Antimicrobial Resistance: Optimization of antibiotic practices

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Antibiotic

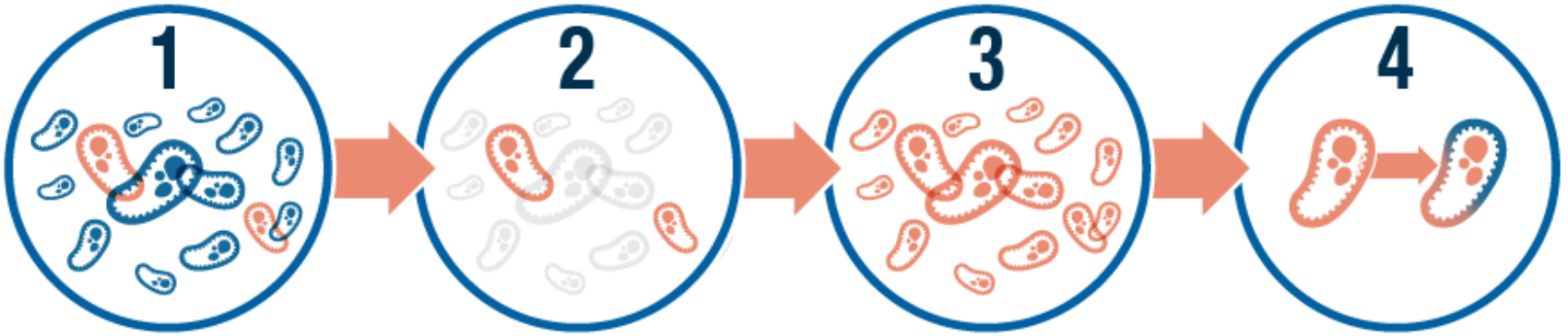
Resistance

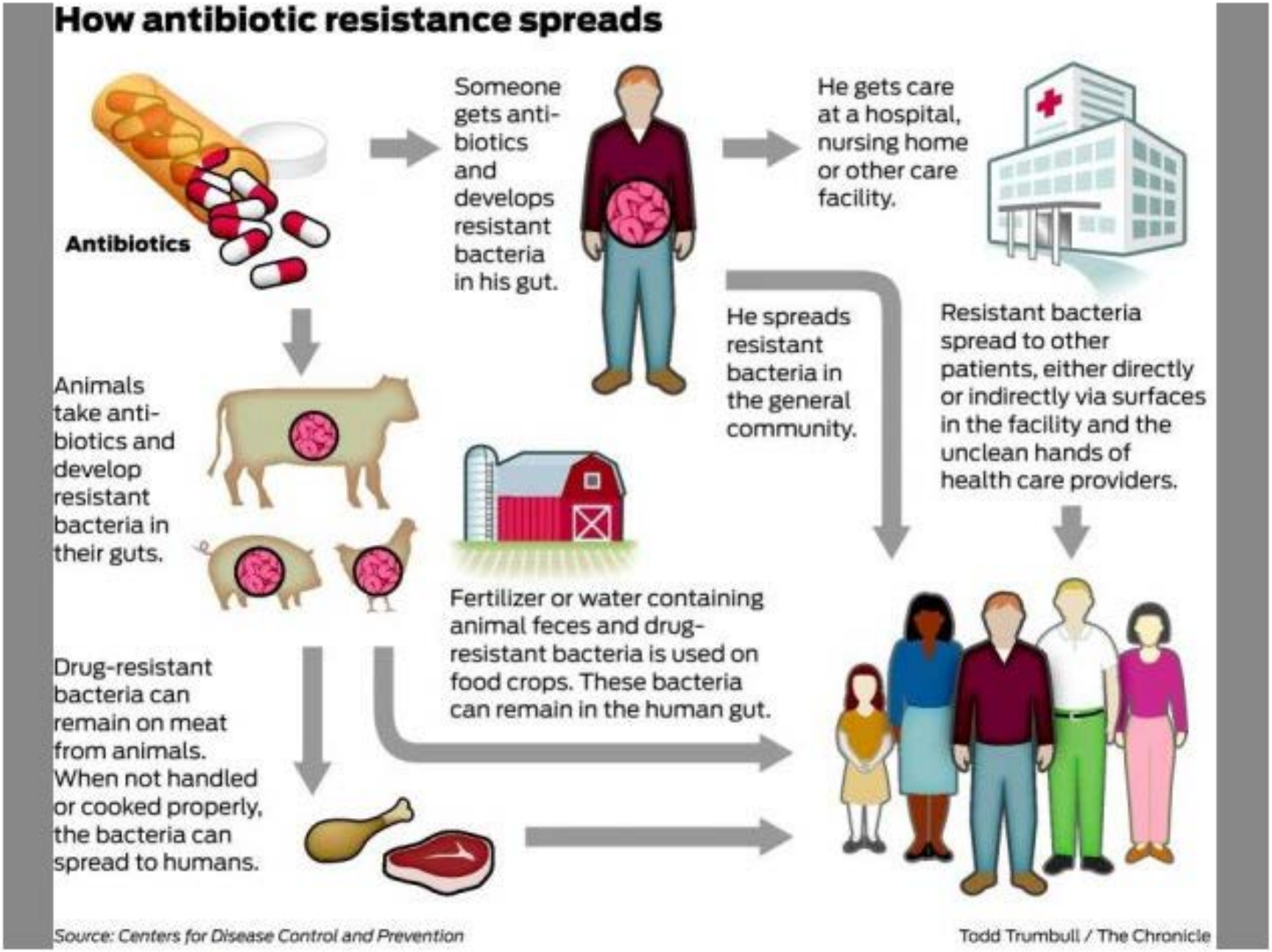
Definition

- WHO defines antimicrobial resistance as a microorganism's resistance to an antimicrobial drug that was once able to treat an infection by that microorganism

- Acquisition of resistance to one antibiotic conferring resistance to another antibiotic, to which the organism has not been exposed, is called cross resistance

How does antibiotic resistance occur?



