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Original Article

The Significance of Antibiotic Treatment for Patients After Surgery

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Abstract: Antibiotics play a vital role in preventing and treating bacterial infections, but their improper use and excessive administration can foster the emergence of antibiotic-resistant bacteria. This issue is particularly significant in post-operative patients, where selecting the right antibiotics becomes paramount. Factors like the site of infection, the responsible microorganism, and the pharmacokinetics of antibiotics must guide this selection. In these cases, the judicious use of empirical antibiotics is essential, hinging on clinical indicators such as an increase in total white blood cell count and spikes in body temperature. Striking the right balance is imperative to ensure effective treatment without promoting antibiotic resistance. To guarantee the rational use of antibiotics, careful consideration of the timing and duration of treatment is imperative. Additionally, the choice of antibiotics should be tailored to each patient's specific condition and medical history. In summary, antibiotics are indispensable in both preventing and treating bacterial infections. Healthcare professionals bear the responsibility of prescribing them wisely to maximize patient outcomes while minimizing the risk of antibiotic resistance.

Keywords: Antibiotic stewardship, Antibiotics prescription pattern, Antibiotic policy, Empirical antibiotics, National treatment guideline

1. INTRODUCTION

Antibiotics, a class of medications, play a pivotal role in combating bacterial infections. They function by either directly eliminating bacteria or impeding their ability to proliferate (1). Particularly within medical fields like general medicine, surgery, cardiac surgery, rheumatoid arthritis, and end-stage renal disease, antibiotics wield substantial influence over patient outcomes, significantly enhancing them (1).

The discovery of antibiotics stands as a milestone in averting countless fatalities (2). However, the emergence of antibiotic-resistant pathogens, predominantly multidrug-resistant bacteria, presents a grave concern within the realm of healthcare (2). Antibiotic resistance materializes when bacterial cells develop mechanisms to withstand the bactericidal or bacteriostatic effects of antibiotics. This resistance can manifest through various mechanisms, including inherent resistance, multi-drug resistance, induced resistance, and other adaptive processes (3).

The unwarranted and excessive use of antibiotics can yield adverse consequences, notably the rise of antibiotic-resistant bacterial strains (4). This, in turn, poses obstacles to the

development of innovative medicines and may even precipitate a crisis in the management of treatable illnesses (5).

Effective empirical antimicrobial treatment necessitates a thoughtful consideration of factors such as the site of infection, patient medical history, epidemiological data related to the probable cause, susceptibility of the pathogen, and the specific attributes of the antibiotic in question (6). The primary determinants guiding the selection of antibiotics should encompass the type of microorganisms involved, host characteristics, and the location of the infection (6).

Inadequate use of anti-infective medications to combat causative bacteria can profoundly impact a patient's prognosis (7). To optimize clinical recovery and prevent infection, well-defined antibiotic policies must delineate the precise indications, selection criteria, dosages, administration methods, treatment durations, and scheduling protocols for antibiotic regimens (8).

2. CHOICE OF EXPERIMENTAL ANTIBIOTIC

2.1. TIMING

Antimicrobial treatment often becomes a necessity for individuals undergoing medical care in the intensive care unit (ICU) who are grappling with severe, life-threatening bacterial or fungal infections. The timing of antibiotic selection carries immense significance in ICU patients suffering from sepsis and septic shock, as any delay in administration can exacerbate the severity of the infection. Furthermore, the choice of antibiotics can substantially influence patient outcomes (9).

Hospital-acquired sepsis, frequently initiated by gram-negative bacteremia, represents a critical concern. Over a span of 30 days, this condition can exhibit mortality rates ranging from 12% to 38%. Notably, inadequate antibiotic treatment in patients with bacteremia caused by Klebsiella, Pseudomonas aeruginosa, and Escherichia coli has been associated with a heightened likelihood of mortality within 30 days following the onset of blood culture (10).

