ANTIBIOTIC USAGE IN PEDIATRICS

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Abstract: Antibiotics are one of the most important classes of medications prescribed by physicians. Proper antibiotic prescribing is an important medical practice skill. Antibiotic misuse is increasing, over prescribing remains widespread. If the gains in the treatment of infectious diseases are to be preserved, clinicians must be wiser and more selective in the use of antimicrobial agents.

Keywords: Antibiotics, Antibiotic resistance, Diseases, Paediatrics, Medicine.

INTRODUCTION:

Antibiotics are the type of antimicrobials used in the treatment and prevention of bacterial infection. They may either kill or inhibit the growth of bacteria. Some antibiotics are also effective against fungi and protozoan's while some are toxic to human and animals, even when they are given in therapeutic dosage. Antibiotics are not effective against viral diseases such as the common cold or influenza and may be harmful when taken inappropriately. Using them unnecessarily would only increase the risk of antibiotic resistance.

Antibiotics are generally safe and should always be taken as prescribed. Antibiotics may alter the effectiveness of other medications and cause side effects or allergic reactions. Antibiotics can kill most of the bacteria in the body that are sensitive to them, including good bacteria by destroying the bacterial balance; it may cause stomach upset, diarrhoea, or other problems. [1]

Physicians can take a culture to see if bacteria are causing a particular illness such as a throat culture to determine the presence of strep throat. For hospital infection and some community acquired infections, the doctor will obtain an antimicrobial susceptibility testing report that indicate which families of antibiotic drugs are useful for the particular bacteria recovered from the infection.[2]

HISTORY OF ANTIBIOTICS:

In 1928 Alexander Fleming identified ***Penicillin***, the first chemical compound with antibiotic properties. Antibiotics revolutionized medicine in the 20th century. The era of antimicrobial chemotherapy began with the discovery of ***Arsphenamine,*** first synthesized by **Alfred Bertheim** and **Paul Ehrlich** in 1907 used to treat syphilis.

The first systemically active antibacterial drug Prontosil was discovered in 1933 **by Gerhard Domagk** for which he wasawarded the 1939 Nobel Prize. All classes of antibiotics in use today were first discovered prior to the 1980.

Antibiotics together with vaccination lead to near eradication of disease such as tuberculosis in the developed world. But effectiveness and easy access of antibiotics leadto it's over use and resistance which has become a serious threat in many countries. It has the potential to affect anyone of any age. [3]

CLASSIFICATIONS:

Antibiotics are commonly classified based on their mechanism of action, chemical structure, or spectrum of activity. Most antibiotics target bacterial functions or growth process. Bactericidal antibiotics works by killing the bacteria and their actions is irreversible. Bacteriostatic antibiotics inhibit growth or reproduction of bacteria; whose actions are reversible .Those that target the bacterial cell wall (***Penicillins***and ***Cephalosporins***) or the cell

membrane (***Polymixins***), or interfere with essential bacterial enzymes (***Rifamycins***, ***Lipiarmycins, quinolones*** and ***sulphonamides***) have antibacterial activities. Those that target protein synthesis (***macrolides,lincosamides, and tetracyclines***)are usually bacteriostatic (with the exception of bactericidal aminoglycosides).

Further categorization target is based on their target specificity. Narrow–spectrum antibacterial antibiotics target specific types of bacteria,Such as Gram-negative or Gram–positive bacteria, whereas Broad–spectrum antibiotics affect a wide range of bacteria. Four new classes of antibacterial antibiotics have been brought into clinical use in the late 2000s and early 2010s: cyclic ***Lipopeptides (Daptomycin), Glycylcyclines (tigecycline) or oxazolidinones (linezolid)and Lipiarmycins (fidaxomycin***). [4]

ANTIBIOTIC GROUPING BY MECHANISM [5]

CELL WALL SYNTHESIES	• Penicillin • Cephalosporin • Vancomycin • Beta-lactamase inhibitors • Carbapenam • Aztreonam • Polymycin • Bacitracin
PROTEIN SYNTHESIS INHIBITORS	• Inhibit 30's subunit ➢ Aminoglycosides ➢ Tetracyclines • Inhibits 50's subunits ➢ Macrolides ➢ Chloramphenicol ➢ Clindamycin ➢ Linezolid ➢ Streptogramins
DNA SYNTHESIS INHIBITORS	• Fluroquinolines • Metronidazole
RNA SYNTHESIS INHIBITORS	• Rifampin
MYCOLIC ACID SYNTHESIS INHIBITORS	• Isoniazid
FOLIC ACID SYNTHESIS INHIBITORS	• Sulphonamides • Trimethoprim

SIDE EFFECTS OF ANTIBIOTICS:

Common side effects include

- Soft stools or diarrhea
- Mild stomach upset
- Allergic reactions such as shortness of breath, hives, swelling of lips, face or tongue and fainting.

