A brief journey from Sulpha Drug to Modern Antibiotics: Molecular Architectural Approach

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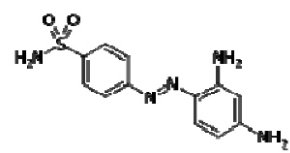
Abstract:

The amide of sulfanilic acid and certain related substituted amides are of considerable medical importance as the sulfa drugs. Although they have been supplanted to a wide extent by the antibiotics (e.g. Penicillin, Terramycin, Chloromycetin etc), the sulfa drugs still have their medical uses and make up a considerable portion of the output of the pharmaceutical industry. With the passage of time more and more sophisticated and specific antibiotics are discovered. Here is the brief discussion about the currently used popular Antibiotics in their structural point of view.

Many micro-organisms produce within themselves chemical substances which when excreted interfere with growth or metabolism of other micro-organisms. Such compounds are known as antibiotics.

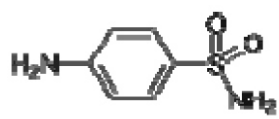
Prontonsil was the first sulpha drug ever discovered that could effectively treat a range of bacterial infections in side the body. Sulpha drugs save life of tens of thousands of patients during world war-II including Winston Churchill & Franklin Delano Roosevelt Jr in 1936.

Prontosil:



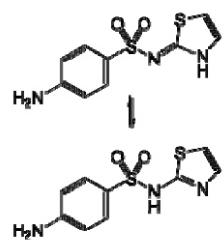
It was suggested that Prontosil broke down in the body to sulphanilamide.Actullay sulphanilamide was the active intermediate against the bacteria.

Sulphanilamide:



Another well known sulpha drug is:

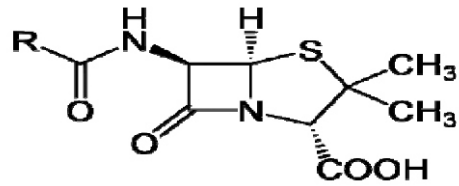
Sulphathiazole:



In 1929 Fleming discovered a mould of the Pencilliim species which inhibited the growth of certain bacteria. The full classification antibiotic is very difficult. However some of the potent antibiotic are discussed in the light of their structural variation.

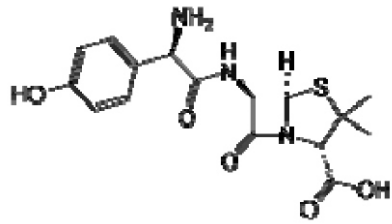
Penicillins:

Penicillin-G



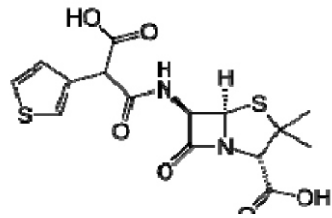
Penicillin is a group of antibiotics which include penicillin G, penicillin V and procaine penicillin. Penicillin antibiotics were among the first medications to be effective against many bacterial infections caused by staphylococci and streptococci. Penicillins are still widely used today, though many types of bacteria have developed resistance.

Amoxycillin:



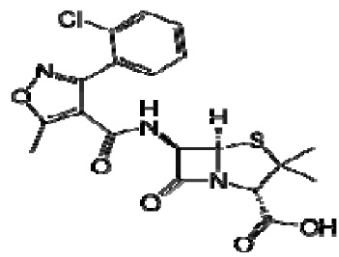
Amoxicillin is an antibiotic useful for the treatment of a number of bacterial infections. It is the first line treatment for middle ear infections. It may also be used for pneumonia, skin infections, and urinary tract infections among others.

Ticarcillin:



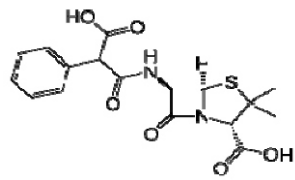
Ticarcillin is a carboxypenicillin. Because it is a penicillin, it also falls within the larger class of beta-lactam antibiotics.

Cloxacillin:



Cloxacillin is an antibiotic useful for the treatment of a number of bacterial infections. This includes impetigo, cellulitis, pneumonia, septic arthritis and otitis externa.It is not effective for Methicillin-resistant Staphylococcus aureus.

Carbenicillin:

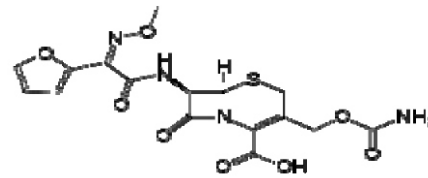


Carbenicillin is a bactericidal antibiotic belonging to the carboxypenicillin subgroup of the penicillins. It was discovered by scientists at Beecham. It has Gram-negative coverage which includes Pseudomonas aeruginosa but limited Gram-positive coverage.