Research encompassing 17,990 patients, conducted retrospectively, has established a correlation between the timing of the initial antibiotic administration after sepsis diagnosis and the probability of mortality. Delaying antibiotic delivery significantly escalates the risk of death (11).

In the case of sepsis patients, especially those situated in the ICU, the effective use of antimicrobial medications hinges on promptness. In emergency department settings, selecting the appropriate empirical therapy can reduce complication-related mortality (12).

Regarding the duration of antibiotic therapy, certain illnesses may necessitate continuous medication. However, this can lead to concerns such as an elevated risk of antibiotic resistance, unfavorable drug reactions, and medicalization effects. Strategies aimed at curtailing the duration of antibiotic therapy involve discontinuing medication when it is deemed unnecessary, persisting with treatment only when warranted, and keeping the treatment course as concise as possible (13).

Current recommendations advocate the use of nitrofurantoin for five days after three days of trimethoprim-sulfamethoxazole or ofloxacin for uncomplicated urinary tract infections (UTIs) (14).

Delving into the pharmacokinetic and pharmacodynamic properties of specific antimicrobials allows for estimations regarding the appropriate duration of antibiotic therapy (15).

Recent guidelines propose that, contingent upon the patient's clinical response, the duration of antibiotic therapy for hospitalized individuals with community-acquired pneumonia (CAP) may be abbreviated (16).
The application of these recommendations in clinical practice remains uncertain. The duration of therapy in CAP patients has been explored based on disease severity upon admission and the time required for clinical stabilization (17).

Effective therapy for sepsis patients necessitates the timely administration of antibiotics. Studies have underscored that time is a more critical factor than dosage (18). The

variable relationship between dosage and exposure can pose challenges in adjusting doses (19). Timely antibiotic administration is imperative for achieving successful outcomes in severely ill sepsis patients (20). Several factors, including the infection's location, prior microbiological findings, comorbid conditions, illness severity, the patient's allergy history, and the potential for antibiotic resistance, should be communicated to the patient before administration (20). Special care and attention are warranted for neonatal patients, with a focus on achieving optimal effectiveness while minimizing harm (21).

3. THE CHOOSING OF AN EMPIRICAL ANTIBIOTIC: RATIONALE

Antibiotic resistance poses a significant challenge within healthcare, underscoring the critical need for patient and community education on the judicious use of antibiotics to prevent infections and enhance patient well-being (22). Research indicates that both natural and induced factors contribute to the escalating antibiotic resistance observed in individuals undergoing antimicrobial treatment (22). Unwise antibiotic practices have the potential to elevate global morbidity and mortality rates, resulting in increased healthcare costs (23).

Education plays a pivotal role in promoting the prudent use of antibiotics (24). It should emphasize the imperative of employing antibiotics only when medically warranted and ensuring the completion of the entire treatment course. Patients should also be well-informed about the potential adverse effects of antibiotics, including adverse drug reactions, and should be educated on how to promptly report these effects to their healthcare providers (24).

In the context of selecting antibiotics for intensive care unit (ICU) patients, it is crucial to consider the most likely source of infection. Optimal outcomes can only be achieved through accurate antibiotic selection. Additionally, antibiotic therapy should be administered for the shortest feasible duration to mitigate the risks associated with resistance, medicalization effects, and the overall burden on the patient (25). While determining the most suitable antibiotic regimen, careful consideration of the pharmacokinetic and pharmacodynamic properties of the specific antimicrobial is essential, as dose adjustments may be challenging due to unexpected dose-exposure relationships (26).

Efficient treatment of sepsis patients with antibiotics hinges predominantly on the timing of administration, particularly for critically ill individuals. Thus, the prompt initiation of antibiotic therapy is imperative for effective treatment. It is essential to communicate the choice of empirical antibiotics to the patient before commencing treatment. When selecting antibiotics for newborns, special attention must be paid to minimizing toxicity and maximizing effectiveness (27).

