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Drug Utilization Study Of Antimicrobials In Tertiary Care Hospitals

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Abstract

Background: Antimicrobials are among the most frequently prescribed drugs in tertiary care hospitals. Inappropriate and excessive antimicrobial use contributes significantly to antimicrobial resistance (AMR), increased healthcare costs, prolonged hospital stay, and adverse drug reactions. Medicine application studies (DUS) give a methodical approach to estimate antimicrobial prescribing patterns and support rational use enterprise (1 –3). Ideal To review antimicrobial medicine application patterns in tertiary care hospitals and punctuate the part of medicine application studies in promoting rational antimicrobial use and strengthening antimicrobial stewardship programs.

Keywords: Antimicrobial stewardship, Fixed dose combinations, Antimicrobial resistance, Empirical and definitive antimicrobial therapy

Introduction

Concept of Drug Utilization Study (DUS)

Drug Utilization Study (DUS) is a systematic and scientific method that evaluates the prescribing, dispensing, and consumption of medicines in a defined population, with emphasis on their medical, social, and economic consequences [(1)]. Medicine use studies help identify defining patterns similar as polypharmacy, inordinate antibiotic and injection use, and no adherence to essential drug generalities, all of which contribute to increased healthcare costs and antimicrobial resistance[(2)]. The World Health Organization(WHO) developed core defining pointers as formalized tools to assess rational medicine use and ameliorate the quality of healthcare delivery[(3)]. Overall, DUS plays a critical part in promoting rational drug use and strengthening healthcare systems. Significance of Antimicrobial Application Review Antimicrobial application review (AUR) is a nonstop process that evaluates the defining, distribution, and administration of antimicrobial in healthcare settings. Transnational health agencies fête illogical antimicrobial use as a major contributor to the global AMR extremity. AUR is a core element of antimicrobial stewardship programs (Asps), icing that antimicrobial are specified according to evidence based norms with applicable consideration of medicine selection, cure, route, duration, and safety [5 –9]. Studies demonstrate that stewardship programs incorporating application review significantly reduce unhappy antimicrobial use without negatively affecting clinical issues [6 –9]. In addition, optimized antimicrobial use improves patient safety, reduces length of hospital stay, and lowers healthcare costs...

Burden of Antimicrobial Resistance in Tertiary Care Settings

the frequency of antimicrobial resistance (AMR) in tertiary care hospitals is a significant and growing issue, given the high frequency of use of antibiotics and the frequent burden of cases. The circumstance of resistant organisms is due to the frequent use of antibiotics, invasive individual and remedial procedures, extended hospital stays, and the presence of immunocompromised cases. This creates a terrain conducive to their development. Intensive care units (ICUs), oncology wards (similar as MDROs), transplant units or surgical departments tend to be areas where antibiotic exposure and device use are most current ([10, 11]. Tertiary care settings frequently encounter resistant pathogens, similar as MRSA, VRE, Enterobacter, Acinetobacter baumannii, and Pseudomonas aeruginosa [12]. Accordingly, there are many remedial options for these organisms and they frequently need last- line antimicrobial medicines similar as carbapenems, polymyxins or newer reserve agents. Similar agents are getting more and more reliant on use, leading to increased resistance development and implicit pitfalls for their long-term effectiveness. AMR's clinical significance in tertiary care hospitals is noteworthy. The presence of resistant pathogens leads to infections that are more likely to beget morbidity and mortality, delayed clinical response, prolonged hospital stays, and increased threat of treatment failure. Treatment costs and resource use are lowered by the need for longer courses of remedy, combination treatments [11, 12], and ferocious monitoring in cases with resistant infections. Also, AMR makes infection control more complex and increases the threat of hospital- acquired outbreaks. The World Health Organization identifies shy antimicrobial prescribing, poor infection forestalment measures, and weak stewardship practices as the primary reasons for resistance in hospital settings. Routine medicine Application Studies, antimicrobial stewardship programs, and resistance patterns covering are crucial strategies that WHO advocates advocate for to help guide defining and policy development in this area. We need to strengthen these measures to reduce the impact of AMR in tertiary care hospitals and ameliorate patient issues.