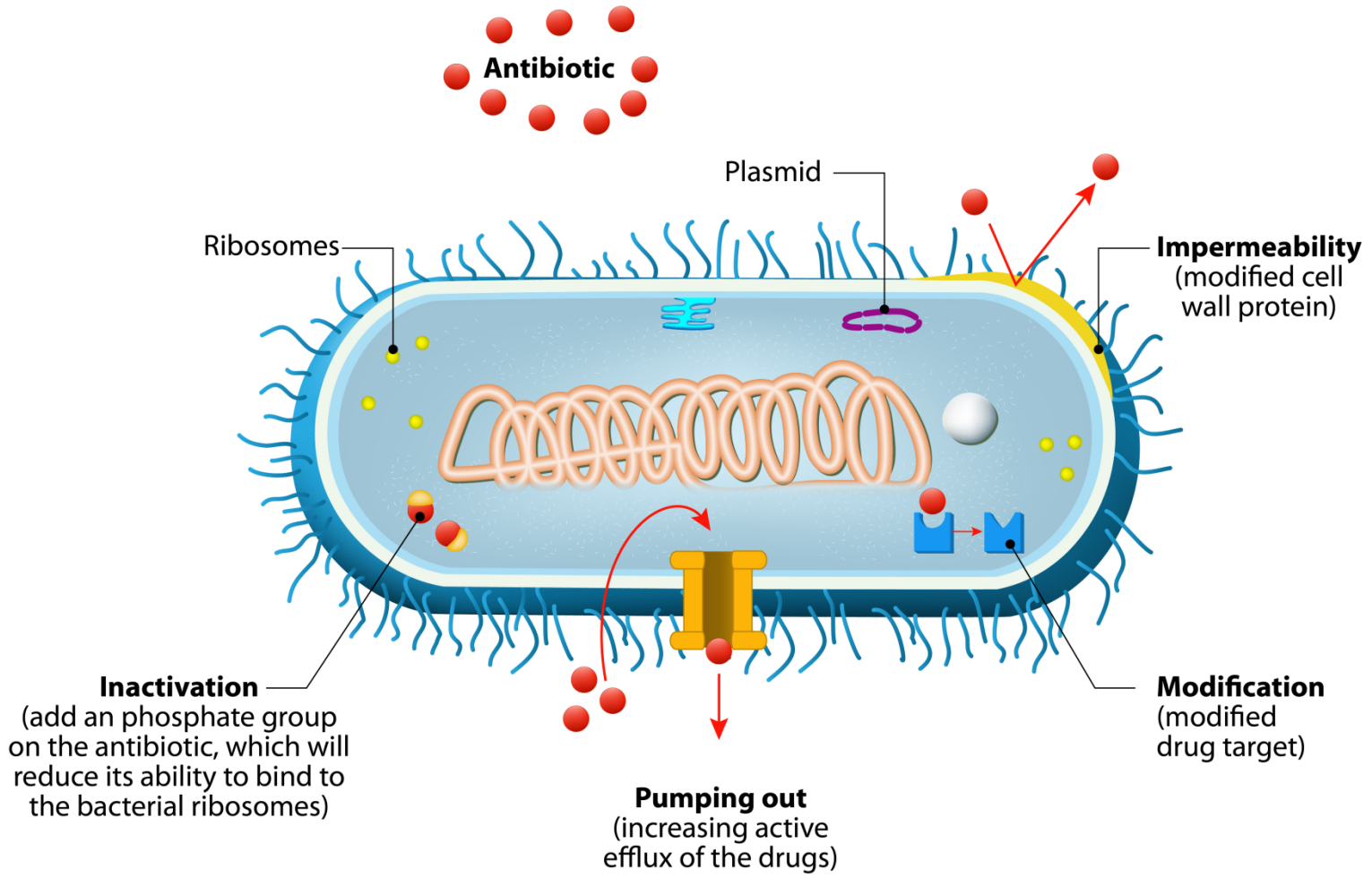

How antibiotic resistance spreads
Antibiotics
Someone gets anti-biotics and develops resistant bacteria in his gut.
He gets care at a hospital, nursing home or other care facility.
He spreads resistant bacteria in the general community.
Resistant bacteria spread to other patients, either directly or indirectly via surfaces in the facility and the unclean hands of health care providers.
Animals take anti-biotics and develop resistant bacteria in their guts.
Fertilizer or water containing animal feces and drug-resistant bacteria is used on food crops. These bacteria can remain in the human gut.
Drug-resistant bacteria can remain on meat from animals. When not handled or cooked properly, the bacteria can spread to humans.
Source: Centers for Disease Control and Prevention
Todd Trumbull / The Chronicle