4. NATIONWIDE TREATMENT RECOMMENDATIONS

The effective management of infectious diseases hinges on the proper administration of antibiotics. To ensure the prudent use of these crucial medications, numerous countries have developed national treatment guidelines. These guidelines are designed to offer precise recommendations on the appropriate use of antibiotics, considering factors such as the causative agents, infection site, illness severity, and other pertinent variables. They undergo regular updates to align with shifting trends in infectious disease epidemiology, emerging resistance patterns, and novel treatment options.

These recommendations encompass specific advice on the selection, administration, and dosing of antibiotics for various infectious conditions. Antibiotic choices are tailored based on the most probable causative organisms, which may vary according to the infection's location. For instance, the guidelines provide distinct antibiotic recommendations for conditions like skin and soft tissue infections, urinary tract infections, and community-acquired pneumonia. Moreover, they offer insights into the judicious use of combination therapy, which may be warranted in severe infections or when the causative agents are unidentified.

National treatment recommendations serve as a pivotal resource for healthcare providers, aiding them in ensuring the appropriate prescription of antibiotics. These guidelines emphasize the significance of employing

antibiotics exclusively when medically necessary, advocating for the selection of the most efficacious and narrow-spectrum antibiotic suitable for the specific infection. Furthermore, they advocate for the utilization of laboratory tests, such as culture and susceptibility testing, to inform antibiotic therapy decisions. Addressing the issue of antibiotic resistance is also a key focus, with recommendations aimed at preventing its development through the prudent use of antibiotics and the avoidance of unnecessary prescriptions. By adhering to these guidelines, healthcare providers can contribute significantly to the preservation of antibiotic efficacy for future generations. Overall, these guidelines stand as an indispensable tool for optimizing patient outcomes while mitigating the risk of antibiotic resistance.

4.1. GASTROINTESTINAL

Bacterial dysentery is a gastrointestinal infection caused by specific types of bacteria. The recommended treatments for bacterial dysentery include ceftriaxone, administered at a dose of 2 mg intravenously once a day for a duration of 5 days, or oral cefixime, dosed at 10-15 mg per kilogram of body weight per day for 5 days. Ceftriaxone is a broad-spectrum antibiotic effective against a wide range of bacteria. Its intravenous administration allows for rapid and efficient delivery of the medication to the site of infection. Alternatively, oral cefixime provides another option for the treatment of bacterial dysentery.
Amoebic dysentery, on the other hand, is caused by the parasite Entamoeba histolytica. The recommended treatment for amoebic dysentery involves metronidazole, prescribed at a dose of 400 mg taken orally three times a day for a duration of 7-10 days. Metronidazole is an antibiotic with efficacy against a broad spectrum of anaerobic bacteria and parasites, including Entamoeba histolytica. Its mechanism of action involves disrupting the DNA of these microorganisms, ultimately leading to their demise.

4.2. CENTRAL NERVOUS SYSTEM

It is of utmost importance to emphasize that the treatment of conditions such as bacterial meningitis, brain abscess, and subdural empyema demands immediate medical attention and should solely be administered by healthcare professionals. National treatment guidelines recommend specific antibiotics for these critical conditions.

In the case of acute bacterial meningitis, the preferred antibiotics are ceftriaxone and cefotaxime. Ceftriaxone is typically administered intravenously (IV) at a dose of 2 grams every 12 hours, while cefotaxime is given at a dose of 2 grams IV every 4-6 hours. The standard treatment duration for bacterial meningitis usually spans 10-14 days, although it may extend longer based on the severity of the infection and the patient's response to treatment.
For brain abscess and subdural empyema, ceftriaxone and cefotaxime are again the recommended antibiotics. Ceftriaxone is typically administered IV at a dose of 2 grams every 12 hours, and cefotaxime at a dose of 2 grams IV every 4-6 hours. The treatment duration for these conditions can also vary, often exceeding the duration required for bacterial meningitis due to the complexity and severity of the infections involved.

