomycin, plus	15 mg/kg/dose	6 hrly IV	14 days
		Cefepime, or	150 mg/kg/24 hr	8 hrly IV	
		Ceftazidime	100 mg/kg/dose	8 hrly IV	
	2nd line	Meropenem, and	40 mg/kg/dose	8 hrly IV	
		Vancomycin	15 mg/kg/dose	6 hrly IV	
Head trauma, basilar skull fracture and penetrating trauma	1st line	Vancomycin, plus	15 mg/kg/dose	6 hrly IV	10-14 days
		Cefepime, or	150 mg/kg/24 hr	8 hrly IV	
		Ceftazidime	100 mg/kg/dose	8 hrly IV	
	2nd line	Meropenem, and	40 mg/kg/dose	8 hrly IV	
		Vancomycin, and	15 mg/kg/dose	6 hrly IV	
Acute encephalitis syndrome	1st line	Ceftriaxone, or	50 mg/kg/dose	12 hrly IV	10-14 days
		Cefotaxime, plus	75 mg/kg/dose	8-12 hrly IV	
		Vancomycin, plus	15 mg/kg/dose	6 hrly IV	
		Acyclovir	60 mg/kg/24 hr	8 hrly IV	
	2nd line	Meropenem, and	40 mg/kg/dose	8 hrly IV	10-14 days
		Vancomycin	15 mg/kg/dose	6 hrly IV	
		Acyclovir	60 mg/kg/24 hr	8 hrly IV	

Respiratory Tract Infection

	Age	Antibiotic		Dose	Dosing interval	Duration
Community acquired pneumonia	< 3months	1st line	Ceftriaxone or	75-100 mg/kg/day	12 hrly IV or PO	7-10 days and afebrile for 72 hours before stopping antibiotics
			Cefotaxime ±	150 mg/kg/day	8 hrly IV	
			Gentamicin or	5-7 mg/kg/day	24 hrly IV	
			Amikacin	15 mg/kg/day	24 hrly IV	
		2nd line	Piperacillin-tazobactam	100 mg/kg/dose	8 hrly IV	
			Or Cefoperazone sulbactam ±	40-80 mg/kg/day	6-12 hrly IV	
			Gentamicin, or	5-7 mg/kg/day	24 hrly IV	
			Netilmicin	5-7.5 mg/kg/day	8-12 hrly IV	
	3 months to 5 years	1st line	Co-amoxiclav or	100 mg/kg/day	8 hrly IV or PO	
			Ceftriaxone, or	50-100 mg/kg/day	12 hrly IV	
			Cefotaxime	150 mg/kg/day	8 hrly IV	
		2nd line	Piperacillin-tazobactam	100 mg/kg/dose	8 hrly IV	
			Netilmicin	5-7.5 mg/kg/day	8-12 hrly IV	
	> 5 years	1st line	Co-amoxiclav or	80-100 mg/kg/day	8 hrly IV or PO	
			Ceftriaxone, or	50-100 mg/kg/day	12 hrly IV	
			Cefotaxime	150 mg/kg/day	8 hrly IV	
		2nd line	Piperacillin-tazobactam	100 mg/kg/dose	8 hrly IV	
			Netilmicin	5-7.5 mg/kg/day	8-12 hrly IV	
			Azithromycin	10 mg/kg/day for 1st day f/b 5mg/kg/day for 5 days	24 hrly IV or PO	
	If S. aureus is suspected, Ceftriaxone + Cloxacillin (50-100mg/kg/day, QID) or Vancomycin (40-60 mg/kg/day, QID) or Clindamycin (20 mg/kg/day, 6-8 hrly)					

Empyema	1st line	Ceftriaxone	50-100 mg/kg/day	12 hrly IV	2- 4 weeks
		Cloxacillin	50-100 mg/kg/day	6 hrly IV	
	2nd line	Meropenem, and	20-40 mg/kg/dose	8 hrly IV	2- 4 weeks (Duration may be escalated/ modified as per patient's response and culture results)
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	
Cystic Fibrosis (CF)-Pulmonary exacerbation	1st line	Piperacillin-tazobactam	100 mg/kg/dose	8 hrly IV	7-14 days
		Amikacin	15 mg/kg/day	24 hrly IV	
	2nd line	Meropenem, and	20-40 mg/kg/dose	8 hrly IV	7-14 days
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	
Suppurative lung disease	1st line	Piperacillin-tazobactam	100 mg/kg/dose	8 hrly IV	2-4 weeks
		Amikacin	15 mg/kg/day	24 hrly IV	
	2nd line	Piperacillin - tazobactam	100 mg/kg/dose	8 hrly IV	2-4 weeks
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	
Immuno-deficiency condition + LRTI	1st line	Piperacillin-tazobactam	100 mg/kg/dose	8 hrly IV	2-4 weeks
		Amikacin	15 mg/kg/day	24 hrly IV	
	2nd line	Piperacillin - tazobactam	100 mg/kg/dose	8 hrly IV	2-4 weeks
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	

Infections related to kidney and urinary tract

Condition/Disease	Antibiotic		Dose	Dosing interval	Duration
Nephrotic syndrome with peritonitis	1st line	Ceftriaxone, or	50-100 mg/kg/day	12 hrly IV	7-10 days
		Cefotaxime	150 mg/kg/day	8 hrly IV	
	2nd line	Culture sensitivity guided			
Nephrotic syndrome with Cellulitis	1st line	Co-amoxiclav	80-100 mg/kg/day	8 hrly IV	7-10 days
	2nd line	Cloxacillin	50-100 mg/kg/day	6 hrly IV	7-10 days
		Ceftriaxone	100 mg/kg/day	12 hrly IV	
Nephrotic syndrome with	Oral	Co-amoxiclav, or	80-100 mg/kg/day	8 hrly PO	10-14 days
		Cefuroxime	20-30 mg/kg/day	12 hrly PO	

Pneumonia	IV	Ceftriaxone, and	50-100 mg/kg/day	12 hrly IV	7-10 days
		Amikacin	15-20 mg/kg/day	12-24 hrly IV	
UTI (uncomplicated)	-	Oral Co-amoxiclav	30-50 mg/kg/day	12 hrly PO	7-10 days
		or Cefixime	10 mg/kg/day	12 hrly PO	
UTI (complicated)	1st line	Ceftriaxone, or	50-100 mg/kg/day	12 hrly IV	10-14 days
		Cefotaxime	150 mg/kg/day	8 hrly IV	
	2nd line	Culture sensitivity guided	-	-	-
Haemodialysis with suspected catheter related blood stream infection	-	Ceftazidime	100-150 mg/kg/day	8 hrly IV	10-14 days
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	

Infection of bone and joints

Condition/ Disease	Antibiotic		Dose	Dose interval	Duration
Acute Bacterial Osteomyelitis	1st line	Ceftriaxone	50-100 mg/kg/day	12 hrly IV	4 weeks
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	
	2nd line	Culture sensitivity guided	-	-	
Septic Arthritis	1st line	Ceftriaxone	50-100 mg/kg/day	12 hrly IV	2-4 weeks*
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	
	2nd line	Culture sensitivity guided	-	-	
** depends on culture sensitivity - 2 weeks for Streptococci, K. kingae; 3 weeks for S. aureus and gram-negative infections; 4 weeks for concomitant osteomyelitis*					

Infections of skin and soft tissues

Condition	Antibiotic		Dose	Dosing interval	Duration
Cellulitis	Oral	Amoxicillin-Clavulanate	80-100 mg/kg/day	8 hrly PO	7-10 days
	IV	Ceftriaxone, or	50-100 mg/kg/day	12 hrly IV	
		Clindamycin	20-30 mg/kg/day	6-8 hrly IV or PO	

Infection of gastrointestinal system

Condition/ Disease	Antibiotic		Dose	Dosing interval	Duration
Liver abscess	1st line	Ceftriaxone	75-100 mg/kg/day	12 hrly IV	4-6 weeks
		Metronidazole	35-50 mg/kg/day	8 hrly IV	7-10 days