Role of Rational Antimicrobial Use

RAU is the process of opting applicable antimicrobial agents grounded on suggestion, dose, route of administration, and duration of remedy, guided by sound clinical judgment and microbiological evidence. The implementation of rational prescribing results in reduced gratuitous exposure to antimicrobials and bettered patient care while entering effective treatment. In addition, applicable use of antibiotics plays an important part in decelerating down the picky pressure on microorganisms to produce antimicrobial resistance. [13-14] Besides resistance constraint, RAU improves clinical issues by perfecting treatment efficacy with lower adverse medicine response, dwindling hospital duration and adding overall healthcare savings. Effective implementation of RAU is largely dependent on well-structured ASPs. Evidence- grounded prescribing is promoted by these programs, which include the creation and dispersion of treatment guidelines, prospective inspection and feedback process; dose optimization; the timely-escalation of broad- diapason agents; intravenous- to-oral switch strategies; and nonstop education of healthcare professionals. Antimicrobial remedy should be reviewed grounded on culture and vulnerability findings in stewardship interventions, to insure applicable treatment during illness. The use of antimicrobials in low- and middle- income countries (LMICs) is delicate to achieve due to colourful systemic walls. The factors include inadequate access to microbiology laboratory services, wide vacuity of antibiotics without tradition, shy healthcare staff training, high patient load, and weak nonsupervisory enforcement. Empirical prescribing limitations constantly affect in the nonstop and empirical use of antibiotics, which increases the liability of resistance development. These problems can be resolved through environment-specific measures similar as strengthening laboratory capacity, administering nonsupervisory programs, improving access to stewardship coffers, and adding education(and mindfulness) among healthcare providers. The conservation of antibiotic effectiveness and sustainable healthcare issues bear the creation of rational antimicrobial use [15]

Relevance of WHO Indicators and Stewardship Principles

to quantify antimicrobial consumption in healthcare settings, the World Health Organization (WHO) has developed standardized pointers that cleave to the Anatomical remedial Chemical/ Defined Daily Dose (ATC/ DDD) methodology. The dimension of DDD per 1,000 case days, medicine Application 90(DU90) parts, and the conservative type are unprejudiced measures for monitoring and assessing antimicrobial use patterns[16,17]. These metric are used to describe consumption trends, identify patterns where practices differ from those specified by the FDA (e.g. Healthcare brigades can cover the use of high- threat antibiotics distributed under the " Watch " and " Reserve " groups, which facilitates antimicrobial stewardship through the methodical use(through monitoring of WHO pointers). Monitoring these groups helps to keep track of adherence, allows for better selection of antimicrobials(e.g. Stewardship programs can identify unhappy prescribing, polypharmacy, sour dosing(under the guidance of WHO- guided medicine Application Studies) and gratuitous antimicrobial use using quantifiable data generated through medicine Utilizations Studies(DUS). The objectification of these criteria into diurnal hospital practice enables institutions to measure performance against both public and transnational marks, assess the effectiveness of stewardship interventions, and effectively guide resource allocation. DUS, which is grounded on WHO, assists in the development of programs by relating areas where defining practices differ from guidelines, leading to changes in institutional protocols, treatment guidelines and educational strategies for prescribers. Also, the structured data attained from WHO pointers reinforces ongoing quality enhancement enterprise by furnishing practical guidance for prescriber education, formulary regulation, and infection control measures.[18-19] These pointers are used to regularly assess antimicrobial use patterns, which helps identify arising trends in resistance and inform evidence- grounded opinions on ant microbiology selection, dosing, and duration. Also also, data- grounded stewardship training can help to minimize gratuitous antimicrobial exposure, reduce adverse medicine events, and ameliorate patient safety. The WHO pointers and stewardship principles give a comprehensive, invariant, and unprejudiced system for assessing antimicrobial use, recommending interventions (and perfecting healthcare care delivery) in an intertwined manner. They insure rational prescribing of antimicrobials, inform policy- making and help drive overarching objects of stewardship of antibiotics. (20)

Objectives and Scope of Antimicrobial DUS

The objects of antimicrobial DUS include assessing frequency and patterns of antimicrobial use using standardized criteria similar as ATC/ DDD; assessing deliciousness of defining with respect to suggestion, medicine choice, cure, route, and duration; relating contributors to resistance similar as polypharmacy and dragged remedy; and generating birth data for strengthening stewardship programs(21 –25).Over the past five years, hospital DUS has evolved from descriptive audits to integrated surveillance linked with pharmacovigilance, pharmacoeconomic evaluation, and stewardship activities [26]

Importance in Improving Prescribing Practices

appropriate prescribing improves patient outcomes by reducing drug-related harm, hospital readmissions, and antimicrobial resistance (27, 28). Educational and behavioural interventions, audit-and-feedback, and pharmacist-led stewardship reviews have consistently demonstrated reductions in inappropriate antimicrobial use and therapy duration across diverse healthcare settings (29-30)

Antimicrobial Use in Tertiary Care Hospitals

Prescribing Trends

Between 2020 and 2025, tertiary care antibiotic defining showed an initial surge in empirical and broad spectrum use during the COVID-19 epidemic, followed by traditional enhancement with implementation of Asps(31 –35). Multicentre studies from India and other LMics report patient overuse of Watch and Reserve antibiotics, variable guideline adherence, and significant interinstitutional variability told by original coffers and stewardship maturity.