4.3. CARDIOVASCULAR SYSTEM

Penicillin G stands out as one of the recommended antibiotics for addressing infective endocarditis, a condition that impacts the inner core of the heart chambers and/or the heart valves. In the treatment of infective endocarditis, the suggested dosage for penicillin G is 20 million units (MU), administered intravenously in divided doses every 4 hours. Depending on various factors such as the causative organism, the patient's age, and their medical history, other antibiotics like vancomycin, gentamicin, and ceftriaxone may also be considered for treatment. The treatment regimen for infective endocarditis typically entails a combination of antibiotics administered over an extended period, often spanning several weeks. It is of paramount importance to adhere to the recommended treatment guidelines and to closely monitor the patient for any signs of complications or adverse reactions to the antibiotics.

4.4. RESPIRATORY TRACT INFECTION

It's worth emphasizing that treatment guidelines for community-acquired pneumonia

can vary depending on factors such as the severity of the illness and the presence of comorbidities. In cases of mild to moderate pneumonia, the typical recommended antibiotic is amoxicillin, administered orally at a dose of 500mg to 1g three times a day (TDS). However, in more severe pneumonia cases or when there are risk factors for drug-resistant bacteria, a combination therapy may be employed, consisting of a beta-lactam antibiotic like ceftriaxone in addition to a macrolide antibiotic such as azithromycin.

When dealing with lung abscesses, the preferred antibiotic choice is typically piperacillin-tazobactam, administered intravenously (IV) at a dose of 4.5 grams every six hours. This combination antibiotic is effective against a broad spectrum of bacteria, including anaerobic organisms, which are frequently implicated in the development of lung abscesses.

4.5. URINARY TRACT INFECTION

Proper antibiotic usage is essential for effectively treating infectious diseases and preventing the emergence of antibiotic resistance. National clinical guidelines for antimicrobial use in infectious diseases provide recommendations for antibiotic usage based on the causative organisms. For instance, bacterial dysentery is typically treated with ceftriaxone at a dose of 2 mg IV once daily for 5 days or oral cefixime at a dose of 10-15 mg/kg/day for 5 days. On the other hand, amoebic dysentery is best managed with metronidazole at a dose of 400 mg orally three times daily for 7-10 days.

Ensuring safe and high-quality healthcare involves the prevention of hospital-acquired infections. Factors like transmission between healthcare workers and patients, as well as inappropriate antibiotic use, can contribute to the development of such infections. In Thailand, the implementation of an Antibiotic Smart Use (ASU) program aims to promote the rational use of antibiotics by assessing prescribing patterns and recommending appropriate therapeutic interventions.

It's important to emphasize that improper antibiotic use can indeed lead to antibiotic resistance, which not only jeopardizes patient health but also increases the financial burden on healthcare systems. Therefore, when making empirical antibiotic decisions, healthcare providers should consider factors such as the site of infection, previous microbiological data, comorbidities, and the severity of the disease. Additionally, the timing of antibiotic administration is often more critical than the specific dosing, and selecting the right antibiotic is essential for achieving the best possible treatment outcomes.

5. THE USE OF ANTIBIOTICS

The presence of higher resistance rates in European Union countries with significant antibiotic usage serves as a stark reminder that antibiotic resistance is a critical issue, impacting both individuals and the wider community (EU-JAMRAI, 2021). The adoption of evidence-based recommendations for the treatment of community-acquired illnesses can significantly enhance the management of common diseases in primary care settings (van der Velden et al., 2013).

It's important to recognize that the development of antibiotic resistance is closely linked to the natural flora of the oropharynx, gastrointestinal tract, and skin. These areas can quickly become colonized by antibiotic-resistant bacteria within days of initiating antibiotic treatment (Spellberg et al., 2019). This underscores the necessity of establishing a rational antibiotic policy as a key strategy in the fight against antimicrobial resistance while simultaneously improving patient care (World Health Organization, 2019).