	2nd line	Meropenem	20-40 mg/kg/dose	8 hrly IV	4-6 weeks
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	
Acute Cholangitis	1st line	Piperacillin-tazobactam or	100 mg/kg/dose	8 hrly IV	7-10 days
		Ceftriaxone +	75-100 mg/kg/day	12 hrly IV	
		Metronidazole	35-50 mg/kg/day	8 hrly IV	
	2nd line	Meropenem	20-40 mg/kg/dose	8 hrly IV	7-10 days
		Vancomycin	10-15 mg/kg/dose	6 hrly IV	7-10 days
Infected pancreatic collection	1st line	Piperacillin-tazobactam or	100 mg/kg/dose	8 hrly IV	7-10 days
	2nd line	Meropenem	20-40 mg/kg/dose	8 hrly IV	
Dysentery	1st line	Oral Ciprofloxacin	15 mg/kg/dose	12 hrly PO	3 days
		or Ceftriaxone	50-100 mg/kg/day	12 hrly IV	3 days
	2nd line	Oral Azithromycin	12 mg/kg on day 1 f/b 6 mg/kg for next 3 days	24 hrly PO	3 days
		Or Cefixime	8 mg/kg/day	24 hrly PO	3 days
		Or Metronidazole	10 mg/kg/dose	8 hrly IV	5 days
Acute watery diarrhea (AWD) **Indications for starting antibiotics in AWD:* *a) Infants <3 months* *b) Children with underlying chronic conditions/ immune-deficiency* *c) Children with SAM Invasive bacterial infection* *d)Infections with Shigella, ETEC, Vibrio cholerae, Yersinia enterocolitica*	1st line	Cefixime, or	8-10 mg/kg/day	12 hrly PO	2-5 days
		Ciprofloxacin, or	20-30 mg/kg/day	12 hrly PO	
		Ceftriaxone	50-75 mg/kg/day	12 hrly IV	
	2nd line	Azithromycin	10 mg/kg/day	24 hrly PO	2-5 days
		Ciprofloxacin	20-30 mg/kg/day	12 hrly PO	
	If cholera is suspected/ confirmed by culture	Doxycycline (>2 years), or	2-4 mg/kg	PO single dose	Single dose
		Azithromycin, or	10 mg/kg	PO single dose	Single dose
		Ciprofloxacin	20 mg/kg	PO single dose	Single dose
Enteric fever (uncomplicated/ OPD basis)	1st line	Cefixime	20 mg/kg/day (max. dose of 1200)	12 hrly PO	14 days or at least 7 days after

	2nd line	Azithromycin*	10-20 mg/kg/day (max. dose 1 gm)	24 hrly PO	fever defervescence or, whichever is later *A total 7 days for azithromycin
Enteric fever (complicated/ IPDpatient)	1st line	Ceftriaxone, or	100 mg/kg/day (max 4g)	12 hrly IV	14 days or at least 7 days after fever defervescence or, whichever is later Shift to oral antibiotics once fever resolves
		Cefotaxime	150-200 mg/kg/day	12 hrly IV	
	2nd line	Ofloxacin	10-15 mg/kg/day	12 hrly IV or PO	
		Chloramphenicol	50-75 mg/kg/day PO;100mg/kg/day IV	6-8 hrly IV	
		Co-trimoxazole (TMP-SMX)	8-10 mg/kg/day of TMP	12 hrly IV or PO	
Scrub typhus	1st line	Doxycycline, or	2.2 mg/kg/dose or 100mg if > 40kg (max. 200mg)	12 hrly PO or IV	7 days or 3 days after fever subsides *10 days in severe cases
		Azithromycin	10 mg/kg/day	24 hrly PO or IV	
	2nd line	Clarithromycin, or	10-15 mg/kg/day	12 hrly PO or IV	
		Chloramphenicol	50-75 mg/kg/day for oral 100 mg/kg/day for IV	6 hrly PO orIV	

Infection in immunocompromised children

Condition/ Disease	Antibiotics		Dose	Dosing interval and route	Duration of antibiotics and remarks
Febrile Neutropenia (No focus)	1st line	Piperacillin-tazobactam	100 mg/kg/dose	8 hourly IV	Till patient is afebrile for atleast ≥ 24 - 48 hours, with evidence of count recovery ***Indications for starting Vancomycin:*** -Clinically unstable patients (hypotension and shock)
		Amikacin	15-22.5 mg/kg/24 hr	8 hourly IV	
	2nd line	Vancomycin	15-20 mg/kg/dose	8 hourly IV	
		Meropenem	20 mg/kg/dose (max1g/dose)	8 hourly IV	

					-Skin and soft-tissue infections -Clinically suspected central-line infection -In centers with high prevalence MRSA -Hospital-acquired pneumonia
Febrile neutropenia with pneumonia	1st line	Amoxicillin-clavulanic acid	50-100 mg/kg/day (amoxycillin base)	6-8 hourly IV	Till patient is afebrile for at least ≥ 24-48 hours, with evidence of count recovery and resolution of focus. ***Indications for changing/upgrading antibiotics:*** -Development of hemodynamic instability -Development of fresh focus of infection -Increase in inflammatory markers (CRP and procalcitonin) -Blood-culture showing growth of a bacteria resistant to first-line antibiotics
		Amikacin	15-22.5 mg/kg/24 hr	8 hourly IV	
	2nd line	Piperacillin-tazobactam	100 mg/kg/dose	8 hourly IV	
		Amikacin	15-22.5 mg/kg/24 hr	8 hourly IV	
	3rd line	Vancomycin	15-20 mg/kg/dose	8 hourly IV	
		Meropenem	20 mg/kg/dose (max.1g/dose)	8 hourly IV	
Febrile neutropenia with GIT involvement	1st line	Piperacillin-tazobactam	100 mg/kg/dose	8 hourly IV	Till patient is afebrile for at least ≥ 24 - 48 hours, with evidence of count recovery and resolution of focus. ***Indications for changing/upgrading antibiotics:*** -Development of hemodynamic instability -Development of fresh focus of infection
		Metronidazole	30-40 mg/kg/24 hr	8 hourly IV	
	2nd line	Vancomycin	15-20 mg/kg/dose	8 hourly IV	
		Meropenem	20 mg/kg/dose (max.1g/dose)	8 hourly IV	

					-Increase in inflammatory markers (CRP and procalcitonin) -Blood-culture showing growth of a bacteria resistant to first-line antibiotics
Febrile neutropenia with shock	1st line	Cefipime	150 mg/kg/day	8 hourly IV	Till patient is afebrile for atleast ≥ 24-48 hours, with evidence of count recovery and resolution of focus. ***Indications for changing/ upgrading antibiotics:*** -Development of hemodynamic instability -Development of fresh focus of infection -Increase in inflammatory markers (CRP and procalcitonin) -Blood-culture showing growth of a bacteria resistant to first-line antibiotics
		Vancomycin	15-20 mg/kg/dose	8 hourly IV	
	2nd line	Meropenem	20 mg/kg/dose (max.1g/dose)	8 hourly IV	
		Vancomycin	15-20 mg/kg/dose	8 hourly IV	
Febrile neutropenia with meningitis	1st line	Ceftriaxone	100 mg/kg/24 hr (max. dose 4g/24 hr)	12 hourly IV	21-28 days (Duration to be decided as per culture sensitivity for culture-positive cases)
		Vancomycin	60 mg/kg/24 hr	6 hourly IV	
	2nd line	Meropenem	40 mg/kg/dose	8 hourly IV	
		Vancomycin	60 mg/kg/24 hr	6 hourly IV	
Febrile neutropenia with features of invasive fungal disease (IFD)	1st line	Liposomal amphotericin-B	3-5 mg/kg/24 hr	24 hourly IV	Till neutropenia is resolved or at least 14 days with invasive fungal infections
		Amphotericin-B Lipid-complex (if liposomal	2.5-5 mg/kg/24 hr	24 hourly IV	

		amphotericin-B is not available)			*Note:* Empirical antifungal therapy should be started in case of febrile neutropenia with persistent fever beyond 96 hours of appropriate antibiotics.
	2nd line	Amphotericin-B	1-1.5 mg/kg/ day	24 hourly	
PCP Pneumonia *(Pneumocystis jirovecii)*	1st line	Trimethoprim-sulfamethoxazol (TMP-SMX)	TMP 15-20 mg/kg/day SMX 75-100 mg/kg/day	6-8 hourly (start IV in severe cases, shift to oral when patient shows clinical improvement)	21 days

Infection in Pediatric Intensive Care Unit (PICU)

Sepsis without focus (community acquired)	1st line	Ceftriaxone	75-100 mg/kg/day	12 hourly	7-14 days (Duration of antimicrobials changed/escalated /de-escalated as per site, etiology, treatment response and control of source *(Add Vancomycin 10-15 mg/kg/dose q6H if MRSA suspected)*
		Amikacin	15-22.5 mg/kg/24 hr	8 hourly IV	
	2nd line	Piperacillin-tazobactam	300-400 mg/kg/day	8 hourly IV	
		Netilmicin sulfate	Children: 5-7.5 mg/kg/day Infants: 7.5-10 mg/kg/day	8-12 hourly IV	
	3rd line	Meropenem	60 mg/kg/day	8 hourly IV	
		Vancomycin	10-15 mg/kg/dose	6-8 hourly IV	
Nosocomial sepsis (without focus)	1st line	Piperacillin-tazobactam	80-100 mg/kg/dose	8 hourly IV	7-14 days
		Amikacin	15-20 mg/kg/day	12-24 hourly IV	
	2nd line	Meropenem	20 mg/kg/dose	8 hourly IV	7-14 days
		Vancomycin	10-15 mg/kg/dose	6-8 hourly IV	
	3rd line	Colistin	2.5-5 mg/kg/day of Colistin base *1 mg Colistin base = 2.4 mg or 30,000 IU colistimethate sodium	6-12 hourly IV	7-14 days **Colistin should never be used alone as it is a bacteriostatic drug. Use in combination (e.g.beta-lactam)*
		Vancomycin, *or*	10-15 mg/kg/dose	6-8 hourly IV	