ANTIBIOTIC INTERACTIONS:

Antibiotics may have interaction with prescription and non-prescription medications. For example, Clarithromycin should not be taken with metoclopramide prescription [6]

ROUTES OF ADMINISTRATION:

Oral Antibiotics: Tablets, pills and capsules or a liquid can be used to treat most types of mild to moderate infections in the body.

Topical Antibiotics: Creams, lotions, sprays or drops are often used to treat skin infections.

Injections of Antibiotics: Antibiotics can be given as an injection or infusion through a drip directly into blood or muscle, and are usually reserved for more serious infections.[7]

SELECTION OF ANTIMICROBIAL AGENTS:

Most antimicrobial agents requires knowledge of,

The organism's identity

- Characterization of the organism is necessary for the selection of the proper drug.
- A rapid assessment of the nature of the pathogen can be made on the basis of Gram stain, which is particularly useful in identifying the presence and morphological features of microorganisms in body fluids.

The organism's susceptibility to various agents

After a pathogen is cultured, its susceptibility to specific antibiotics serves as a guide in choosing antimicrobial therapy. Confronted by increasing amounts of antibiotics over the past 60 years, bacteria have responded to the deluge with the propagation of progeny no longer susceptible to them.

Some pathogen such as ***Streptococcus pyrogen***and ***Nesseriamenigitidis***, usually have predictable susceptibility patterns to certain antibiotics. In contrast, most Gram negative bacilli, ***Enterococci*** and ***Staphylococcus*** species show unpredictable susceptibility pattern to various antibiotics.

Patient factors

- The status of the patient immune system
- Renal dysfunction
- Hepatic dysfunction
- Poor perfusion
- Age
- Pregnancy
- Lactation
- compliance with treatment

Safety of the agent

Many of the antibiotics such as penicillin are among the least toxic drugs because theyinterfere with a site unique to the growth of microorganism.

While choosing drug for the patient, a least toxic antibiotic with maximum activity should be selected.

Cost of the therapy

Often several drugs may show similar efficiency in treating an infection but vary widely in the cost .Drug with more efficiency must be selected for the treatment.

SELECTING AND INITIATING ANTIBIOTIC REGIMEN:

Obtaining an accurate infectious disease diagnosis

- To optimize an accurate microbiological diagnosis, clinicians should ensure that diagnostic specimens are properly obtained and promptly submitted to the microbiological laboratory, preferably before the initiation of antimicrobial therapy.

Timing of initiation of antimicrobial therapy

- The timing of initial therapy should be guided by the urgency of the situation.

Empiric vs Definitive antimicrobial therapy

- Microbiological results do not become available for 24-72 hrs, initial therapy for the infection is often empiric and guided by the clinical presentation.
- Common approach is to use broad spectrum antimicrobial agents as initial empiric therapy with the intent to cover multiple possible pathogens commonly associated with the specific clinical syndrome.

Interpretation of antimicrobial susceptibility testing (AST) results.

- The goal of AST is to predict the clinical success or failure of the antibiotic being tested against a particular organism.
- AST has some limitations, it is important for both clinicians and laboratory personal to be aware of the site of infection.

DETERMINANTS OF RATIONAL DOSING:

Rational dosing of antimicrobial agent is based on their pharmacodynamics as well pharmacokinetic properties. Three important properties that have a significant influence on the frequency of dosing are:

Concentration dependent killing

Certain antimicrobial agents, including aminoglycosides, Fluroquinolines and Carbapenams show a significant increase in the rate of bacterial killing as the infecting organism attacks the immune system.

Time dependent killing (concentration independent)

The clinical efficiency of antimicrobials that have a non-significant, dose dependent killing effect is best predicted by the percentage of time that blood concentration of a drug remain above the MIC.

Some experts suggest that some severe infections are best treated by continuous infusion of these agents rather than by intermittent drug.