Commonly Used Classes of Antimicrobials

Across tertiary care hospitals, beta-lactams(penicillin's and cephalosporin's) remain the most generally specified agents, followed by fluoroquinolones, accolades, carbapenems, amino glycosides, glycopeptides, oxazolidinones, polymyxins, tetracycline, sulfonamides, and nitroimidazoles. While broad spectrum agents are essential for severe infections, their overuse is explosively associated with resistance emergence, emphasizing the need for stewardship guided selection and monitoring.

Class (short)	Representative drugs (examples)	Main mechanism	Typical clinical uses	5-yr trend / note
Beta-lactams — Penicillin (narrow & broad)	Benzyl penicillin, Amoxicillin, Ampicillin	Inhibit cell-wall (PBPs) → bactericidal	Respiratory, ENT, skin, UTIs (suscep tible organisms)	Still the most commonly prescribed first line ag ents; watch rising resistance in some pathogens.
Beta-lactams Cephalosporin (1st–4th gen)	Cephalexin, Ceftriaxone, Ceftazidime, Cefepime	PBP inhibition → bactericidal	Wider spectr um uses com munity& hos pital infections,sep sis workup	Heavy usage in hospit als; broader spectrum cephalosporin's associ ated with selection for ESBLs/C. difficile.
Carbapenems	Meropenem, Imipenem, Ertapenem	Very broad PBP inhibition	Severe hospital-acquired infections, suspected MDR Gram-negatives	Use has risen where E SBLs common; stewardship aims to preserve these agents.
Macrolides	Azithromycin, Clarithromycin ,Erythromycin	Inhibit 50S ribosomal subunit (protein synthesis)	Atypical pneumonia, some STIs, ENT infections	Remain common in co mmunity practice; resi stance rising in some respiratory pathogens.
Fluoroquinolones	CiprofloxacinL evofloxacin Moxifloxacin	Inhibit DNA gyrase/topois omerase → bactericidal	UTIs, GI, respiratory (where indicated)	Historically widely us ed; growing restriction s due to resistance and safety signals (tendino pathy, CNS).Stewards hip drives reduced empirical use.
Aminoglycosides	Gentamicin, Amikacin	Inhibit 30S ribosomal subunit; bactericidal	Severe Gram-negative infe ctions (often	Reserved for severe infections due to toxicity; usage stable but targeted.

			combination therapy)	
Glycopeptides / Lipoglycopeptides	Vancomycin, Teicoplanin, Dalbavancin	Inhibit cell-wall precursor binding (peptidoglycan synthesis)	MRSA, serious Gram-positive infections	Continued use for MRSA; newer lipoglycopeptides appear for long-acting therapy.
Oxazolidinones	Linezolid, Tedizolid	Inhibit 23S rRNA of 50S → block initiation	Resistant Gram-positive infections (VRE, MRSA)	Important reserve agents; use guided by susceptibility.
Polymyxins	Colistin, Polymyxin B	Disrupt Gram-negative outer membrane	Last-line for carbapenem-resistant Gram negatives	Use increased in MDR settings; concerns about nephrotoxicity and emerging resistance.
Tetracycline	Doxycycline, Minocycline	Inhibit 30S ribosomal subunit (protein synthesis)	Acne, atypical pneumonia, some zoonosis	Stable community use ; doxycycline remains important for specific indications.
Sulphonamides & Trimethoprim	Trimethoprim-sulfamethoxazole(co- trimoxazole)	Folic acid synthesis inhibitors → bacteriostatic/cidal combo	UTIs, PCP prophylaxis/treatment, some community infections	Continued use where susceptibilitiesallow; resistance variable by region.
Nitroimidazole	Metronidazole	DNA strand breakage in anaerobes	Anaerobic infections, C. difficile (oral vancomycin >metronidazole for C. diff now)	Use continues for anaerobic infections; role in C. difficile reduced in guidelines.

Table No.1 Commonly Used Classes of Antimicrobials

Empirical versus Definitive Therapy

Empirical therapy is initiated before microbiological confirmation based on suspected pathogens, illness severity, and local epidemiology, and is often life-saving in severe infections [36]. Definitive (targeted) therapy is guided by culture and susceptibilityResults and aims to use the narrowest effective agent for an applicable duration [37 –40]. Timely de-escalation and duration optimization are crucial stewardship strategies to balance clinical benefit and resistance forestalled.