		Linezolid	10 mg/kg/dose (max. 600 mg)	12 hourly IV	
Septic shock	1st line	Ceftriaxone	75-100 mg/kg/day	12 hourly	7-14 days
		Vancomycin	10-15 mg/kg/dose	6-8 hourly IV	
	2nd line	Meropenem	20 mg/kg/dose	8 hourly IV	7-14 days
		Vancomycin	10-15 mg/kg/dose	6-8 hourly IV	
Ventilator associated pneumonia (VAP)	1st line	Piperacillin-tazobactam	80-100 mg/kg/dose	8 hourly IV	7-14 days
		Amikacin	15-20 mg/kg/day	12-24 hourly IV	
	2nd line	Meropenem	20 mg/kg/dose	8 hourly IV	7-14 days
		Vancomycin	10-15 mg/kg/dose	6-8 hourly IV	
	3rd line	Colistin	2.5-5 mg/kg/day of Colistin base *1 mg Colistin base = 2.4 mg or 30,000 IU colistimethate sodium	6-12 hourly IV	7-14 days **Colistin should never be used alone as it is a bacteriostatic drug. Use in combination (e.g. beta lactam)*
		Vancomycin	10-15 mg/kg/dose	6-8 hourly IV	
Meningococcal sepsis	1st line	Ceftriaxone, *or*	100 mg/kg/day	12 hourly IV	
		Cefotaxime	100-150 mg/kg/day (Use 200 mg/kg/day for meningitis)	6-8 hourly IV	7-14 days
	2nd line	Meropenem	40 mg/kg/dose	8 hourly IV	7-14 days
		Vancomycin	60 mg/kg/24 hr	6 hourly IV	
Central-line associated blood stream infection (CLABSI)	1st line	Cefoperazone -sulbactam, *plus*	40-80 mg/kg/day	6-12 hourly	*Uncomplicated bacteremia:* 10-14 days from the day culture was negative. *Persistent bacteremia:* 4-6 weeks
		Gentamicin, *plus*	5-7.5 mg/kg/day	12-24 hourly	
		Vancomycin, or	10-15 mg/kg/dose	6-8 hourly IV	
		Teicoplanin	10 mg/kg/dose q 12 hr for 3 doses, then 10 mg/kg/day q 24 hr	10 mg/kg/dose q 12 hr for 3 doses, then 10mg/kg/day q 24 hr	
	2nd line	Meropenem, *plus*	20 mg/kg/dose	8 hourly IV	*Uncomplicated bacteremia:* 10-14 days from the
		Vancomycin,	10-15 mg/kg/dose	6-8 hourly	

		or		IV	day culture was negative. *Persistent bacteremia:* 4-6 weeks
		Teicoplanin	10 mg/kg/dose q 12 hr for 3 doses, then 10 mg/kg/day q 24hr	10mg/kg/ dose q 12 hr for 3 doses, then 10 mg/kg/day q 24 hr	
	3rd line	Colistin	2.5-5 mg/kg/day of Colistin base *1 mg Colistin base = 2.4 mg or 30,000 IU colistimethate sodium	6-12 hourly IV	*Uncomplicated bacteremia:* 10-14 days from the day culturewas negative. *Persistent bacteremia:* 4-6 weeks
		Vancomycin	10-15 mg/kg/dose	6-8 hourly IV	

REFERENCES

1) Kliegman R, Stanton B, St. Geme J, Schor N, Behrman R, Nelson W. (eds.) *Nelson Textbook of Pediatrics.* 21st ed. Philadelphia:Elsevier;2019.
2) Hansen A, Eichenwald E, Stark A. (eds.) *Cloherty and Stark's Manual of Neonatal Care.* 9th ed. Philadelphia: Wolters Kluwer Medical;2021.
3) Gleason C, Juul S. (eds.) *Avery's Diseases of the Newborn.* 11th ed. Philadelphia: Elsevier;2023
4) Cherry J, Demmler-Harrison G, Kaplan S, Steinbach W. (eds.) *Feign and Cherry's Textbook of Pediatric Infectious Diseases.* 8th ed. Elsevier;2021.
5) Srivastava R, Bagga A. (eds.) *Pediatric Nephrology*. 6th ed. Jaypee Brothers Medical Publishers; 2021.
6) Anderson CC, Kapoor S, Mark TE. (eds.) *The Harriet Lane Handbook.* 23rded. Elsevier;2023.
7) Kumar R, Ratageri V, Gupta P (Eds.). *IAP Standard Treatment Guidelines 2022.* 1st ed. Jaypee Brothers Medical Publishers.2023.
8) Singh M, Deorari AK. *Drug dosages in Children.* 10th ed. CBS Publishers & Distributors Pvt. Ltd. 2020.
9) National Neonatology Forum (NNF), India. Clinical Practice Guidelines- Diagnosis and Management of Neonatal Sepsis (2021). Available from: https://www.nnfi.org/assests/upload/useful-links-pdf/Diagnosis_and_Management_of_Neonatal_Sepsis_NNFI_CPG_Dec 2021.pdf. [Accessed on 24th January, 2024].

8. ANTIBIOTIC STEWARDSHIP IN INTENSIVE CARE UNIT SETTINGS

Introduction: Over the years, antibiotics have been used in a large and steady way around the world. There is a risk of adverse events, as well as an antibiotic resistance. Resistance to antibiotic is an emerging public health threat around the globe and will probably be one of the leading causes of death in coming years. In intensive care unit (ICU), infection with resistant bacteria is a risk factor for increase mortality. One of the most effective ways to fight against resistance is to decrease antibiotic consumption. Intensive care units are place where antibiotics are widely prescribed and where multidrug resistance are frequently encountered. In this context antimicrobial stewardship program (ASP) should be the forefront efforts to control antibiotic consumption in ICU.

Antimicrobial stewardship may be defined as "a coherent set of actions which promote using antimicrobials in ways that ensure sustainable access to effective therapy for all who need them".

It should be viewed as a strategy to optimize antimicrobial prescribing, its main goals being to improve patient outcomes, prevent adverse events, and reduce antimicrobial resistance.

ICU physicians have the opportunities to decrease antibiotic consumption and to apply antimicrobial stewardship programs. The main measures that may be implemented include refraining from immediate prescription of antibiotics when infection is suspected (except in patients with shock, where immediate administration of antibiotics is essentials); limiting empiric broad-spectrum antibiotics (including anti-MRSA antibiotics) in patient without risk factor for multidrug resistance pathogens; switching to monotherapy instead of combination therapy and narrowing spectrum when culture and susceptibility test result are available; limiting the use of carbapenems to extended spectrum beta-lactamase producing Enterobacteriaceae, and new beta-lactams to difficult to treat pathogens (when these new beta-lactams are the only available option); and shortening the duration of antimicrobial treatment, the use of pro-calcitonin being a tool to attain the goal.

Antimicrobial stewardship programmes should combine these measures rather than applying a single one. ICU and ICU physicians should be at the frontline for developing antibiotic stewardship programs.

