Methodology of Prevention of Antibiotic Resistance

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Antibiotics have been used since the 1940s to treat infections. These drugs have significantly reduced morbidity and mortality from infections. When used appropriately antibiotics can make a huge difference to patient care. Due to the wide spread use of these drugs, microbes have adapted to them, making them less effective. Patients infected with resistant organisms are more likely to have longer, more expensive hospital stays and have higher mortality due to the infection.

Treating a serious infection is a balancing act between timely appropriate empiric antibiotic therapy and avoiding unnecessary antibiotics. This means sending appropriate cultures prior to initiating therapy, targeted treatment, de-escalation once the pathogen is identified with susceptibilities and shorter courses of antibiotics at the appropriate doses.

Rapidly increasing antibiotic resistance is one of the major clinical, epidemiological and microbiological problems facing the medical fraternity. This problem needs to be tackled head on using a multi-pronged approach.

Send Appropriate Samples for Investigation and Target the Pathogen

It is essential to thoroughly work up the patient with infection. It may turn out that the patient is being treated empirically with antibiotics for a viral infection. Such a result leads to cessation of antibiotic therapy which would have otherwise been used inappropriately. Also de-escalation of antibiotics is only possible once culture identifies the pathogen and provides antibiotic susceptibilities.

From an epidemiological perspective it is very important to have local data on the common pathogens causing specific infections and their susceptibilities. This enables the clinician to make an informed choice when treating an infection empirically. Also if pathogens are treated appropriately up front, better cure rates are observed with reduced mortality.

Treat the Infecting Organism and not the Contaminant / Colonizer

When clinicians see a microbiology result which states the organism isolated with its susceptibilities, they feel compelled to treat the culture result even in the absence of other signs of infection. This can be prevented by ensuring that the patient meets the criteria for infection before going ahead with unnecessary treatment. Clinicians need to be aware of common contaminants that may be isolated from cultures.

Often when antibiotics are started there is a reluctance to stop them. Many patients who get treated with antibiotics do not have infection and if one cannot establish the presence of infection, one should consider stopping the antibiotics at the earliest point.

Daily Check on Devices

When bacteria come in contact with surfaces such as intravascular catheters they see it as a favourable environment than the planktonic phase. The initial interaction with the surface is with cell organelles such as pili and flagella. Microcolonies are then formed. Then exopolysaccharide is produced which stabilizes the biofilm. Biofilm serves to protect the organisms from antimicrobials and also inhibits immune function by interfering with neutrophil function and inhibiting cellular immunity. Hence any device inserted in a patient is a nidus for infection.

Clinicians need to do a daily check on the devices inserted in the patient and their ongoing need. Devices may be inserted and then forgotten about resulting in life threatening infections eg bacteraemia from a central venous venous catheter that was no longer required. Any device that is not in use should be promptly removed.

Access the Experts

Infectious diseases specialists deal with infections on a daily basis and have a wealth of experience in treating difficult infections. Clinicians should consult them when dealing with difficult cases so that the patient gets early appropriate therapy leading to better outcomes. It is not realistic to expect a general physician or surgeon to keep up to date with all the developments in the field of infectious diseases. Hence they need to access the specialists in the field at the earliest.

Vaccinate

In the year 2000 the Advisory committee on Immunization Practices recommended that all children under 2 years of age in the United States be vaccinated with the pneumococcal conjugate vaccine. This vaccine has prevented more than 70% of severe pneumococcal infections. Due to herd immunity even unvaccinated children benefited. The added benefit is that the herd immunity extends to older adults (grand parents). As the number of infections reduces, the number of antibiotic prescriptions also reduces. This is a very effective way of reducing antibiotic use.

The yearly influenza virus vaccine for seasonal influenza would also lead to a reduction in visits to the doctor and thereby a reduction in antibiotic prescriptions.

Antimicrobial Stewardship

Antimicrobial stewardship is the ongoing effort by a healthcare institution to optimize antimicrobial use among hospitalized patients to improve patient outcomes, ensure cost effective therapy and reduce adverse sequelae of antimicrobial use (including antibiotic resistance). It has many components. Educating clinicians is of paramount importance as they need to understand that prescribing an antibiotic to a patient does not only affect the patient but has an impact on the bacterial flora of the hospital. Formulary restriction is a method of restricting the use of high end antibiotics, such that they can only be prescribed post authorization by an infectious diseases specialist. The program needs to be spear headed by the antimicrobial management team, which is a multi-disciplinary team consisting of a microbiologist, infectious diseases specialist and antibiotic pharmacist. This group should audit the use of antibiotics, perform surveillance of resistance data and provide a timely feedback to clinical teams. Dose optimization, de-escalation,
patients being positioned at 30° to 45°. Staff education should be done on a regular basis to emphasize the importance of these infection control measures.

### Infection Control

In the current era of increase in antibiotic resistance, good infection control plays a key role in controlling the spread of resistance. Good hand hygiene practices still form the backbone of a good infection control program. Staff need to be educated on the importance of hand hygiene, when it should be performed and with what (soap and water or alcohol gel). Regular audits should be done and timely feedback provided to the staff. The reasons for poor compliance are many and they need to be investigated. Contact precautions need to be adhered to, with isolation of patients harbouring resistant organisms (if possible).

Staff performing invasive procedures should adhere to practice guidelines e.g. insertion of central venous catheter requires maximal sterile barrier precautions such as sterile gloves, cap, mask, gown and large sterile drape. Once an invasive procedure is performed it is important to take adequate precautions to prevent infections e.g. invasively ventilated patients changing the route of administration from intravenous to oral in a timely manner and implementing care pathways form part of the scope of activities of this team.

### Breaking the Chain

Source control is vital when treating infections. Patients with an undrained abscess, empyema, contaminated catheter, need surgery, drainage of pus, catheter removal respectively to treat the infection. Antibiotics alone will do little for these patients.

Clinicians are used to the antibiotic fix. This means that even when a patient has no infection but is unwell, antibiotics are used to treat them. This is reassuring to the doctor but may cause infections such as pseudomembranous colitis due to Clostridium difficile.

The old paradigm has been to use narrow spectrum antibiotics, at lower doses for prolonged duration. The newer paradigm is getting it right in the beginning - appropriate initial treatment, at the right dose (to ensure adequate drug concentration at the site of infection), rapid de-escalation and avoiding unnecessary prolonged courses.