Post antibiotic effect

The post antibiotic effect (PAE) is a persistent suppression of microbial growth that occurs after the levels of antibiotics have fallen below the MIC. The PAE is defined as length of time it takes (after the transfer to an antibiotic free medium) for the culture to achieve the log phase growth. Antimicrobial drugs exhibiting a long PAE (several hours) often require only one dose per day. [8]

COMBINATION OF ANTI MICROBIAL DRUGS:

- . More than one antimicrobial agent is frequently used
- The objectives of using antimicrobial combinations are:
    - To achieve synergism.
    - To reduce severity or incidence of adverse effects.
    - To prevent emergence of resistance
    - To broaden the spectrum of antimicrobial activity. [9]

Host factors to be considered in selection of antimicrobial agents.

- **Renal and hepatic function**

Kidney and the liver are the primary organs responsible for elimination of drugs from the body.

- **Age**

Patients at both extremes of age handle drugs differently, primarily due to difference in body size and kidney function. Most pediatric drug dosing is guided by weight.

- **Genetic variation**

Genetic susceptibility to the adverse effects of antimicrobial agents, which has been demonstrated for several antimicrobial agents, is occasionally significant enough to warrant testing for such variability before administration of certain drugs. [10]

Antibiotic resistance

Antimicrobial resistance is resistance of a microorganism to an antimicrobial drug that was originally effective for treatment of infections caused by it.

Although some people are at greater risk than others, no one can completely avoid the risk of antibiotic-resistant infections. Infections with resistant organisms are difficult to treat, requiring costly and sometimes toxic alternative.The existence of antibiotic resistant bacteria creates the danger of life threatening infections that don't respond to antibiotics. [11]

There are several reasons for the development of antibiotic resistance bacteria; one of the most important thing is antibiotic overuse. This includes the common practice of prescribing antibiotics unnecessarily for the common cold or flu. [12]

Antibiotics can also destroy many of the harmless strains of bacteria that live in and on the body. This allows resistant bacteria to multiply quickly and replace them. It has led to emergence of "superbugs". These are strains of bacteria that have developed resistance to different types of antibiotics and cannot be effectively treated by existing new antibiotics. They include,

- Methicillin resistant *staphylococcus aureus*.
- *Clostridium difficile*.
- The bacteria that cause multidrug resistant tuberculosis.
- Carbapenamproducing*Enterobacteriaceae.*

Antibiotic resistant bacteria can spread from person to person in the community or from patient to patient in the hospital. Careful prescribing of antibiotic will minimize the development of more antibiotic resistant strains of bacteria.

Some bacteria are naturally resistant to some antibiotics. For example benzyl penicillin has very little effect on most organisms found in the human digestive system.

The most serious concern with antibiotic resistance is that some bacteria have become resistant to almost all of the easily available antibiotics. These bacteria's are able to cause serious disease and this is a major health problem. [11]

ANTIBIOTIC THERAPY:

Antibiotics are one of the most important classes of medications prescribed by physicians. Proper antibiotic prescribing is an important medical practice skill.

Antibiotic therapy is initiated in three basic ways.

- Empiric therapy
- Specific therapy
- Prophylaxis.

Empiric therapy

- It is the selection of treatment based on clinical and laboratory information with the exception of culture and sensitivity information.

- It is based on three step process
  - Identifying a clinical condition.
  - Common organisms which cause these condition.
  - Selecting an antibiotic which covers these organisms.

Specific therapy

- Specific therapy is the selection of an antibiotic based on the culture and sensitivity testing of the organism causing the infection, which is usually available 1-3 days later. The general principle is to select the antibiotic which is the most effective with least side effect.
- Additionally, it may be preferable to select antibiotics with the most narrow spectrum to reduce the likelihood of significant alterationin the patient's normal flora.

Prophylaxis

- This refers to the use of Anti-microbial agents (AMA) for preventing the setting in of an infection or suppressing contacted infection before it becomes clinically manifested.
- The difference between treating and preventing infection is that treatment is against a specific organism infecting an individual patient. While prophylaxis is often against all organism capable of causing infection. [12]

PEDIATRICS:

Pediatrics is the specialty of medical science concerned with the physical, mental, and social health of children from birth to young adulthood.

Abraham Jacoby (1830-1919) is known as the father of paediatrics because of his contributions to the field. Providing effective drug therapy for neonates, infants, children and adolescents remains a challenge for all those working in the field of paediatrics medicine. Children pose special challenges in the drug order and delivery process. Drug dosages are often calculated individually leading to increased chances of errors.