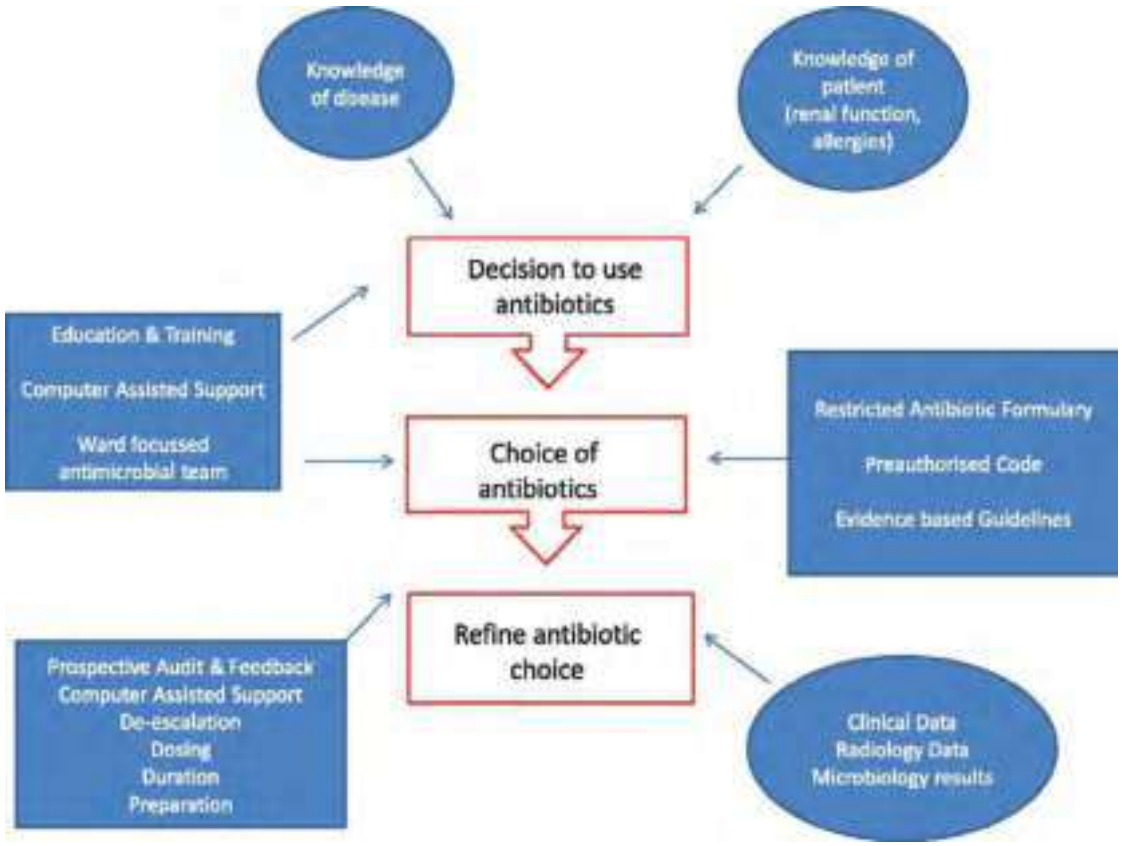


Fig. 1

STRATEGIES OF ANTIBIOTIC STEWARDSHIP

a. Prospective audit and feedback - A ward-focused antimicrobial round is recommended where Microbiologists and Pharmacists review antibiotic prescriptions with the prescribing critical care team. Prescriptions can then be scrutinized in the light of emerging microbiological results and the patient's changing clinical condition, recommending changes according to microbe coverage, tissue penetration and duration. Deviations from local guidelines or the clinical failure to achieve adequate source control can also be addressed early.

Provide feedback to healthcare providers to promote accountability and adherence to stewardship practices.

b. Formulary restriction - Formulary restriction or the requirement of a numerical prescribing code is the most effective method of curtailing widespread use of specific antibiotics. Antibiotics may also be restricted by clinical area, specialty or seniority and commonly involve antibiotics with broad spectrum activity, those associated with rapid emergence of resistance or those with a risk of toxicity. But the clear disadvantage of this intervention is the perceived loss of prescriber autonomy and potential delay in drug administration whilst approval is sought.

c. Evidence-based guidelines - Multidisciplinary development of evidence based guidelines incorporating local microbiology and resistance patterns can improve antimicrobial utilization. They should include diagnosis and treatment of common infections and surgical prophylaxis regimes. Guidelines should recommend empirical antibiotic dosing, route, duration and de-escalation regimes, monitoring advice, and contingency plans for treatment failure. The implementation of guidelines in critical care has been shown to reduce hospital length of stay, duration of mechanical ventilation, and the duration of antibiotic treatment.

These guidelines should consider local antimicrobial resistance patterns.

d. Antibiotic optimization - Prolonged courses of broad spectrum antibiotics are known to contribute to antibiotic resistance and de-escalation (or stopping antibiotics if infection is less likely) should be considered at 48 to 72 hr or as soon as culture sensitivities are available. An alternative approach to using a broad-spectrum agent is to use a combination of narrower-spectrum agents exploiting antibiotic synergy, however the sensitivity of the organism is required for this approach and it may subject the patient to poly-pharmacy and toxic side effects without any reduction in antimicrobial resistance.

Chastre *et al*. compared 8 *vs* 15 days of therapy for ventilator associated pneumonia in a randomized, multicentre trial. They demonstrated that a shorter duration of antibiotic treatment reduced the emergence of multi-resistant pathogens without adversely impacting on mortality, critical care length of stay, or mechanical ventilator-free days.

Most critical care units now use white cell count and biochemical markers as well as an improving clinical picture to customize treatment duration and support shorter antibiotic courses.

The conversion from parenteral to enteral antibiotic therapy should occur once clinically indicated and when reliable enteral absorption is assumed. We should consider antibiotic streamlining, switching from intravenous to oral therapy when appropriate, to facilitate earlier discharge from the critical care setting.

e. Dose optimization - It is well known that sub-therapeutic antibiotic concentrations can result in antibiotic resistance and treatment failure. Antibiotics can be challenging to dose in the context of critical illness where volume of distribution and drug clearance vary markedly on a day to day basis. So dosing of drugs in critical care should be in guidance to ensure maximal efficacy whilst minimizing side effects.

The MIC is the concentration of an antimicrobial required to completely inhibit microbe growth. Some antibiotics are consistently bactericidal when their concentration is above the MIC whilst others depend upon the peak concentration achieved at the infection site (concentration-dependent).

With *time-dependent killing*, the rate and extent of microbe killing remain unchanged regardless of how high antimicrobial concentration is, providing it is above the MIC. The pharmacodynamic parameter predictive of outcome is the time the concentration is above the

MIC (T > MIC). To maximize time-dependent activity, these antibiotics need to be administered regularly so that the antibiotic concentration is above the MIC for as long as possible (e.g. beta lactams). The use of extended antibiotic infusions has been shown to reduce treatment failure and critical care length of stay but has not been shown to impact on mortality.

With *concentration-dependent killing*, the rate and extent of microorganism killing are dependent on the antimicrobial concentration. The pharmacodynamic parameter predictive of outcome for concentration dependent drugs is the peak concentration (Cmax/MIC). These antibiotics are given at high doses at less frequent intervals (e.g. aminoglycosides).

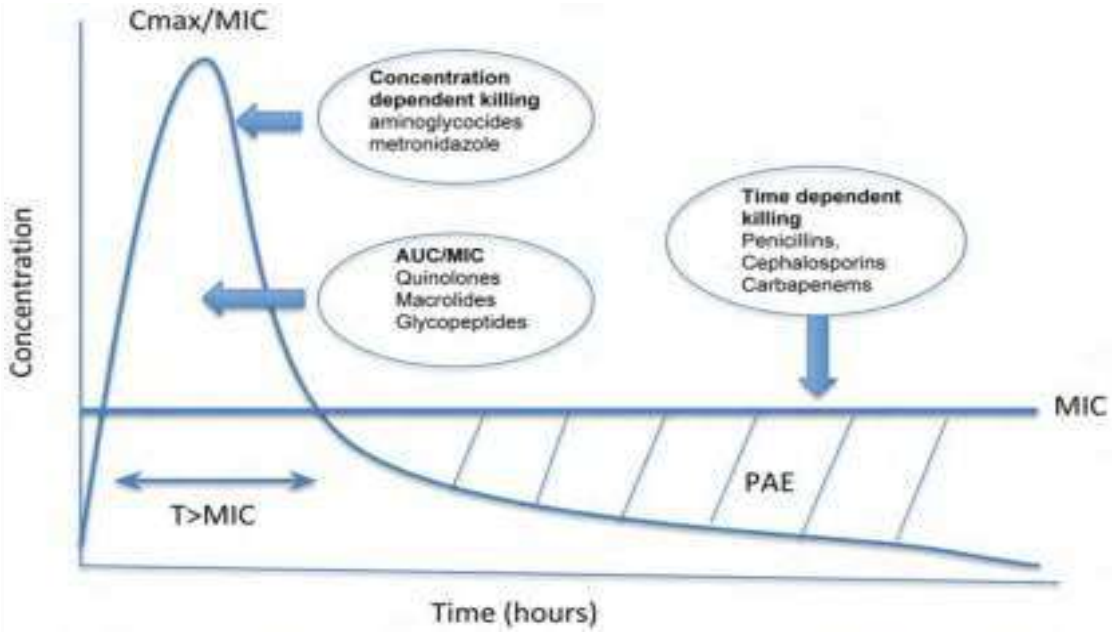


Fig. 2

- Pharmacokinetic and pharmacodynamic parameters of antibiotics on a concentration vs time curve.
- Concentration dependent killing extent of microorganism killing is dependent on the antimicrobial concentration.
- Time dependant killing—extent of microbe killing remains unchanged providing it is above the MIC. AUC/MIC—exhibit both concentration and time dependent killing. AUC, area under curve; MIC, minimum inhibitory concentration; Cmax, maximum serum antibiotic concentration; PAE, post antibiotic effect.