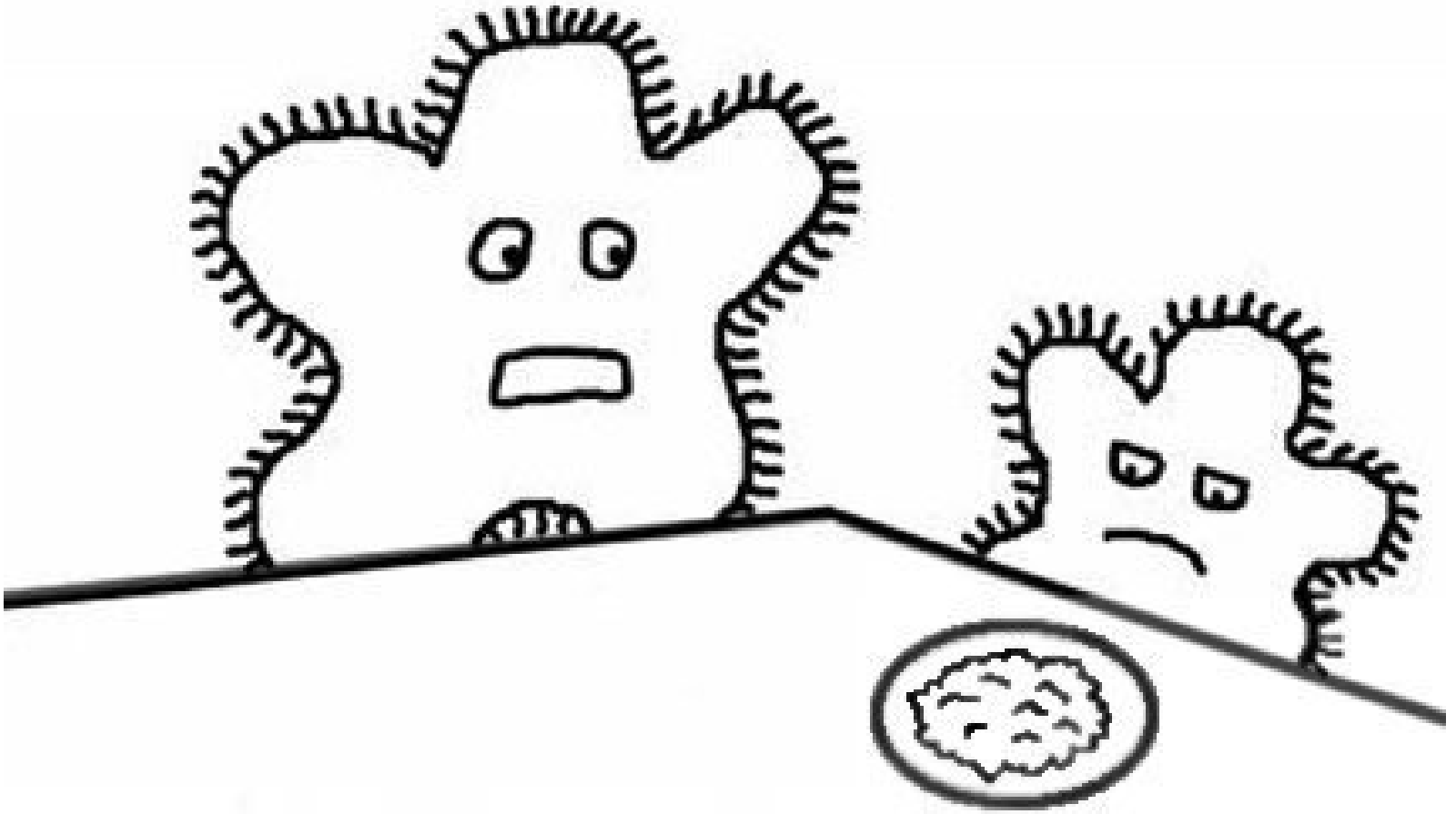
Factors responsible

Mechanism of antimicrobial drug resistance

- Inactivation of the antimicrobial drug
- Alteration of the antimicrobial target
- Adaptation of alternative metabolic pathway
- Active efflux pumping out of the drug
- Decreased permeability of the drug

MECHANISMS OF ANTIMICROBIAL RESISTANCE





"But Timmy, you have to eat your antibiotics or you'll never become a big strong bacteria."

Drug resistant bacteria

- Penicillin resistant cocci- Staphylococcus, streptococcus, neisseria, extended spectrum beta lactamase(ESBL)
- MRSA
- Beta lactum/aminoglycoside resirtant rods- Haemophilus, Pseudomonas, Enterobacteriaceae, Klebsiella pneumoniae(e.g New Delhi metallo beta lactamase 1,NDM-1)
- MDR TB, XDR TB

Detection of antimicrobial drug resistance

- A. Phenotypic

Phenotypic methods consist of detection or estimation of phenotypic expression of resistance to one or several antimicrobial drugs. These include agar screen, disk diffusion, MIC determination and automated methods

- B. Genotypic

Genotypic methods rely on detection of genes or nucleotide sequences responsible for coding antimicrobial resistance. Nucleotide sequences specific to resistance genes can be detected by DNA hybridization, nucleic acid amplification (PCR) technique or by microarray techniques

COMBAT DRUG RESISTANCE

Prevention

Prevention

In 2014, WHO stated: People can help tackle resistance by:

- Using antibiotics only when prescribed by a doctor
- Completing the full prescription, even if they feel better
- Never sharing antibiotics with others or using left over prescriptions

Mission Critical: Preventing Antibiotic Resistance (CDC report, 2014)