Cephalosporins:

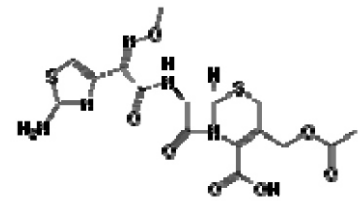
Cefuroxime:

Cefuroxime is a useful second-generation cephalosporin antibiotic. It was discovered by the Glaxo, now GlaxoSmithKline.



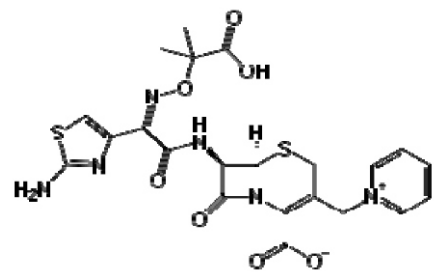
Cefotaxime:

Cefotaxime is an antibiotic used to treat a number of bacterial infections. Specifically it is used to treat joint infections, pelvic inflammatory disease, meningitis, pneumonia, urinary tract infections, sepsis, gonorrhea and cellulites.



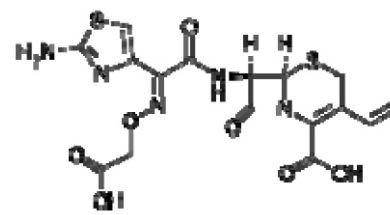
Ceftazidime:

Specifically it is used for joint infections, meningitis, pneumonia, sepsis, urinary tract infections, malignant otitis externa, pseudomonas aeruginosa infection and vibrio infection.



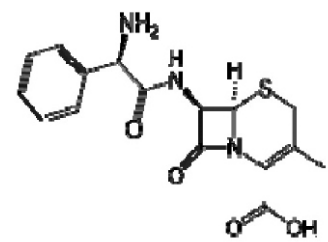
Cefixime:

Cefixime is an antibiotic useful to treat a number of bacterial infections. This includes otitis media, strep throat, pneumonia, urinary tract infections, gonorrhea and Lyme disease.



Cefalexin:

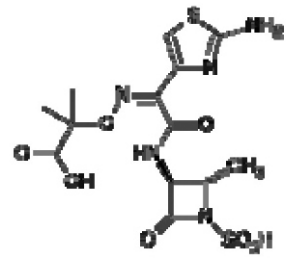
Cefalexin also spelled cephalexin, is an antibiotic that can treat a number of bacterial infections. It kills gram-positive and some gram-negative bacteria by disrupting the growth of the bacterial cell wall.



Monobactam:

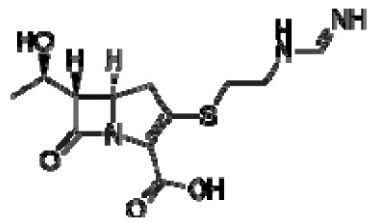
Aztreonam:

Aztreonam is a monobactam antibiotic used primarily to treat infections caused by gram-negative bacteria. It is a synthetic drug based on a simpler monobactam isolated from Chromobacterium.



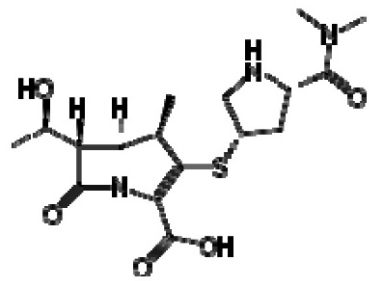
Carbapenems:

Imipenem is a β-lactam antibiotic discovered by Merck scientists Burton Christensen, William Leanza, and Kenneth Wildonger in 1980. It was the first member of the carbapenem class of antibiotics.



Meropenum:

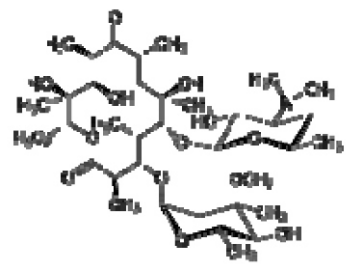
Meropenem is an ultra-broad-spectrum antibiotic used to treat a wide variety of infections. It is a β-lactam and belongs to the subgroup of carbapenem, similar to imipenem and ertapenem.