f. Education and training - Education is the cornerstone of antibiotic stewardship with mandatory core training in antibiotic use for nurses, doctors, and pharmacists.

g. Information technology and computer assisted support - Health care information technology (IT) in the form of electronic medical records, electronic prescribing, and clinical

decision support systems can enhance decision-making and patient safety. These systems can be designed to trigger ‘drug-bug’ mismatch alerts, liver and renal impairment dosing alterations, drug interaction, and allergy warnings. Although setting up IT systems can be costly, it has been shown to improve antibiotic prescribing and reduce overall health care costs.

h. Microbiology laboratories - The clinical microbiology laboratory plays a crucial role in antibiotic stewardship. Specific antibiograms identify local microbe resistance and sensitivity patterns and are used to develop antibiotic guidelines and ‘police' antibiotic formularies. Blood cultures are still considered the gold standard to diagnose blood stream infections as but this process can incur significant delays and incomplete results are common. More recently, attention has been focused on the use of fully automated mass spectrometry and real-time polymerase chain reaction (PCR), Matrix Assisted Laser Desorption Ionization Time-of-Flight (MALDI-TOF) etc. Although these techniques involve significant investment in both equipment and training, they have been shown, in combination with an Antibiotic Stewardship Program, to reduce organism identification time, mortality, critical care length of stay, and bacteraemia recurrence.

i. Leadership and teamwork - Multidisciplinary team involvement is a must for effective antibiotic stewardship. The hospital administration should holds programs and appoint responsible leader from senior faculties to ensure all staff nurses and doctors are engaged and a coordinated well throughout the hospital.

Future advances in antibiotic stewardship

As pathogens are isolated from only a minority of microbiological samples and often after a significant delay, the development of a biomarker that could accurately identify infection would greatly enhance effective antibiotic stewardship. So far more than 150 biomarkers have been tested as potential diagnostic and prognostic markers including pro-calcitonin (PCT).

Conclusion

Appropriate antimicrobial stewardship in ICU incorporates the rapid identification and treatment of infection based on pharmacokinetics/pharmacodynamic properties, avoiding the use needlessly broad spectrum antibiotics agents, shortening the duration of administration and minimizing the number of patients receiving unnecessary antibiotics. Alongside the appropriate use of antibiotics the survival sepsis campaign emphasise the importance of rapid source control.

A diagnosis of infection amendable to rapid source control should be managed at the earliest opportunity and within critical care, they not only includes identifications of anatomical collections/infection but also removal of implantable devices, intravascular and urinary catheters. Appropriate prescribing of antibiotic therapy in critical care would undoubtedly contribute towards reducing antimicrobial resistance patterns, however the

complexity of presentation and severity of illness in many patients makes rationalizing antibiotic therapy extremely challenging. The use of a formal Antibiotic Stewardship Program within critical care could therefore aid these difficult decisions.

Antibiotic Stewardship in critical care is an ongoing process that requires a commitment from healthcare providers to balance the need for effective treatment with the imperative to minimize the emergence of antibiotic resistance. Regular evaluation and adjustment of stewardship programs contribute to improved patient care and long-term sustainability of antibiotic effectiveness.

Antibiotic Stewardship Programs provide a practical and manageable approach to the use of antibiotics within our health care system aiming to reduce antibiotic resistance and prolong their ability to continue fighting infection. The potential benefits to future health care are significant and ultimate success of a stewardship program depends on interdisciplinary team working, education, and feedback.

REFERENCES

1. Santé Publique France. Surveillance de la consommation des antibiotiques et des résistances bactériennes en établissement de santé. Mission SPARES, résultats 2019. 2021;81.
2. Vincent J-L, Sakr Y, Singer M, Martin-Loeches I, Machado FR, Marshall JC, et al. Prevalence and outcomes of infection among patients in intensive care units in 2017. JAMA. 2020;323:1478–87.
3. Vincent J-L, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, et al. International study of the prevalence and outcomes of infection in intensive care units. JAMA. 2009; 302: 2323–9.
4. Brown K, Valenta K, Fisman D, Simor A, Daneman N. Hospital ward antibiotic prescribing and the risks of Clostridium difficile infection. JAMA Intern Med. 2015; 175: 626–33.
5. Jensen J-US, Hein L, Lundgren B, Bestle MH, Mohr T, Andersen MH, et al. Invasive Candida infections and the harm from antibacterial drugs in critically ill patients: data from a randomized, controlled trial to determine the role of ciprofloxacin, piperacillin-tazobactam, meropenem, and cefuroxime. Crit Care Med. 2015; 43:594–602.
6. Holmes AH, Moore LSP, Sundsfjord A, Steinbakk M, Regmi S, Karkey A, et al. Understanding the mechanisms and drivers of antimicrobial resistance. Lancet. 2016; 387:176–87.
7. European Centre for Disease Prevention and Control, World Health Organization. Antimicrobial resistance surveillance in Europe: 2022 : 2020 data. LU: Publications Office; 2022. Disponible sur:https://data.europa.eu/doi/https://doi.org/10.2900/112339. Accessed 17 Nov 2022.
8. Dyar OJ, Huttner B, Schouten J, Pulcini C, ESGAP (ESCMID Study Group for Antimicrobial stewardshiP). What is antimicrobial stewardship? Clin Microbiol Infect. 2017; 23:793–8.
9. Kaki R, Elligsen M, Walker S, Simor A, Palmay L, Daneman N. Impact of antimicrobial stewardship in critical care: a systematic review**.** *J. Antimicrob Chemother.* 2011; 66: 1223-1230.
10. Chastre J, Wolff M, Fagon J-Y et al. Comparison of 8 vs 15 days of antibiotic therapy or ventilator-associated pneumonia in adults: a randomized trial. *JAMA.* 2003; 290: 2588-2598.
11. Chant C, Leung A, Friedrich JO. Optimal dosing of antibiotics in critically ill patients by using continuous/extended infusions: a systematic review and meta-analysis. *Crit Care.* 2013; 17: R279
12. Nachtigall I, Tafelski S, Deja M, et al. Long-term effect of computer-assisted decision support for antibiotic treatment in critically ill patients: a prospective 'before/after' cohort study**.** *BMJ Open.* 2014; 4: e005370.
13. Huang AM, Newton D, Kunapuli A, et al. Impact of rapid organism identification via matrix-assisted laser desorption/ionization time-of-flight combined with antimicrobial stewardship team intervention in adult patients with bacteremia and candidemia**.** *Clin Infect Dis.* 2013; 57: 1237-1245.

9. ANTIMICROBIAL STEWARDSHIP: GYNAECOLOGICAL PERSPECTIVES

Introduction: Obstetrics and Gynaecology is one of the most busy or overloaded department in our institute. Presently, the volume has been reduced unlike the earlier decade with the coming up of newer medical colleges and many private hospitals and nursing homes. Still the high risk and the poor came here for their treatment and delivery. Among the surgical branches of Regional Institute of Medical Sciences (RIMS), the operations in Obstetrics and Gynaecology constitute a major bulk. So, there lies the importance of giving emphasis in this field. The common procedures or surgeries that are perform in the department are Dilatation and Curettage, Dilatation and evacuation, Suction evacuation, MTPs (Medical Termination of Pregnancies), Vaginal deliveries, Cesarean sections, Laparotomies, Hysterectomies (abdominal vaginal and laparoscopic) and other laparoscopic surgeries. While coming to the usage of antibiotics in the department it varies from unit to unit and surgeon to surgeon. Minor procedures (Dilatation and curettage or Dilatation and evacuation, Suction evacuation): one dose injectable antibiotic (ceftriaxone/ceftriaxone + salbactum) to 5 days oral antibiotics.

The usual antibiotics are vaginal delivery: one dose of injectable (ceftriaxone/ceftriaxone + salbactum) followed by five days oral antibiotic though oral antibiotic differs from unit to unit and surgeon to surgeon. Cesarean section: (ceftriaxone/ceftriaxone + salbactum) and Tinidazole for two to four days depending upon the surgeon, followed by five days of oral antibiotic. In hysterectomies and laparotomies: (ceftriaxone/ceftriaxone + salbactum), inj. Tinidazole for three to five days. All these regimes are administered for clean cases without any complications. In case of complications, Amikacin is added or changed to Piperacillin + Tazobactum, or sometimes to Meropenem. In this era of AMS, we need to follow a particular protocol which applies to the whole of the department, from starting to changing of antibiotics along with the duration of antibiotic. We have already known the common pathogens found in the genital tract and also the organisms responsible for HAI and causing wound infection. Our institute have our own antibiogram. Now is the time for us to follow standard guidelines and also what we have seen and learned from the past experiences. We may put up certain questions?