The primary objectives of antibiotic policies are multifaceted and include reducing healthcare costs, lowering resistance rates, and enhancing the overall quality of antibiotic prescribing practices (Cooke et al., 2015). In the pursuit of these goals, pharmacists emerge as pivotal figures in the effective management of antibiotic policies, and physicians should actively participate in all phases of cost-saving programs (Barlam et al., 2016).

6. PEDIATRIC ANTIBIOTIC PRESCRIPTION TRENDS

A research study conducted among private specialists in Chennai, India aimed to assess the extent of antibiotic usage in children for common diseases and gain insights into the factors influencing antibiotic prescriptions

(39). This study analyzed 403 prescriptions issued by 40 doctors across selected healthcare facilities. The findings revealed that a substantial 79.9% of children diagnosed with both acute respiratory infection (ARI) and attention deficit disorder (ADD) were administered antibiotics. Among the antibiotics prescribed, penicillin emerged as the most frequently recommended, accounting for 43.9% of the cases. Several factors were identified as influencers of antibiotic prescriptions, including the doctor's postgraduate qualification, their experience, their sources and methods of updating medical information, recent work settings, and the presence of fever.

In a tertiary hospital facility, several issues were identified concerning children who were admitted, including polypharmacy, a high reliance on injectable antibiotics, and non-adherence (40-42). The antibiotics most commonly administered in this setting were ceftriaxone and gentamicin, with selection guided by culture and sensitivity tests. It was recommended that a shift to appropriate oral antibiotics whenever feasible would help reduce the long-term cost associated with parenteral antibiotics.

Furthermore, a study conducted over six months in a tertiary care facility in rural Gujarat involving 606 patients shed light on prescription practices (43-45). The research revealed that the average number of medications per prescription was approximately 3.7, and only 20.1% of the medicines were deemed suitable for the children's conditions. Cephalosporins were frequently administered for durations ranging from 1 to 5 days, partly due to the higher incidence of mild infections in children and their increased vulnerability to severe bacterial infections.

7. GERIATRICS' ANTIBIOTIC PRESCRIPTION TREND

The appropriate prescription of antibiotics for elderly patients relies on the enhancement of local antibiotic guidelines and the provision of better training to prescribers. An analysis of the prescription histories of 142 patients revealed that respiratory tract infections, urinary tract infections, skin infections, and stomach infections were the most common conditions for which antibiotics were prescribed. However, a concerning finding was that 50% of the prescribed drugs were deemed inappropriate. Among these prescriptions, 32 were inappropriate in terms of their duration, and 38 were inappropriate in terms of their spectrum of activity. Consequently, it is imperative to implement suitable interventions for both healthcare providers and patients to ensure favorable clinical outcomes in elderly patients (46,47).

7.1. PRESCRIPTION PATTERNS FOR ANTIBIOTICS IN VARIOUS AREAS GASTROINTESTINAL

Gastrointestinal surgery can be associated with post-operative complications that result in considerable morbidity and mortality. Elective surgeries in this particular area pose a heightened risk of complications due to the presence of naturally occurring bacteria within the body, which are a primary source of infections. However, research has demonstrated that when suitable antibiotics are administered as a preventive measure, often based on clinical judgment (empirical treatment), it can significantly reduce the incidence of complications and enhance patient outcomes (48, 49).

8. THE CENTRAL NERVOUS SYSTEM

Diseases affecting the central nervous system represent a significant global contributor to both mortality and morbidity. This challenge is further compounded by the increasing prevalence of antibiotic resistance and our limited understanding of the causes of these diseases. It is crucial to emphasize the early initiation of empirical antibiotic therapy, especially when dealing with conditions like bacteremia, which can be challenging to diagnose accurately. Neurological emergencies such as bacteremia-related encephalopathy and spinal epidural abscess demand swift initiation of empirical antibiotic treatment. Commonly utilized antibiotics in this context encompass medications such as amoxicillin, ciprofloxacin, and aminoglycosides (50-52).