Macrolids:

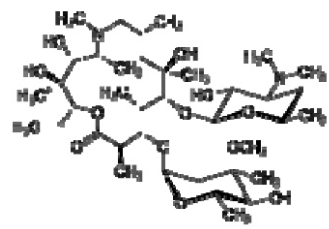
Erythromycin:

Erythromycin is an antibiotic useful for the treatment of a number of bacterial infections. This includes respiratory tract infections, skin infections, chlamydia infections and syphilis. It may also be used during pregnancy to prevent Group B streptococcal infection in the newborn.



Azithromycin:

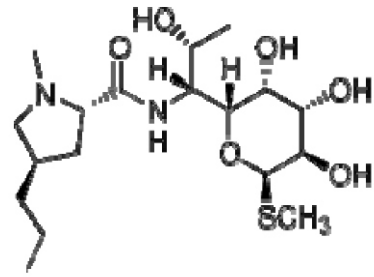
Azithromycin is an antibiotic useful for the treatment of a number of bacterial infections.This includes middle ear infections, strep throat,



pneumonia, traveler's diarrhea and certain other intestinal infections. It may also be used for a number of sexually transmitted infections including chlamydia and gonorrhea infections.

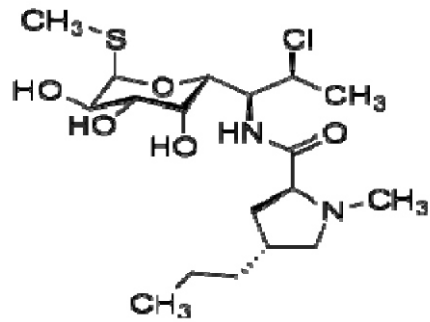
Lincosamide:

Lincosamides are a class of antibiotics which include lincomycin, clindamycin and pirlimycin.



Clindamycin:

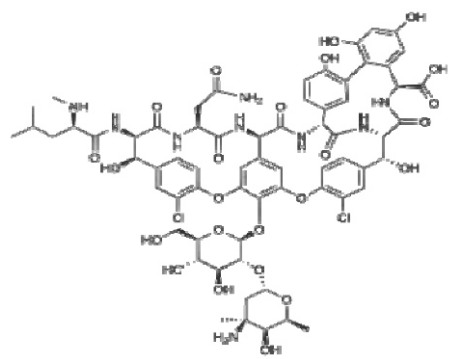
Clindamycin is an antibiotic useful for the treatment of a number of bacterial infections. This includes middle ear infections, bone or joint infections, pelvic inflammatory disease, strep throat, pneumonia and endocarditis among others. The structure is as follows:



Glycopeptides:

Vancomycin

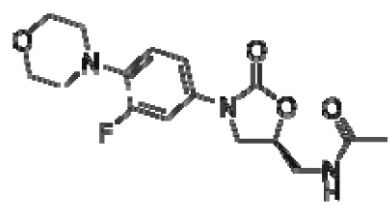
Vancomycin is an antibiotic used to treat a number of bacterial infections. It is used as a first-line treatment for complicated skin infections, bloodstream infections, endocarditis, bone, joint infections and meningitis caused by methicillin-resistant S. aureus.



Oxazolidinone:

Linezolid:

Linezolid is an antibiotic used for the treatment of infections caused by Gram-positive bacteria that are resistant to other antibiotics. Linezolid is active against most Gram-positive bacteria that cause disease,



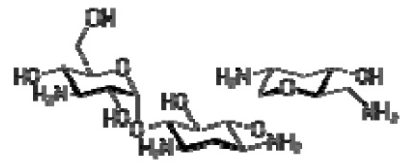
including streptococci, vancomycin-resistant enterococci (VRE), and methicillin-resistant Staphylococcus aureus (MRSA).

Aminoglycosides:

Gentamicin:

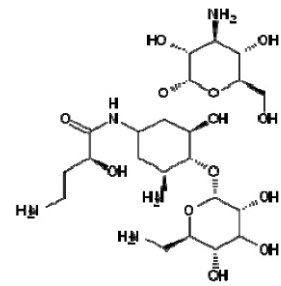
Gentamicin is an antibiotic used to treat several types of bacterial infections. This may include bone infections, endocarditis, pelvic inflammatory disease, meningitis, pneumonia, urinary tract infections and sepsis among others.

Tobramicin:



This is an example of aminoglycoside antibiotics.

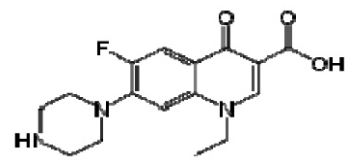
Amikacin:



These is an example of aminoglycoside antibiotics.