1. Can down grading of antibiotic be done?
2. Can duration of antibiotic be reduced: both injectable and oral?
3. Can oral antibiotic be omitted at the time of discharge?
4. Starting of the first line of antibiotic need to be as per a new protocol.
5. Duration of injectable should be similar in all the units.
6. Protocol of changing antibiotic in case of fever or sepsis has to be streamlined.

With the review from standard studies, we can have a new protocol for the department which should be locally feasible and acceptable. Certain observations which we need correction in our department are: the timing of intravenous antibiotic before caesarean or any gynaecological surgery should be administered within 30 to 60 minutes of skin incision. The

timing of catheterization has always been a problem. It has been observed that most of the cases are catheterized before anaesthesia while waiting in the pre anaesthetic check up room (PAC), which causes discomfort and burning sensation to the patients. The residents working here need to be trained periodically till they follow a particular protocol which is uniform for the whole department. Catheter is to be inserted when analgesia is established and is then left in situ for 12 to 24 hours until patient is able to mobilize.

The goals of antibiotic prophylaxis during obstetric/gynaecological surgery are similar to those for intra-abdominal surgery. The overall aim is to prevent postoperative infection of the surgical site and reduce postoperative infectious morbidity and mortality, and thereby reduce the duration and the cost of postoperative health care.[1] To achieve this goal, the antibiotic regimen must satisfy several conditions. First, the agent needs to be administered at the correct dose and at a time that ensures adequate concentrations at the incision site during the period of potential contamination. Second, the agent needs to be active against the pathogens most likely to contaminate the wound and the pelvis. Third, it also needs to be safe. In this regard, the antibiotic should be administered for the shortest effective period to minimize adverse effects and cost of treatment as well as the development of bacterial resistance.

The organisms responsible for obstetric/gynaecological infections fall into two broad categories, sexually transmissible organisms and members of the endogenous vaginal flora. The normal ratio of anaerobes to aerobes is between 2:1 and 5:1. However, when the ecosystem becomes unbalanced, as in the case of bacterial vaginosis (BV), there is a marked reduction in the concentration of lactobacilli and an increase in the concentration of anaerobes. 15-20 % of pregnant women has bacterial vaginosis.[2,3]

The obstetric/gynaecological procedures at highest risk of postoperative infection include vaginal hysterectomy and abdominal hysterectomy, radical hysterectomy, caesarean section, as well as so-called minor procedures like elective abortions, IUCD (Intrauterine contraceptive device) insertion, HSG (Hysterosalpingogram) etc. In case of hysterectomy, the vaginal procedure carries a higher risk of postoperative infection (vaginal cuff infection, pelvic cellulitis, pelvic abscess or wound infection) than the abdominal procedure (14-57 % versus 15-24 % respectively).[4]

Surgical site infections (SSIs) are a common adverse event in hospitalised patients.[5] 8-10 % of gynaecological surgery patients undergoing an operative procedure will develop an SSI. Rates of infection vary according to the premorbid condition of the patient, as well as surgical and anaesthetic factors.[6] Women who undergo caesarean section have a 5 to 20 fold greater risk of infectious complications.[7] For most infections that occur after obstetric or gynaecological surgery, the source of pathogens is the endogenous flora of the woman's vagina or skin. The endogenous flora of the genital tract is polymicrobial, consisting of anaerobes, gram-negative aerobes and gram positive cocci (such as Staphylococci and Streptococci). In contrast, laparoscopic procedures that do not breach any mucosal surfaces

are more commonly contaminated with skin organisms only (usually gram positive organisms such as Staphylococci). It should be noted that prophylactic antibiotics do not need to cover every possible pathogen that may cause infection. Decreasing the number of organisms present (the bacterial load) will usually enable the patient's immunological defences to function adequately. Other factors to consider when choosing an appropriate antibiotic for prophylaxis include low toxicity, an established safety record and the ability to reach an effective concentration in the relevant tissue prior to the procedure.[5] Appropriate and timely antibiotic prophylaxis has been shown to be highly effective in reducing the incidence of SSI.[8] Antibiotics need to be present in the tissue at the time of incision to be effective.[9]

In general, antimicrobial prophylaxis after wound closure is unnecessary as it does not provide additional benefit.[10,11] It is rare in obstetric or gynaecological practice to require additional doses of antibiotics beyond the initial dose administered at induction of anaesthesia. Most studies comparing single with multiple dose strategies do not show a benefit.[10,12] Accordingly, study favour the intravenous administration, 30 minutes before the induction of anaesthesia, of a single dose of one of four agents- cefazolin, cefoxitin, cefotetan (in cases of appendectomy) or clindamycin (in case of beta-lactam allergy). A second dose is administered if the procedure lasts more than 3 hours or if there is excessive blood loss (more than 1500 mL).[4]

Studies have shown that single-dose antibiotic prophylaxis is as effective as multiple doses of antibiotic.[12,13] Recent evidence suggests that antibiotics administered prior to skin incision may further reduce the risk of postoperative infection.[14] The currently available evidence suggests that all women undergoing caesarean section should receive antibiotic prophylaxis. A single dose administered in the 30 min prior to skin incision for emergency caesarean sections is appropriate. In general, doses only need to be repeated if the operation lasts longer than the half life of the antimicrobial agent.

One study has shown that a single 200 mg oral dose of doxycycline can reduce minor complications such as pain, discharge and bleeding, but there is no evidence that it can reduce the incidence of serious complications such as pelvic inflammatory disease or postabortal endometritis.[15]

Development of antimicrobial resistance (AMR) in myriad groups of bacteria, fungi, viruses and parasites is a complex global health challenge, largely driven by man in human health care, animal farming, veterinary medicine, agriculture, pisciculture *etc*.[16] Our responsibility in human health care becomes paramount as development and the discovery of newer antimicrobial agents (AMA) and newer classes of AMA is rapidly drying up, even though the use/abuse is increasing all over.[17,18] One of the best methods to prolong the shelf-life of existing and newer future AMA is antimicrobial stewardship programme (AMSP).[19,20]

During the early years of the antibiotic era, there was little concern for antimicrobial stewardship. Today, antimicrobials are frequently over utilized as a result of the relatively low incidence of toxicity and the perception of benefit gained with minimal risk. This

overuse has led to multidrug-resistant organisms and extremely drug-resistant organisms. Unfortunately, the discovery of new agents has not kept pace with rapidly emerging antimicrobial-resistant bacterial threats.[21] Antimicrobial stewardship programs are important components of these plans to preserve antimicrobial utility for current and future patients. Antimicrobial stewardship is commonly described as a program that supports selection, dosing, route of administration and duration of antimicrobial therapy.[22] However, with the widespread identification of infections with multidrug-resistant organisms and the dearth of new antimicrobials in the pipeline, antimicrobial stewardship has moved beyond cost and toward a critical mission of preservation of antimicrobial utility.

REFERENCES

1. B, G., E, P. & F, M. Antimicrobial prophylaxis in obstetric and gynecological surgery. J. Chemother. Florence Italy 11, (1999).
2. Sobel, J. D. Bacterial vaginosis. Annu. Rev. Med. 51, 349-356 (2000).
3. Eschenbach, D. A. Bacterial vaginosis and anaerobes in obstetric-gynecologic infection. Clin. Infect. Dis. off. Publ. Infect. Dis. Soc. Am. 16 Suppl 4, S282-287 (1993).
4. ASHP Therapeutic Guidelines on Antimicrobial Prophylaxis in Surgery. American Journal of Health-System Pharmacy. Oxford Academic. https://academic.oup.com/ajhp/article-abstract/56/18/1839/5159406.
5. ACOG practice bulletin No. 104: Antibiotic prophylaxis for gynecologic procedures. Obstet. Gynecol. 113, 1180-1189 (2009).
6. Kamat A. A., Brancazio L. & Gibson M. Wound infection in gynecologic surgery. Infect. Dis. Obstet. Gynecol. 8, 230-234 (2000).
7. Smaill F. & Hofmeyr G. J. Antibiotic prophylaxis for cesarean section. Cochrane Database Syst. Rev. CD000933 (2002) doi: 10.1002/14651858. CD000933.
8. Steinberg J. P. et al. Timing of antimicrobial prophylaxis and the risk of surgical site infections: results from the Trial to Reduce Antimicrobial Prophylaxis Errors. Ann. Surg. 250,10-16 (2009).
9. Burke J. F. The effective period of preventive antibiotic action in experimental incisions and dermal lesions. Surgery 50, 161-168 (1961).
10. McDonald M., Grabsch E., Marshall C. & Forbes. A Single versus multiple dose antimicrobial prophylaxis for major surgery: a systematic review. Aust. N. Z. J. Surg. 68, 388-396 (1998).
11. Harbarth S., Samore M. H., Lichtenberg D. & Carmeli Y. Prolonged antibiotic prophylaxis after cardiovascular surgery and its effect on surgical site infections and antimicrobial resistance. Circulation 101, 2916-2921 (2000).
12. McGregor J. A., French J. I. & Makowski E. Single-dose cefotetan versus multidose cefoxitin for prophylaxis in cesarean section in high-risk patients. Am. J. Obstet. Gynecol. 154, 955-960 (1986).
13. Tita A. T. N. et al. Emerging concepts in antibiotic prophylaxis for cesarean delivery: a systematic review. Obstet. Gynecol. 113, 675-682 (2009).
14. Lamont R. F. et al. Current debate on the use of antibiotic prophylaxis for caesarean section. BJOG Int. J. Obstet. Gynaecol. 118, 193-201 (2011).
15. ACOG educational bulletin. Antibiotics and gynecologic infections. American College of Obstetricians and Gynecologists. Number 237, June 1997 (Replaces No. 153, March 1991). Int. J. Gynaecol. Obstet. off. Organ Int. Fed. Gynaecol. Obstet. 58, 333-340 (1997).
16. Antimicrobial resistance: global report on surveillance. https://www.who.int/publications-detail-redirect/9789241564748.