9. CONCLUSION

In conclusion, the proper utilization of

antibiotics plays a pivotal role in the effective management and treatment of a diverse array of illnesses. Nonetheless, the pervasive issue of antibiotic resistance has emerged as a significant global public health concern, primarily attributable to the excessive and inappropriate use of these medications. Consequently, it becomes imperative to adhere to established guidelines and protocols governing the prescription of antibiotics and to exercise prudence in their administration. The judicious use of empirical antibiotics remains critical in numerous scenarios, particularly in the context of severe infections like those affecting the central nervous system or post-operative complications. Nonetheless, equal emphasis should be placed on the identification of the specific causative organisms, facilitating the application of targeted therapy whenever feasible.

REFERENCES

[1]. Antibiotic Use Questions and Answers; 2021. Available from: https://www.cdc.gov/antibiotic-use/q-a.html.

[2]. Gould IM, Bal AM. New antibiotic agents in the pipeline and how they can help overcome microbial resistance. Virulence. 2013;4(2):185–91.

[3]. Aminov RI. The role of antibiotics and antibiotic resistance in nature. Environ Microbiol. 2009;11(12):2970–88.

[4]. Hasan TH, Ra AH. Mechanisms of antibiotic resistance in bacteria. Sys Rev Pharm. 2020;11(6):817–40.

[5]. Kraemer SA, Ramachandran A, Perron GG. Antibiotic pollution in the environment: from microbial ecology to public policy. Microorganisms. 2019;7(6):180. doi:10.3390/microorganisms7060180.

[6]. Romero D, Traxler MF, López D, Kolter R. Antibiotics as Signal Molecules. Chem Rev. 2011;111(9):5492–505.

[7]. Bassetti D, Bassetti M, Mantero E. Strategies for antibiotic selection in empirical therapy. Clin Microbiol Infect. 2000;6(3):98–100.

[8]. Harbarth S, Nobr V, Pittet D. Does antibiotic selection impact patient outcome? Clin Infect Dis. 2007;44(1):87–93.

[9]. Songer CN, Calip GS, Srinivasan N, Barbosa VM, Pham JT. Factors influencing antibiotic duration in culture-negative neonatal early-onset sepsis. .Pharmacotherapy. 2021;41(2):148–61.

[10]. Kollef MH, Shorr AF, Bassetti M, Timsit JF, Micek ST, Michelson AP. Timing of antibiotic therapy in the ICU. Crit Care. 2021;25(1):1–1.

[11]. Baltas I, Stockdale T, Tausan M, Kashif A, Anwar J, Anvar J. Impact of antibiotic timing on mortality from Gram-negative bacteremia in an English district general hospital: the importance of getting it right every time. J Antimicrobial Chemother. 2021;76(3):813–22.

[12]. Ferrer R, Loeches IM, Phillips G, Osborn TM, Townsend S, Dellinger RP. Empiric antibiotic treatment reduces mortality in severe sepsis and septic shock from the first hour: results from a guideline-based performance improvement program. Crit Care Med. 2014;42(8):1749–55.

[13]. Allison MG, Heil EL, Hayes BD. Appropriate antibiotic therapy. Emergency Med Clin. 2017;35(1):25–42.

[14]. Zilahi G, Mcmahon MA, Povoa P, Loeches IM. Duration of antibiotic therapy in the intensive care unit. J Thoracic Dis. 2016;8(12):3774– 80.

[15]. Songer CN, Calip GS, Srinivasan N, Pham JT. Factors influencing antibiotic duration in culture-

negative neonatal early-onset sepsis. Pharmacother: J Hum Pharmacol Drug Ther. 2021;41:148–61.

[16]. Aliberti S, Giuliani F, Ramirez J, Blasi F, Study D. How to choose the duration of antibiotic therapy in patients with pneumonia. CurrOpin Infect Dis. 2015;28(2):177–84.