Health workers and pharmacists can help tackle resistance by:

- Enhancing infection prevention and control
- Only prescribing and dispensing antibiotics when they are truly needed
- Prescribing and dispensing the right antibiotic(s) to treat the illness

Policymakers can help tackle resistance by:

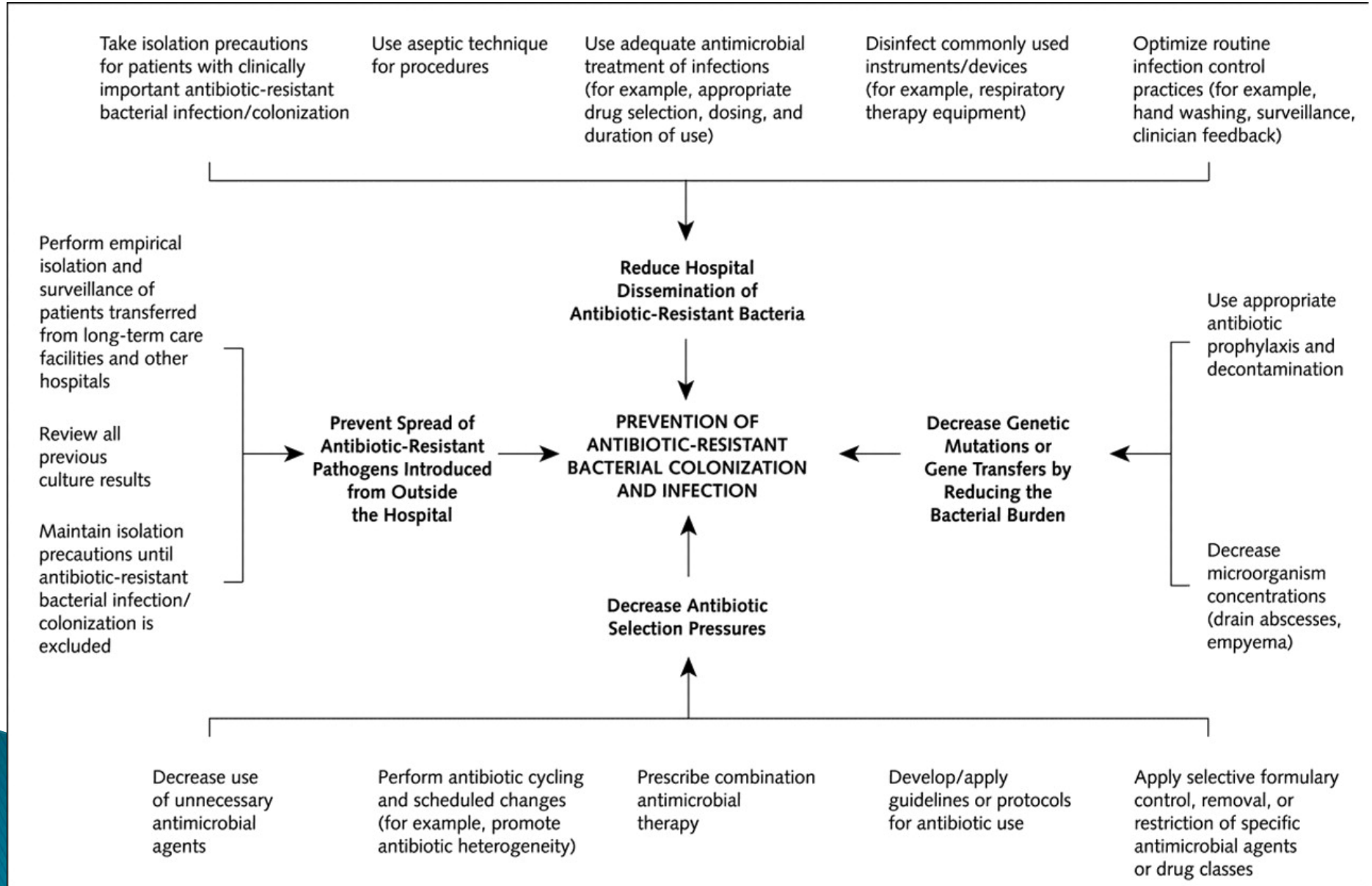
- Strengthening resistance tracking and laboratory capacity