17. Howard, S. J., Catchpole, M., Watson, J. & Davies, S. C. Antibiotic resistance: global response needed. Lancet Infect. Dis. 13, 1001–1003 (2013).
18. Laxminarayan R. et al. Antibiotic resistance- the need for global solutions. Lancet Infect. Dis. 13, 1057–1098 (2013).
19. MacDougall C. & Polk R. E. Antimicrobial stewardship programs in health care systems. Clin. Microbiol. Rev. 18, 638–656 (2005).
20. Griffith M., Postelnick M. & Scheetz M. Antimicrobial stewardship programs: methods of operation and suggested outcomes. Expert Rev. Anti Infect. Ther. 10, 63–73 (2012).
21. Infectious Diseases Society of America (IDSA) et al. Combating antimicrobial resistance: policy recommendations to save lives. Clin. Infect. Dis. Off. Publ. Infect. Dis. Soc. Am. 52 Suppl 5, S397- 428 (2011).
22. Dellit T. H. et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. Clin. Infect. Dis. Off. Publ. Infect. Dis. Soc. Am. 44, 159–177 (2007).

10. ANTIMICROBIAL STEWARDSHIP IN NURSING PRACTICE

Abstract

This paper highlights the critical role of nurses in antimicrobial stewardship programs, emphasizing their contributions to patient care, communication, surveillance, education, and patient engagement. Nurses serve as frontline responders, facilitating early infection detection and targeted antimicrobial therapy, yet face challenges such as inadequate staffing and limited interprofessional collaboration. Education and empowerment are crucial to maximizing nurses' impact in antimicrobial stewardship programs, with a focus on formal recognition and enhanced involvement in decision-making processes. Future efforts should prioritize broadening advocacy beyond clinical roles to influence healthcare professionals and patients alike, ultimately advancing the global fight against antimicrobial resistance and safeguarding public health.

Introduction

Antimicrobial resistance poses a global threat to public health, necessitating a multidisciplinary approach. Nurses serve as the frontline responders to antibiotics, play pivotal roles in communication, care coordination, and continuously monitor patients around the clock for their status, safety, and response to antibiotic treatment.[1] From a nursing perspective, the implementation of an antimicrobial stewardship program is important for promoting patient safety, preventing the emergence of antibiotic resistance, and optimizing healthcare outcomes. Achieving success in antimicrobial stewardship involves raising awareness and educating both the public and healthcare professionals about antimicrobial resistance. Additionally, it requires the training and collaboration of all healthcare providers to effectively address this growing threat to human health.[2]

Nursing and Antimicrobial Stewardship

a) Nursing Assessment, Surveillance, Communication and Collaboration

Nurses maintain a continuous presence on the ward and actively engage throughout the patient's journey from admission to discharge. Their responsibilities encompass patient monitoring, precise and timely documentation, and the administration of antimicrobials.[3] They are also engaged in surveillance activities for signs of infections and collaborating with other healthcare members to implement timely interventions.[4] Through close observation and communication, nurses contribute to the early detection of infections, allowing for prompt and targeted antimicrobial therapy when necessary. But the lack of adequate nursing staffs and collaboration among all the healthcare members hindered the implementation of antimicrobial stewardship leading to adverse effects on the nursing role in this domain.[5] Optimizing team communication and collaboration can have a positive effect on patient outcomes. Establishing a communication approach that formalizes the input from different team members including nursing staffs can enhance and standardize clinical discussions, particularly in infection prevention and antimicrobial stewardship care.[6]

b) Education and Training

The pivotal role of nursing staff in the hospital infection control committee is to improve antibiotic optimization and participate in antimicrobial stewardship (AMS) governance. While nurses acknowledge AMS activities within their responsibilities, there is an underutilization of their potential in AMS programs.[2] The contribution of nurses in AMS is hindered by lack of education, confidence and communication with other healthcare members. Unless there is heightened inter-professional collaboration, education, and integration into the AMS agenda, along with addressing organizational and resource constraints, the scope of the nursing role in stewardship will remain restricted.[7] To boost nurses' involvement in antimicrobial stewardship, there must be recognizing their role formally, educating them on their potential contributions, involving them in local stewardship initiatives, and ensuring leadership engagement among nurses.[8,9]

c) Patient Education and Engagement

One key aspect of nursing involves educating patients and their families about the importance of completing prescribed antibiotic courses and the potential consequences of misuse. Aged-care home nurses can take the lead in relevant antimicrobial stewardship activities towards the end of life by overseeing advance care planning, coordinating care, delivering healthcare, and communicating with families and medical professionals.[10] Nurses also serve as advocates for responsible antibiotic use, emphasizing the necessity of following healthcare providers' recommendations to prevent the development of resistance by educating the patient. Nurses also contribute by promptly helping patients in identifying and reporting any signs of adverse reactions or complications related to antimicrobial therapy.

d) Challenges and Barriers

Nurses presently engage in Antimicrobial Stewardship by aiding system procedures, overseeing safety, promoting optimal antibiotic usage, and educating patients. The absence of a well-defined description of nurses' responsibilities and entrenched professional hierarchies hinders their active involvement. Inconsistent engagement is attributed to inadequate prioritization of AMS tasks, a dearth of formal policies and additional education.[11]

e) Future Directions

It is essential that both student and qualified nurses are able to speak up in order to maximise patient safety, fulfil their professional duty and promote the overall effectiveness of AMS if they witness poor antibiotic management practices. Empowering and activating the nurses could have a profound impact on stewardship initiatives. Although there has been a gradual push for increased nurse participation, it is crucial to actively permit and encourage their involvement, even in decision-making. While existing advocacy often emphasizes nurses' clinical roles, it is advantageous to broaden the focus to include influencing other healthcare professionals and patients, leading campaigns, educating healthcare workers and citizens, and directing infection prevention and control efforts.[12]

Conclusion

Antimicrobial stewardship is a shared responsibility that involves active participation from healthcare professionals across disciplines. From the nursing perspective, the emphasis is on education, collaboration, infection prevention, and continuous monitoring to ensure the judicious use of antimicrobial agents. By integrating these principles into daily practice, nurses contribute significantly to the global effort to combat antibiotic resistance and safeguard public health.

REFERENCES

1. Olans RN, Olans RD, DeMaria Jr A. The critical role of the staff nurse in antimicrobial stewardship-unrecognized, but already there. Clinical Infectious Diseases. 2016 Jan 1;62 (1): 84-9.
2. Olans RD, Hausman NB, Olans RN. Nurses and antimicrobial stewardship: past, present, and future. Infectious Disease Clinics. 2020 Mar 1;34 (1): 67-82.
3. Mostaghim M, Snelling T, McMullan B, Konecny P, Bond S, Adhikari S, Chubaty A, Lovell C, Bajorek B. Nurses are underutilised in antimicrobial stewardship-Results of a multisite survey in paediatric and adult hospitals. Infection, Disease & Health. 2017 Jun 1;22 (2): 57-64.
4. Lerano C, Rajkhowa A, Gotterson F, Marshall C, Peel T, Ayton D, Thursky K. Opportunities for nurse involvement in surgical antimicrobial stewardship strategies: A qualitative study. International Journal of Nursing Studies. 2022 Apr 1; 128:104186.
5. Rout J, Brysiewicz P. Perceived barriers to the development of the antimicrobial stewardship role of the nurse in intensive care: Views of healthcare professionals. Southern African Journal of Critical Care. 2020 Jul 1; 36(1): 51-6.
6. Bonaconsa C, Mbamalu O, Surendran S, George A, Mendelson M, Charani E. Optimising infection control and antimicrobial stewardship bedside discussion: A scoping review of existing evidence on effective healthcare communication in hospitals. Clinical Microbiology and Infection. 2023 Dec 13.
7. Kirby E, Broom A, Overton K, Kenny K, Post JJ, Broom J. Reconsidering the nursing role in antimicrobial stewardship: a multisite qualitative interview study. BMJ open. 2020 Oct 1;10 (10): e042321.
8. Gotterson F, Buising K, Manias E. Nurse role and contribution to antimicrobial stewardship: an integrative review. International journal of nursing studies. 2021 May 1;117: 103787.
9. Padigos J, Ritchie S, Lim AG. Enhancing nurses' future role in antimicrobial stewardship. Collegian. 2020 Oct 1;27 (5): 487-98.
10. Dowson L, Friedman ND, Marshall C, Stuart RL, Buising K, Rajkhowa A, Gotterson F, Kong DC. The role of nurses in antimicrobial stewardship near the end of life in aged-care homes: a qualitative study. International Journal of Nursing Studies. 2020 Apr 1;104: 103502.
11. Van Gulik N, Hutchinson A, Considine J, Driscoll A, Malathum K, Botti M. Perceived roles and barriers to nurses' engagement in antimicrobial stewardship: a thai qualitative case study. Infection, Disease & Health. 2021 Aug 1;26 (3): 218-27.
12. Sánchez EC. Nursing leadership in AMS interventions: Lessons learnt worldwide. International Journal of Infectious Diseases. 2018 Aug 1;73: 46.