Prophylactic, Therapeutic, and Preventive Use

Surgical antimicrobial prophylaxis effectively reduces surgical point infections when administered within 60 twinkles before gash and discontinued within 24 hours postoperatively[41,46]. Remedial use should prioritize evidence based durations, early de-escalation, and guideline adherence, supported by stewardship interventions similar as auditandfeedback and formulary restriction [47].

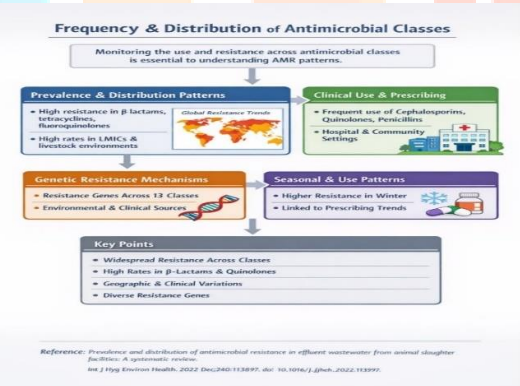
Patterns of Antimicrobial Utilization

Route of Administration

how antimicrobial is administered has a significant impact on remedial results, patient safety and the use of healthcare coffers. The easiest and most cost-effective system of administering oral drug is generally reserved for clinically stable cases. The implementation makes it easier to manage inpatient cases, dock hospital stays, and minimize the procedural difficulties linked to invasive delivery methods. However, oral phrasings may be used as an optional remedy with acceptable systemic medicine situations [48, 49]. If the case is suitable to tolerate oral input and has sufficient gastrointestinal immersion. Critically ill or unstable cases bear parenteral administration, which can be administered intravenously or intramuscularly to insure that the medicine is bioavailable and completely bioavailable within 24 hours. This system facilitates precise dose administration, rapid-fire achievement of remedial tube attention, and prompt treatment for severe infections that may not be suitable to be treated by mouth. However, severe sepsis, or high serum attention necessary to meet their pharmacodynamics pretensions, If the case gests gastrointestinal dysfunction. Programs in antimicrobial stewardship emphasize the identification of campaigners for early transition from parenteral to oral remedy(this strategy is called " IV- to-oral switch "), and have set up evidence that this has led to reduced costs associated with medicines; catheter related complications and dropped hospital stays while maintaining high situations of treatment efficacy. Clinical trials calculate on evidence- grounded protocols to determine the timing and selection of oral druthers as well as their position and case-specific characteristics. The optimization of the route of administration through personalized assessment and stewardship principles enhances patient issues, optimizes resource application, and supports rational antimicrobial use...

Fixed-Dose Combinations

Fixed Cure Combinations, or FDCs, are drugs that have two or further active medicines combined into one cure in specific quantities. These are generally used in tertiary care hospitals to treat infections. The reason clinicians use FDCs is that combining antibiotics that work in different ways can make the treatment more effective and help fight a wider range of bacteria, especially when they aren't sure which bacteria are causing the infection.[50,51] Some common FDCs used in tertiary care hospitals include amoxicillin – clavulanate, piperacillin – tazobactam, cefoperazone – sulbactam, ceftriaxone – sulbactam, and Eminem – dilatation. These are frequently used for serious infections, infections caused by bacteria that are hard to treat, and in intensive care units (ICUs). When used duly, FDCs help the treatment work more, make it easier for cases to take their drug regularly, and can indeed stop bacteria from getting resistant to antibiotics, especially when they include medicines that stop bacteria from breaking down other antibiotics. Still, using these combinations in the wrong way or too important is a big problem, especially in places where medical coffers are limited. Numerous of these medicine combinations do not have strong scientific support and can lead to medicine resistance, dangerous side goods, and advanced medical costs. That is why it's important to have careful monitoring and control of antibiotic use to make sure FDCs are used in the right way. Increase adverse goods. WHO recommends use of only evidence based, rational FDCs with.



Generic versus Brand prescribing

general prescribing enhances affordability, access, and rational drug use. WHO and Indian nonsupervisory authorities explosively endorse defining by general name to reduce costs and promote translucency [52, 53].