[17]. Aliberti S, Blasi F, Zanaboni AM, Peyrani P, Tarsia P, Gaito S. Duration of antibiotic therapy in hospitalized patients with community-acquired pneumonia. Eur Respir J. 2010;36(1):128–62.

[18]. Al-Dorzi HM, Eissa AT, Khan RM, Harbi A, Aldabbagh SA, Arabi T, et al. Dosing errors of empirical antibiotics in critically ill patients with severe sepsis or septic shock: A prospective observational study. Int J Health Sci. 2019;13(4):48–55.

[19]. Parker SL, Sime FB, Roberts JA. Optimizing dosing of antibiotics in critically ill patients. CurrOpin Infect Dis. 2015;28(6):497–504.

[20]. Chang JL, Pearson JC, Rhee C. Early Empirical Use of BroadSpectrum Antibiotics in Sepsis. Curr Infect Dis Rep. 2022;24:77–87.

[21]. Mckenzie C. Antibiotic dosing in critical illness. J AntimicrobChemother. 2011;66(2):25–31.

[22]. Crader MF, Varacallo M. Preoperative antibiotic prophylaxis. And others, editor. StatPearls Publishing, Treasure Island (FL); 2017. Available from: https://europepmc.org/article/NBK/nbk442032#freefull-text.

[23]. Adedeji WA. The treasure is called antibiotics. Ann Ib Postgrad Med. 2016;14(2):56–7.

[24]. Ashok Kumar, Neha Kumari, Anjali Singh, Deepak Kumar, Navneet Sharma. The Effect of Cadmium Tolerant Plant Growth Promoting Rhizobacteria on Plant Growth Promotion and Phytoremediation: A review. Current Microbiology (2023); 80:153.

[25]. Tunger O, Karakaya Y, Cetin CB, Dinc G, Borand H. Rational antibiotic use. J Infect Dev Countries. 2009;3(2):88–93.

[26]. Holloway KA. Promoting the rational use of antibiotics. In Regional Health Forum. 2011;15(1):122–30.

[27]. Singh N, Victor LY. Rational empiric antibiotic prescription in the ICU. Chest. 2000;117(5):1496–505.

[28]. Fish DN. Optimal antimicrobial therapy for sepsis. Am J Health Syst Pharm. 2002;59(1):13–22.

[29]. Fish DN. Optimal antimicrobial therapy for sepsis. Am J Health Syst Pharm. 2002;59:13–22.

[30]. Allerberger F, Amann S, Apfalter P, Brodt HR, Eckmanns T, Fellhauer M, et al. Strategies to enhance rational use of antibiotics in hospital: a guideline by the German Society for Infectious Diseases. Infection. 2016;44(3):395–439.

[31]. Singh N, Victor LY. Rational empiric antibiotic prescription in the ICU. Chest. 2000;117(5):1496–505.

[32]. Sharma N, Uzma M, Shah N. Exploring the Genetic Basis of Tuberculosis Susceptibility in Human Populations. International Journal of Chemical and Biochemical Sciences (2023); 23(2): 288-296.

[33]. 7 Navneet Sharma, Y. K. Jaiswal, M. K. Sunil, Gaurav Malhotra, (2011) “Biochemical Parameters in Diabetic and Non-Diabetic Patients Suffering from Gingivitis”, Journal of Pearldent, Vol 2. Issue 2, April – June’11 (46 – 51).

[34]. Alok Tripathi, Navneet Sharma, Surabhi Singhal Turmeric: A medicinal Plant having Medicinal Importance against Cancer. Biotech Today 2019; 9 (2): 33-35.

[35]. Lambert PA. Bacterial resistance to antibiotics: modified target sites. Adv Drug Deliv Rev. 2005;57(10):1471–85.

[36]. Gyssens IC. Antibiotic policy. Int J Antimicrob Agents. 2011;38:11– 20. doi:10.1016/j.ijantimicag.2011.09.002.