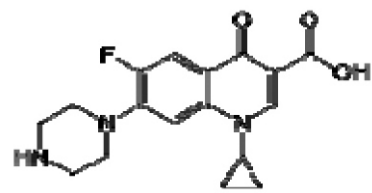
Fluoroquinolones:

Norfloxacin:



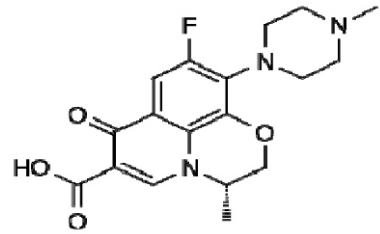
Norfloxacin an antibiotic used to treat a numbe includes bone and joint infections, intra abdomir infectious diarrhea, respiratory tract infections, s urinary tract infections and among others.

Ciprofloxacin:



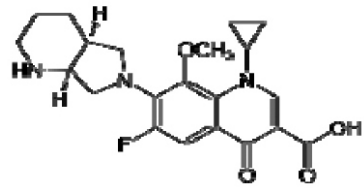
Ciprofloxacin is an antibiotic used to treat a number of bacterial infections. This includes bone and joint infections, intra abdominal infections, certain type of infectious diarrhea, respiratory tract infections, skin infections, typhoid fever and urinary tract infections, among others.

Levofloxacin:



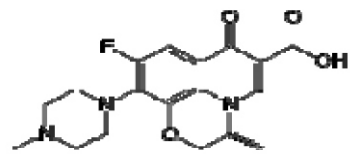
Levofloxacin is another important an antibiotic. It is used to treat a number of bacterial infections including acute bacterial sinusitis, pneumonia, urinary tract infections, chronic prostatitis and some types of gastroenteritis.

Moxifloxacin:



Moxifloxacin is a fourth-generation synthetic fluoroquinolone antibacterial agent developed by Bayer AG.

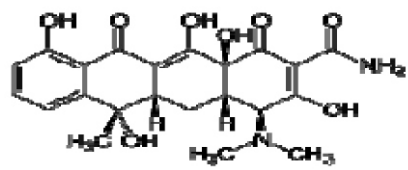
Ofloxacin:



Ofloxacin is a synthetic antibiotic of the fluoroquinolone drug class considered to be a second-generation fluoroquinolone. Ofloxacin is a racemic mixture which consists of 50% levofloxacin (the biologically active component) and 50% of its "mirror image" or enantiomer dextrofloxacin. Ofloxacin has been associated with adverse drug reactions, such as tendon damage and peripheral neuropathy (which may be irreversible).

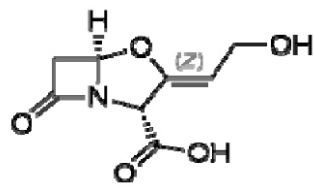
Tetracyclines

Tetracycline:



Tetracycline is an antibiotic used to treat a number of bacterial infections. It is commonly used to treat acne and rosacea. Historically it was important in reducing the number of deaths from cholera.

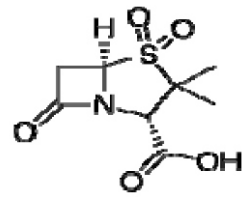
Clavulinic Acid:



Clavulanic acid is a β-lactam drug that functions as a mechanism-based β-Lactamase inhibitor.

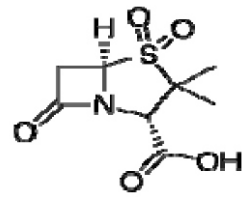
Tazobactam:

Tazobactam is a pharmaceutical drug that inhibits the action of bacterial β-lactamases, especially those belonging to the SHV-1 and TEM groups.



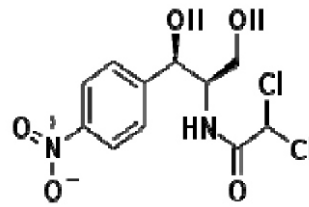
Sulbactam:

Sulbactam is a β-lactamase inhibitor. This drug is given in combination with β-lactam antibiotics to inhibit β-lactamase, an enzyme produced by bacteria that destroys the antibiotics.



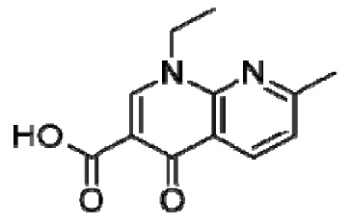
Chloramphenicol:

Chloramphenicol is an antibiotic useful for the treatment of a number of bacterial infections. This includes meningitis, plague, cholera and typhoid fever.