LIST OF CONTRIBUTORS

1. Dr. AK. Kaku Singh
   Prof. & Head, Urology
   RIMS, Imphal

2. Dr. Th. Sudheeranjan
   Prof. & Head, ENT
   RIMS, Imphal

3. Dr. S. Ranita Devi
   Prof. & Head, General Surgery
   RIMS, Imphal

4. Dr. Ch. Shyamsunder Singh
   Prof. & Head, Paediatrics
   RIMS, Imphal

5. Dr. Th. Sachindeba Singh
   Prof. & Head, Cardiology
   RIMS, Imphal

6. Dr. Aribam Devadutta Sharma
   Prof. & Head, GI Surgery
   RIMS, Imphal

7. Dr. Sunanda Haorongbam
   Prof. & Head, Respiratory Medicine
   RIMS, Imphal

8. Dr. Y. Sobita Devi
   Prof. & Head, Radiation Oncology
   RIMS, Imphal

9. Dr. Ksh. Mamta Devi
   Prof., Dept. of Microbiology
   RIMS, Imphal

10. Dr. T. Jeetenkumar Singh
    Prof., Dept. of Medicine
    RIMS, Imphal

11. Dr. Akoijam Ibohal Singh
    Assoc. Prof. & Head, Plastic Surgery
    RIMS, Imphal

12. Dr. T. Brojen Singh
    Assoc. Prof., & Head, Nephrology
    RIMS, Imphal

13. Dr. L. Trinity Meetei
    Assist. Prof., Dept. of Obst. & Gynae.
    RIMS, Imphal

14. Dr. Y. Arunkumar Singh
    Assist. Prof., Dept. of Anesthesiology
    RIMS, Imphal

15. Dr. Shakti Laishram
    Assist. Prof., Dept. of Microbiology
    RIMS, Imphal

16. Dr. Chetan Maibam
    Assist. Prof., Dept. of General Surgery
    RIMS, Imphal

17. Dr. N. Dilokumar Singh
    Senior Resident, Dept. of General Surgery
    RIMS, Imphal

18. Dr. Neeta Sinam
    Senior Resident, Dept. of Radiation Oncology
    RIMS, Imphal

19. Dr. B. Rosylinda Devi
    Senior Resident, Dept. of General Surgery
    RIMS, Imphal

20. Dr. Posa. Vishnu Theja
    PGT, Dept. of Medicine
    RIMS, Imphal

21. Smt. Sobita Ngangbam
    Nursing Officer, Cath Lab
    RIMS, Imphal

22. Smt. Mutum Monica Chanu
    Nursing Officer, General OPD
    RIMS, Imphal

OFFICE OF THE MEDICAL SUPERINTENDENT
REGIONAL INSTITUTE OF MEDICAL SCIENCES HOSPITAL
(An autonomous Institute under the Ministry of Health & Family Welfare, Govt. of India)

O R D E R

Imphal, the 4th January, 2024.

No.46/RIMSH/HAICC/97/1158 A Hospital Acquired Infection Control Committee RIMS Hospital, Imphal consisting of the following member is hereby re-constituted with immediate effect. They are consisting the following. This will supersede all the office orders in this regard.

1. Prof. N. Sanjib Singh, Medical Supdt. - Chairman
2. HOD Microbiology - Member Secretary
3. HOD/Surgery/Medicine/O&G/Ortho/Anaesthesiology Opthalmology/Paediatric/Community Medicine -Member
4. Prof. T. Jeetenkumar Singh, Member Secretary Anti Microbial Stewardship Program -Member
5. Dr. Shakti Laishram, Department of Microbiology -Member
6. Chief Nursing Officer - Member
7. H. Uma Devi, Asst. Nursing Supdt. - Member
8. H. Priyashini Devi, Senior Nursing Officer - Member
9. In-charge O.T/CSSD/Dietary Section/CRED/Laundry - Member
10. Mrs. M. Monica Chanu, Infection Control Nurse - Member
11. Mrs. Sobita ngangbam, Infection Control Nurse -Member
12. Biomedical Engineer - Member

Infection Control Team:

1. Dr. Y. Arunkumar Singh, Assistant Medical Supdt.
2. Dr. Shakti Laishram,Department of Microbiology
3. Dr. Jelina Laishram, Department of Com. Med.
4. One representative from Pharmacology Dept.
5. Dr. Nataraj Singh, Store in charge
6. Chief Nursing Officer
7. Biomedical Engineer
8. Consultant Civil
9. Mrs. M. Monica Chanu, Infection Control Nurse
10. Mrs. Sobita Ngangbam, Infection Control Nurse
11. Dietecian
12. In-charge O.T/CSSD/Laundry/CRED

(Prof. N. Sanjib Singh)
Medical Superintendent,
RIMS Hospital, Imphal.

Memo No.460/RIMSH/HICC/97: Imphal, the4th January, 2024.

Copy to:

1. The P.S. to Director for kind information of the Director RIMS, Imphal.
2. All concerned members.
3. Concerned file.

(Prof. N. Sanjib Singh)
Medical Superintendent,
RIMS Hospital, Imphal.

ACKNOWLEDGEMENTS AND DISCLAIMERS

The first two editions of the "Antibiotic policy of RIMS Hospital" were published in 2019 and 2022. The current edition (3rd edition) is being published by the AMS Committee, RIMS Hospital under the Chairmanship of Prof. N. Sanjib Singh, Medical Superintendent, in collaboration with the ICMR project of Antimicrobial Stewardship Programme (AMSP).

Profound gratitude to the Director, RIMS & Medical Superintendent, RIMS Hospital for the generous financial support and the overall mentorship in making this venture a reality.

All the Heads of Departments and faculties of the Institute offered support by contributing articles and offering valuable suggestions. The Antibiogram as submitted by Prof. Ksh. Mamta Devi of Microbiology Department under the stewardship of Prof. Kh. Ranjana Devi, is being incorporated as the reference Antibiogram of the Hospital. The Editorial board of the policy deserves all words of appreciation and gratitude for approving the contents and taking up the challenging task to edit the document in a short span of time. The publication and dissemination of the policy document is done by the Antimicrobial Stewardship (AMS) committee under the chairmanship of Medical Superintendent, RIMS Hospital.

The policy is essentially suggestive in nature. The contents cannot be considered and claimed to be absolute and final. It is indeed, a work in progress and as such the contents are liable to be reviewed, as and when new information comes to light. The information provided is not intended or implied to be an outright substitute for professional/clinical decision. The contents are for general reference for the healthcare providers only. It is strongly suggested that one never disregard professional medical advice or delay seeking medical treatment because of something one has read on or accessed in this book. This work is not for medico-legal purpose.

We duly acknowledge the support from ICMR, New Delhi and in particular Dr. Kamini Walia, Program officer, and other staff of AMR Program, division of ECD of ICMR. We applaud the efforts made by Post graduates, staff of different departments/sections of RIMS; A-block, MS office, project cell, finance section, Photography section, RIMS, Imphal. Mr. Irom Loha Singh, Research Associate, AMSP and Mr. M. Hirokumar Singh, DEO, AMR Project contributed immensely in compiling and editing the policy document.

It is to mention that the NMC and MOHFW, GOI have issued directives to make it mandatory for every Medical College to develop Antibiotic Policy. We do sincerely hope and believe that this humble effort of ours would prove to be a valuable asset towards the concerted and collaborative initiatives against antibiotic resistance. This sincere effort has been guided by the relevance and in the larger interest of the propagation of Medical science.

Published by:
Anti Microbial Stewardship Committee
RIMS Hospital, Imphal.