DRUG TTHERAPY IN CHILDREN:

CATEGORY	MEAN WEIGHT PER AGE (lb)	MEAN WEIGHT PER AGE (Kg)	PERCENTAGE OF ADULT DOSE (%)
New born	7.7	3.5	12.5
2 months	10	4.5	1.5
4 months	14	6.5	20
1 year	22	10	25
3 year	33	15	33.3
7 year	50	23	50
10 year	66	30	60
12 year	86	39	75
14 year	110	50	80
16 year	128	58	90
Adult	150	68	100

For selecting a method of dosage calculation, the therapeutic index of the drug, should be considered. For agents with narrow therapeutic index, such as cytotoxic agents, where recommendations are quoted per square meter, dosing must be based on the calculated surface area.

For drugs with wide therapeutic index, such as penicillin, single dose may be quoted for a wide age range. Between these two extremes, doses are quoted in milligrams per kilogram and this is most widely used method for calculations.

Factors to be considered

- Age
- weight
- Surface area
- Appropriate dose
- Appropriate interval
- Route of administration based upon the disease state, preparations and the formulations available
- Infections
- Legal considerations[13]

Antibiotics in pediatrics

- Antibiotics are considered to be the main stay of treatment for paediatrics and are the second leading drug prescribed according to the National ambulatory medical care surveys. The choice of antibiotics for infants and children are usually empiric. [14]

- Lack of data on important pharmacokinetic and pharmacodynamics differences have led to several terrible situations in paediatric care.Main obstacleoccurs during infancy and childhood where there is rapid stage of development in various organs, enzymes and body systems that handle drugs and their dosages. So, consideration of age is appropriate while choosing the drug for children.

Pediatric dosing

Paediatric dose is important since, there is no standard dose.

All recommended dosages are based on:

- **Body weight in kilograms**
- **Body Surface Area [15]**

1.13.4 General considerations

- Only 1/4th of drugs approved by FDA are specific for paediatrics.
- Lack of information on pharmacokinetics, pharmacodynamics, safety and efficacy of drugs in paediatrics leads to many disasters like:
    - Gray baby syndrome (chloramphenicol)
    - Phocomelia (thalidomide)
    - Kernicterus (sulphonamide)
- There is limited information on selection, dosing and monitoring of drugs in paediatric population.
- Areas of concern in paediatrics:
    - Identify optimal dose
    - Dosage form
    - Adherence

1.14 ASSESSMENT OF RENAL FUNCTION

In pediatrics,organs will not develop in initial stages. So while choosing drugs and doses we should also consider these equations.

- ***TRAUB and JOHNSON***

(Age 1- 18 years)

CrCl = 42x height/ S.cr

- ***COUNHAHAN***
  (Age 2 months -14 years)

CrCl =38xheight/ S.cr

CrCl = creatinine clearance in ml/min/1.73 m.sq

Height = height in cm

S.cr = serum creatinine in (μmol/l)

These equations should not be used in patients with rapidly changing renal function, anorexia or obesity.

PEDIATRIC CALCULATIONS

Changing requirement for drug dosage during childhood corresponds most closely with change in body surface area.

DOSE CALCULATION RELATED TO AGE	
FRIED' S FORMULA	Child's dosage : Age in month× adult dosage / 150
YOUNG'S RULE	Child's dosage :Age of child in years×adult dosage / Age of child In years +12
DILLING'S RULE	Child's dosage:Age of child in years x Adult dose / 20
DOSE CALCULATION RELATED TO BOGY WEIGHT	
CLARK'S RULE	Child's dosage : Child's weight in pounds×adult dosage / 150
DOSE CALCULATION RELATED TO BODY SURFACE AREA	
BODY SURFACE AREA RULE	Child's dosage:BSA (m²) of child x Adult dose / ∗ Average adult body surface area

*An average adult of 70kg, 175cm has a body surface area of 1.85m2. [16]

Local and national efforts such as the centers for disease control and prevention's *'get smart program'* have tried to decrease inappropriate use of antibiotics.

American Academy of paediatrics, have long promoted judicious use of antibiotics by issuing treatment guidelines for common pediatric infections. Judicious use of antibiotics includes providing adherence to prescribing guidelines, not using antibiotics for probable viral infections, and using the narrowest spectrum agent that is active against the targeted pathogens. [15]

Antibiotics are commonly prescribed for upper respiratory tract infections (URTI) when they are not required. New and expensive antibiotics are preferred, even in rural areas, without knowledge about their safety and efficiency. The duration of the use of antibiotics is often not regulated and the caregivers frequently do not continue the drug for the prescribed period. These practices lead to the emergence of drug resistant strains not only of the causative bacteria but also for other bacteria present in the environment.