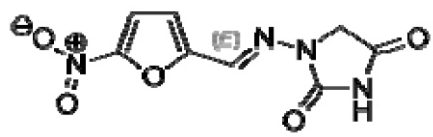
Nalidixic Acid:

Nalidixic acid is effective primarily against gram-negative bacteria, with minor anti-gram-positive activity. In lower concentrations, it acts in a bacteriostatic manner that is it inhibits growth and reproduction. In higher concentrations, it is bactericidal, meaning that it kills bacteria instead of merely inhibiting their growth.



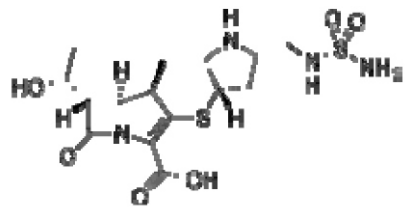
Nitrofurantoin:

Nitrofurantoin is an antibiotic used to treat bladder infections. It is not effective for kidney infections.

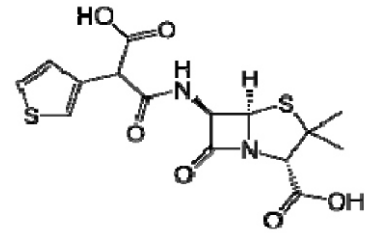


Doripenem:

Doripenem is an ultra-broad-spectrum antibiotic. It is a beta-lactam and belongs to the subgroup of carbapenems.

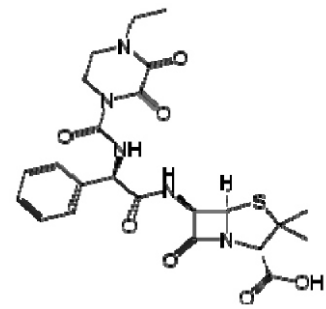


Ticarcillin:



Ticarcillin is a carboxypenicillin. It is almost invariably sold and used in combination with clavulanate. Because it is a penicillin, it also falls within the larger class of beta-lactam antibiotics.

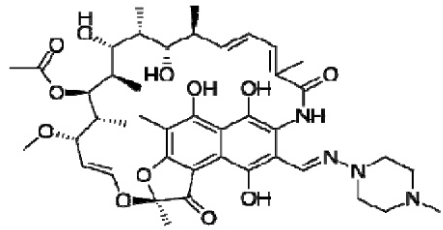
Pipercillin:



Piperacillin/tazobactam is a β-lactam/β-lactamase inhibitor combination with a broad spectrum of antibacterial activity encompassing most Gram-positive and Gram-negative aerobic bacteria and anaerobic bacteria, including many pathogens producing β-lactamases. Evidence from clinical trials in adults has shown that piperacillin/tazobactam, administered in an 8 **:** 1 ratio, is an effective treatment for patients with lower respiratory tract, intra-abdominal, urinary tract, gynaecological and skin/soft tissue infections, and for fever in patients with neutropenia. Combination regimens of piperacillin/tazobactam plus an aminoglycoside are used to treat patients with severe nosocomial (hospital-acquired) infections. In clinical trials, piperacillin/tazobactam was significantly more effective than ticarcillin/clavulanic acid in terms of clinical and microbiological outcome in patients with community-acquired pneumonia. In patients with intra-abdominal infections, clinical and bacteriological response rates were significantly higher with piperacillin/tazobactam than with imipenem/cilastatin.

Piperacillin/tazobactam in combination with amikacin was at least as effective as ceftazidime plus amikacin in the treatment of ventilator-associated pneumonia and was significantly more effective than ceftazidime plus amikacin in the empirical treatment of febrile episodes in patients with neutropenia or granulocytopenia. In other trials, the efficacy of piperacillin/tazobactam was similar to that of standard aminoglycoside-containing and other treatment regimens in patients with intra-abdominal, skin/soft tissue or gynaecological infections. Piperacillin is a broad-spectrum β-lactam antibiotic of the ureidopenicillin class. The chemical structure of piperacillin and other ureidopenicillins incorporates a polar side chain that enhances penetration into Gram negative bacteria and reduces susceptibility to cleavage by Gram negative beta lactamase enzymes.

Refampicin:



Rifampicin also known as rifampin, is an antibiotic used to treat several types of bacterial infections.This includes tuberculosis, leprosy and Legionnaire's disease. It is almost always used along with other antibiotics.

Even though a number of antibiotics are now a days discovered and several other in pipe line, they are being used for the treatment of several diseases for both human & animals. It was a most potential medicines which are found to be much effective in the treatment of many diseases. However there is no potential antibiotics against bacteria like Acitanobactor &Kirabsilla etc for terminally ill patient. So these drugs are needed to be modified further to improve their action and make them more specific and effective.

References:

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*** This paper is dedicated to my mother Smt. Sumita Mukherjee on her 75th birth day***