[37]. Rautakorpi UM, Klaukka T, Honkanen P, Mäkelä M, Nikkarinen T, Palva E, et al. Antibiotic use by indication: a basis for active antibiotic policy in the community. Scand J Infect Dis. 2001;33(12):920–6.

[38]. Hoiby N. Ecological antibiotic policy. J Antimicrobial Chemother. 2000;46(1):59–62.

[39]. Keuleyan E, Gould IM. Key issues in developing antibiotic policies: from an institutional level to Europe-wide. Clin Microbiol Infect. 2001;7(6):16–21.

[40]. Nathwani D. How do you measure the impact of an antibiotic policy. ? J Hospital Infect. 1999;43:265–8. doi:10.1016/s0195-6701(99)90097-x.

[41]. Milkovich G. The role of the hospital pharmacist in cost control and antibiotic policy. Int J Antimicrob Agents. 2000;16(3):291–5.

[42]. Huovinen P, Cars O. Control of antimicrobial resistance: Time for action: The essentials of control are already well known. BMJ. 1998;317(7159):613–4.

[43]. Bharathiraja R, Sridharan S, Chelliah LR, Suresh S, Senguttuvan M. Factor's affecting antibiotic prescribing pattern in paediatric practice. Indian J Paediatr. 2005;72(10):877–9.

[44]. Mathew R, Sayyed H, Behera S, Maleki K, Pawar S. Evaluation of antibiotic prescribing pattern in pediatrics in a tertiary care hospital. Avicenna J Med. 2021;11(1):15–9.

[45]. Feleke M, Yenet W, Lenjisa JL. Prescribing pattern of antibiotics in pediatric wards of Bishoftu Hospital, East Ethiopia. Int J Basic Clin Pharmacol. 2013;2(6):718–22.

[46]. Hersh AL, Shapiro DJ, Pavia AT, Shah SS. Antibiotic prescribing in ambulatory pediatrics in the United States. Pediatrics. 2011;128(6):1053–61.

[47]. Pichichero ME. Dynamics of antibiotic prescribing for children. JAMA. 2002;287(23):3133–5. doi:10.1001/jama.287.23.3133.

[48]. Mirza NY, Desai S, Ganguly B. Prescribing pattern in a pediatric out-patient department in Gujarat. Bangladesh J Pharmacol. 2009;4(1):39–42.

[49]. Prabahar K. Antibiotics Utilization Pattern in Pediatrics in a Tertiary Care Teaching Hospital. Asian J Pharma. 2017;11(1):230–4.

[50]. Afekouh H, Baune P, Abbas R, Falvelly D, Guermah D, Haber F. Antibiotic prescription evaluation in the rehabilitation ward of a geriatric hospital. Med Mal Infect. 2015;45(11-12):427–35.

[51]. Fadare JO, Agboola SM, Opeke OA, Alabi RA. Prescription pattern and prevalence of potentially inappropriate medications among elderly patients in a Nigerian rural tertiary hospital. Ther Clin Risk Manag. 2013;9:115–20. doi:10.2147/TCRM.S40120.

[52]. Nichols RL. Prevention of infection in high risk gastrointestinal surgery.

Am J Med. 1984;76(5):111–20.

[53]. Schnüriger B, Inaba K, Eberle BM, Wu T, Talving P, Bukur M. Microbiological profile and antimicrobial susceptibility in surgical site infections following hollow viscus injury. J Gastrointes Surg. 2010;14(8):1304–14.

[54]. Tan YC, Gill AK, Kim KS. Treatment strategies for central nervous system infections: an update. Expert OpinPharmacother. 2015;16(2):187–203.

[55]. Lapenna PA, Roos KL. Bacterial infections of the central nervous system. Semin Neurol. 2019;39:334–42.

[56]. Cunha BA. Central nervous system infections in the compromised host: a diagnostic approach. Infect Dis Clin North Am. 2001;15(2):567–90.

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