Antibiotic resistance amongst the common pneumonia causing bacteria (*streptococcus pneumonia* and *Haemophilus influenza B)* is being reported with increasing frequency worldwide including India. Unnecessary

antibiotic use also leads to wastage of health care resources, and unnecessarily exposes patient to risk of adverse effects. Under-utilization and misuse of antibiotics are thus the two key features of the current scenario which is to be addressed.

One needs to address the following 3 questions to rationalize the use of antibiotics.

- Decision on antibiotic
- Choice of antibiotic
- Appropriate regimen

Antibiotic misuse is increasing, over prescribing remains widespread. It is driven largely by patient demand, time pressure on clinicians and diagnostic uncertainty.

If the gains in the treatment of infectious diseases are to be preserved, clinicians must be wiser and more selective in the use of antimicrobial agents. [17]

Irrational prescribing is a habit that is difficult to cure and the impact of medication misadventures are still tremendous costly problem. Prevention is possible by intervention such as short problem based training course in pharmacotherapy and rational use focused workshops.[18]

Antibiotics are frequently and irrational prescribed for children for viral conditions such as common colds, laryngitis, bronchitis, sore throat despite their non-recommendations according to the standardized guidelines. There is a need to increase doctor's awareness of the lack of proven benefits, the definitive cost and side effects of many prescriptions for the self-limiting illness. [19]

Antibiotic treatment prescribed in most of the paediatrics cases are without doing much culture sensitivity test which may lead to irrational prescription. Efforts to improve the rational antibiotic prescribing practices are needed for all pediatricians and parents who care for their children.

The manner in which the antibiotics are prescribed by the pediatrician's needs further studies about decision making on more appropriate and cost effective prescribing and patient health-seeking behavior. Using the national guideline-based medicine and standardized guidelines for pediatrics unnecessary increased antibiotic prescription can be reduced.

Therefore, implementing strategies that promote rational use of antibiotics in children and close monitoring of antibacterial use at national, regional and local level are important public health priorities in order to find problematic areas and trends of antibiotic prescribing and to preserve the efficacy of these vital drugs. [20]

Recent studies have shown that not adopting guidelines has led to antibiotic prescription mistakes in pediatrics in terms of dose or duration.In the medicine practice, there is a growing concern regarding the irrational prescription pat-tern and use of antibiotics. The treatment of diseases by the use of essential drugs, prescribed by their generic names, has been emphasized by WHO and National health policy of India.

The study of prescribing patterns is a part of the medical audit and seeks to monitor, evaluate, and modifications in prescribing practices are necessary to make medical care rational and cost-effective.[21]

POLICY FOR GOOD ANTIBIOTIC PRACTICE:

General Principles

Antibiotics do not merely treat infections but affect the microbial environment within and beyond the patient. They must be used appropriately and with care.

Antibiotic resistance is a threat to the effective treatment of infections. To lower the risk of developing antibiotic resistance, antibiotics which are likely to be bactericidal to the pathogen at the site of infection should be chosen.

Antibiotics should be used in adequate doses and for an adequate duration. However to prevent unnecessary use, antibiotics must be prescribed for the shortest duration likely to be effect.

If a senior clinician has a good reason to prescribe a non-restricted antibiotic outside the policy then this should be very clearly documented in the medical notes and the prescription endorsed with the indication.

Review all sensitivity results daily and always change to the sensitive antibiotic with the narrowest spectrum.

For surgical prophylaxis use a single dose of antibiotic wherever appropriate. Where prophylaxis is to be continued for longer than 24 hours, document the reasons clearly in the notes.

If at surgery there is evidence of infection then document the details of antibiotic required, route and review date or duration. Do not confuse prophylaxis and treatment. Refer to the BNF for Children for dosing guidance unless specified in the policy.

Indication

The indication for all antibiotics should be documented on the drug chart by the prescriber.

For all infections the specific diagnosis should be documented clearly in the medical notes and the indicators for making the diagnosis (↑ WBC, ↑temp >38°C, evidence of inflammation, fluid collection, ↑CRP etc).

For all restricted antibiotics used outside the indications in the policy the prescriber should discuss the choice of antibiotic with the microbiologist and write the indication and "Discussed with microbiologist" on the drug chart.