Suitability and Appropriateness of Antimicrobial Use

Felicity and deliciousness of antimicrobial use relate to opting the correct suggestion, antimicrobial agent, cure, route of administration, and duration grounded on clinical assessment and microbiological evidence. Applicable remedy begins with carrying applicable societies previous to antibiotic inauguration whenever doable, followed by empirical selection guided by original angiograms and patient factors. Cure optimization according to age, weight, renal function, and inflexibility of infection is essential to maximize efficacy and minimize toxin. Reassessment of remedy at 48 –72 hours, generally nominated an antibiotic time- eschewed, allows review of culture and vulnerability results. This reassessment supports timely de-escalation from broad- to constrict-diapason agents, revision of remedy, or termination when infection is barred. Nonstop monitoring for adverse medicine responses, medicine – medicine relations, and clinical response is necessary to insure patient safety. Applicable termination of antimicrobial remedy once remedial pretensions are achieved prevents overtreatment, reduces picky pressure, and improves issues. These principles are central to antimicrobial stewardship (54 –57).

Antimicrobial Stewardship Perspective

The multidisciplinary approach of antimicrobial stewardship seeks to optimize treatment selection, administration, route and duration to ameliorate patient issues while minimizing the liability of antibiotic resistance (AMR) [58, 59]. The successful implementation of stewardship programs involves coordinated sweats by croaker's clinical druggists (of colourful medical professions), microbiologists, nurses and infection control brigades to insure the applicable use of antibiotics in all healthcare settings. The evidence base for antimicrobial stewardship is established through medicine Application Studies (DUS), which quantify patterns of antibiotic use, identify unhappy or inordinate use and highlight diversions from established guidelines. DUS is an objective evaluation of antimicrobial practices that utilizes pointers similar as Defined diurnal Boluses, antibiotic application viscosity, and defining trends to give unprejudiced recommendations. Also, DUS supports evaluation of stewardship interventions by considering their impact on resistance patterns, healthcare charges, adverse medicine events, and patient safety issues. By integrating DUS findings into stewardship workflows, data-driven decision timber, nonstop quality enhancement, and targeted interventions are achieved,strengthening antimicrobial reek sweats and contributing to sustainable control of AMR in tertiary care hospitals

Clinical and Economic Implications

Using antibiotics can have significant impact on both patient care and healthcare costs, especially in places where croakers

frequently define them unfairly. One reason for this is that overuse or wrong use of antibiotics can lead to antibiotic resistance. This happens when people take too important, do not need them, or use the wrong type of broad-diapason antibiotics. When resistance develops, infections are harder to treat, leading to longer ails, further failed treatments, further health problems, and indeed more deaths. Cases who get the wrong antibiotic treatment are more likely to have bad side goods from drugs, problems when drugs interact, infections that come back, and longer hospital stays. From a cost point of view, using too numerous, or the wrong antibiotics adds a lot of pressure on healthcare systems. This increase costs for precious backup antibiotics, longer hospital stays, redundant tests, and further use of intensive care units (ICUs). In tertiary care hospitals, programs that help manage antibiotic use, called Antimicrobial Stewardship Programs(Asps), have been shown to lower the quantum of antibiotics used, especially the more important and precious bones, without hurting patient safety. Research also shows that these programs help lower resistance, dock hospital stays, and reduce costs. Using guidelines for tradition, stopping antibiotics when they are no longer demanded, and making sure the right quantum is used can help Asps ameliorate patient issues [62, 63]

Challenges and Strategies for Improvement

numerous obstacles to effective antimicrobial stewardship can hamper optimal prescribing and poor case outcomes.eu). Polypharmacy, where multiple antimicrobials are used at the same time, increases the threat of medicine relations and adverse goods, as well as the development of antibacterial resistance. Misconduct with clinical guidelines complicates remedy, leading to unhappy selection of medicines, their applicable cure, and duration of administration. Also. Prescriber- related variability, similar as lack of mindfulness of resistance trends and defining habits, contributes to variability in antimicrobial use. Effective antimicrobial operation is hindered by colourful factors, including inadequate laboratory structure, absence of stewardship staff, and shy surveillance ways [64, 65]. These challenges demand the implementation of complex results. Tradition enhancement is largely dependent on the implementation of robust Antimicrobial Stewardship Programs (ASP). DUS studies give objective data on antimicrobial use, enabling identification of unhappy defining patterns and areas for targeted intervention. Prescription compliance is assured by the development of hospital-specific antibiotic guidelines that are informed by original resistance patterns and clinical issues, icing applicability within hospitals. Knowledge of rational prescribing, resistance mechanisms, and stewardship principles is enhanced through education or training in healthcare. The use of electronic decision support systems, similar as motorized cautions and guideline- grounded order sets, can prop prescribers in reducing crimes in real time [66 – 67]. When these styles are combined they help with rational operation of the antimicrobials, ameliorate patient safety and reduce the development of resistant pathogens.

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