- Regulating and promoting appropriate use of medicines

Policymakers and industry can help tackle resistance by:

- Fostering innovation and research and development of new tools

- Promoting cooperation and information sharing among all stakeholders


Take isolation precautions for patients with clinically important antibiotic-resistant bacterial infection/colonization
Use aseptic technique for procedures
Use adequate antimicrobial treatment of infections (for example, appropriate drug selection, dosing, and duration of use)
Disinfect commonly used instruments/devices (for example, respiratory therapy equipment)
Optimize routine infection control practices (for example, hand washing, surveillance, clinician feedback)
Reduce Hospital Dissemination of Antibiotic-Resistant Bacteria
Perform empirical isolation and surveillance of patients transferred from long-term care facilities and other hospitals
Review all previous culture results
Maintain isolation precautions until antibiotic-resistant bacterial infection/colonization is excluded
Prevent Spread of Antibiotic-Resistant Pathogens Introduced from Outside the Hospital
PREVENTION OF ANTIBIOTIC-RESISTANT BACTERIAL COLONIZATION AND INFECTION
Decrease Genetic Mutations or Gene Transfers by Reducing the Bacterial Burden
Use appropriate antibiotic prophylaxis and decontamination
Decrease microorganism concentrations (drain abscesses, empyema)
Decrease Antibiotic Selection Pressures
Decrease use of unnecessary antimicrobial agents
Perform antibiotic cycling and scheduled changes (for example, promote antibiotic heterogeneity)
Prescribe combination antimicrobial therapy
Develop/apply guidelines or protocols for antibiotic use
Apply selective formulary control, removal, or restriction of specific antimicrobial agents or drug classes

Pharmacokinetics and Pharmacodynamics

- The dose, duration of antibiotics should be scientific for prevention of antibiotic resistance
- Antimicrobial effect may be concentration dependent, e.g aminoglycosides Cmax> MIC
- Infrequent dosing with high dose decreases drug accumulations.