This allows the consultant microbiologist to check any microbiology reports and monitor resistance issues carefully. The full advice, time and name of consultant microbiologist should be recorded in the notes. Pharmacy will not dispense restricted antibiotics without first confirming the indication and if it is outside policy that the consultant microbiologist has been involved in the decision.

Stat Doses

To prevent delay in the initiation of antibiotic treatment **the first dose should be written as a STAT dose on the front of the prescription chart,** stating the time to be given.

Duration

All antibiotic prescriptions must be for a defined duration only. The prescriber may need to review the patient and extend the duration of treatment if clinically necessary, but again for a defined period only.

When discussing choice of antibiotics with the microbiologist confirm and document the recommended duration.

Antibiotics should be reviewed after 48 hours (earlier if appropriate), unless prescribed for a high risk or deep seated infection requiring longer IV treatment.

A review or stop date should always be indicated on the drug chart by the prescriber for all antibiotics.

For all completed antibiotic courses where the patient has received the specified course length of antibiotics but the doctor has not crossed it off the chart so there is a risk that further doses could be given, the pharmacist will cross off the antibiotic, sign, date and endorse the card “course completed”.

Missed Doses

Antibiotic doses should not be missed unless unavoidable. Missed doses are everyone’s responsibility and should be investigated and the treatment route or dose reviewed as necessary to ensure administration and compliance.

RESTRICTED ANTIBIOTICS IN PAEDIATRICS:

Certain antibiotics are restricted in their use and availability. For empiric therapy, use only in circumstances stated below or discuss with the consultant microbiologist before prescribing. Endorse the prescription with the indication and whenever the microbiologist has been contacted always add "discussed with microbiologist".

Where reported sensitivities are to a restricted antibiotic then prescribe the antibiotic and endorse the chart "as per sensitivities". In addition, document all these clearly in the medical notes, with the name of the microbiologist. [23]

Restricted antibiotic use in paediatrics

ANTIBACTERIAL DRUG CLASSIFICATION	ANTIBACTERIAL DRUG	COMMENT
Beta-Lactam Antibiotics	Meropenem Ertapenam	
Aminoglycosides	Tobramycin injection Tobramycin nebules	For pediatric patient with cystic fibrosis only
Macrolides	Azithromycin syrup and capsules	Can be used for pediatrics third line where compliance is an issue.
Quinolones	Ciprofloxacin tablets, suspension and infusion. Levofloxacin tablets and injections.	For Cardiac Failure patients.
Other antibiotics	Chloramphenicol injection. Colistin injection for nebulised use Daptomycin injection Linezolid inj, tablets and suspensions	For use in penicillin allergic patients. For Cardiac Failure patients only.

CAREFUL ANTIBIOTIC USE:

Practice tips

When parents ask for antibiotics to treat viral infections:

Explain that unnecessary antibiotics can be harmful.

- Tell parents that based on the latest evidence, unnecessary antibiotics can be harmful, whichpromotes resistant organisms in their child and the community.
- Explain that bacterial infections can only be cured by antibiotics, not the viral infections.

Build cooperation and trust

- Convey a sense of partnership and don't dismiss the illness as "only a viral infection".

Encourage active management of the illness

- Explicitly plan treatment of symptoms with parents. Describe the expected normal time course of the illness and tell parents to come back if the symptoms persist or worsen.

Be confident with the recommendation to use alternative treatments.

- Prescribe analgesics and decongestants, if appropriate.
- Emphasize the importance of adequate nutrition and hydration.
- Consider providing "care packages" with non-antibiotictherapies.
- Create an office environment to promotethe reduction in antibiotic use.

Talk about antibiotic use at 4 and 12 month well child visits.

- The AAP Guidelines for Health Supervision III (1997) now include counselling on antibiotic
- Uses as an integral part of child care.

Start the educational process in thewaiting room.

- Videotapes, posters, and other materials areavailable.(www.cdc.gov/ncidod/dbmd/antibioticresistance)

Involve office personnel in the educational process.

- Reinforcement of provider messages by office staff can be a powerful adjunct to change patient attitudes.

Use the CDC/AAP pamphlets and principles to support your treatment decisions.

- Provide information to help parent's understand when the risks of using antibiotics outweigh the benefit. [24]

The quality of medical care relies on judicious prescription which is appropriate, safe, effective and economic. The aim of physician should be to achieve maximum clinical benefit at cost effective price. [25]

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