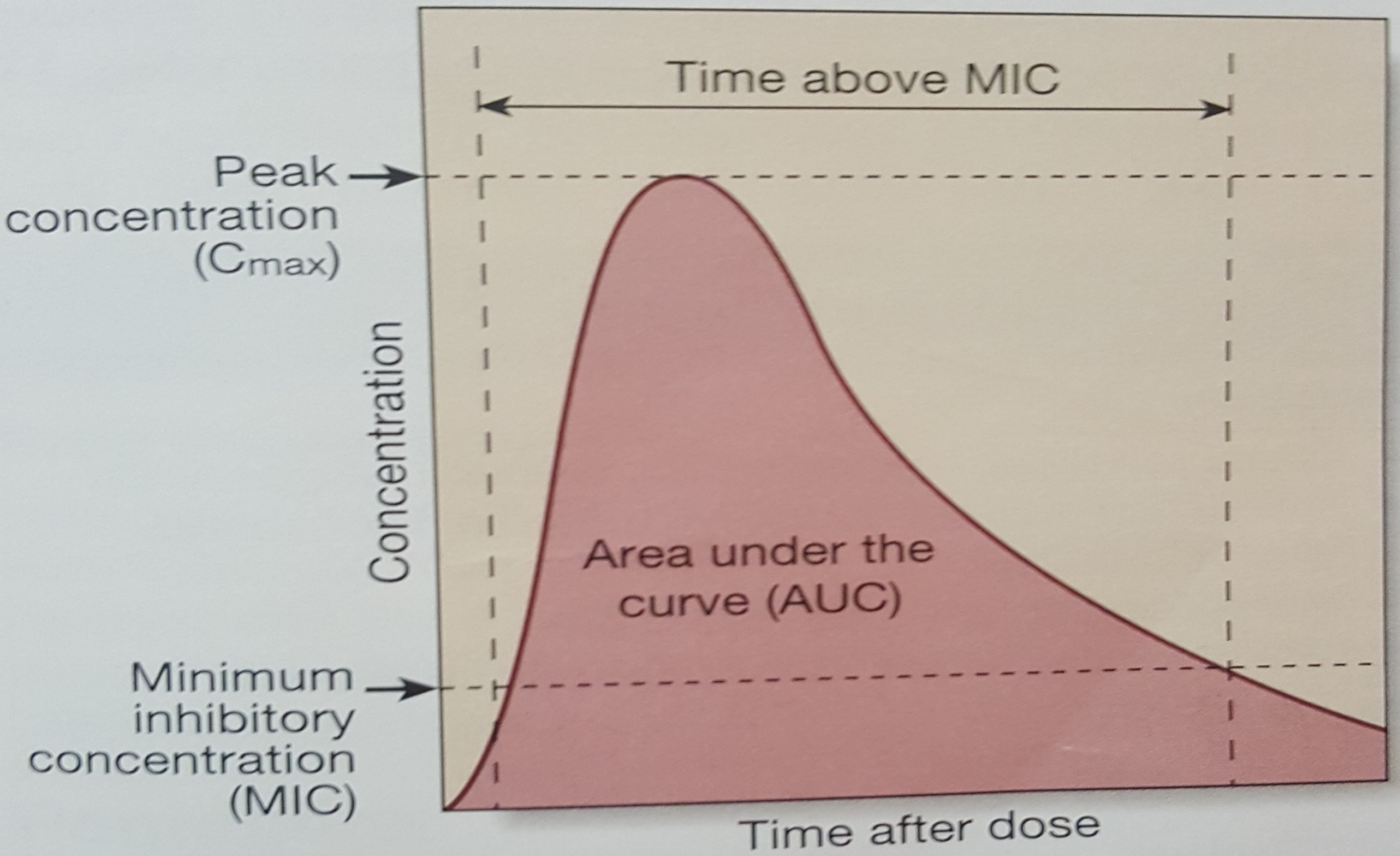


Fig. 6.16 Antimicrobial pharmacodynamics. The curve represents drug concentrations after a single dose of an antimicrobial agent. Factors that determine microbial killing are C_{max}: MIC ratio (concentration-dependent killing), time above MIC (time-dependent killing) and AUC : MIC ratio.

ANTIMICROBIAL STEWARDSHIP

- Antimicrobial stewardship describes the practice of promoting the selection of the appropriate drug, dosage, route, and duration of antimicrobial therapy

- Antimicrobial stewardship programs implement a variety of strategies to:

(1) improve patient care through appropriate antimicrobial use

(2) decrease the development of resistance within patients and populations

(3) reduce the incidence of adverse effects

(4) control costs

- Infections caused by resistant pathogens result in significant morbidity and mortality as well as increased health care costs

- Antimicrobial stewardship programs are typically multidisciplinary and often include infectious disease physicians, clinical pharmacists (usually with special training in infectious disease), clinical microbiologists, information systems specialists, infection prevention and control practitioners, and epidemiologists

- Established strategies of antimicrobial stewardship programs include:

- (1) prospective audit of antimicrobial use, with intervention and feedback
- (2) formulary restriction
- (3) preauthorization

End of the road
for antibiotics?

THE POST-
ANTIBIOTIC
ERA?

- The term post-antibiotic era has been coined to describe a future in which the acquisition of resistance by bacteria will have been so extensive that antibiotic therapy is rendered useless

- A more realistic scenario, which is currently being experienced, is a gradual but inexorable progression of resistance, necessitating the use of ever more toxic and expensive antimicrobials

Bangladesh Scenario

Factors Responsible for Self Medication*

- Pre experience (45.82%)
- Commonly used drugs

  Metronidazole(50%),Azithromycin(30%),
  Cefixime(10%)
- Diseases-

Dysentery ,Diarrhoea, Food Poisoning(35%)

Cough ,cold ,fever(30%)

*Biswas et al. BMC Public Health 2014, 14:847 Self medicated antibiotics in Bangladesh: a cross-sectional health survey conducted in the Rajshahi City.

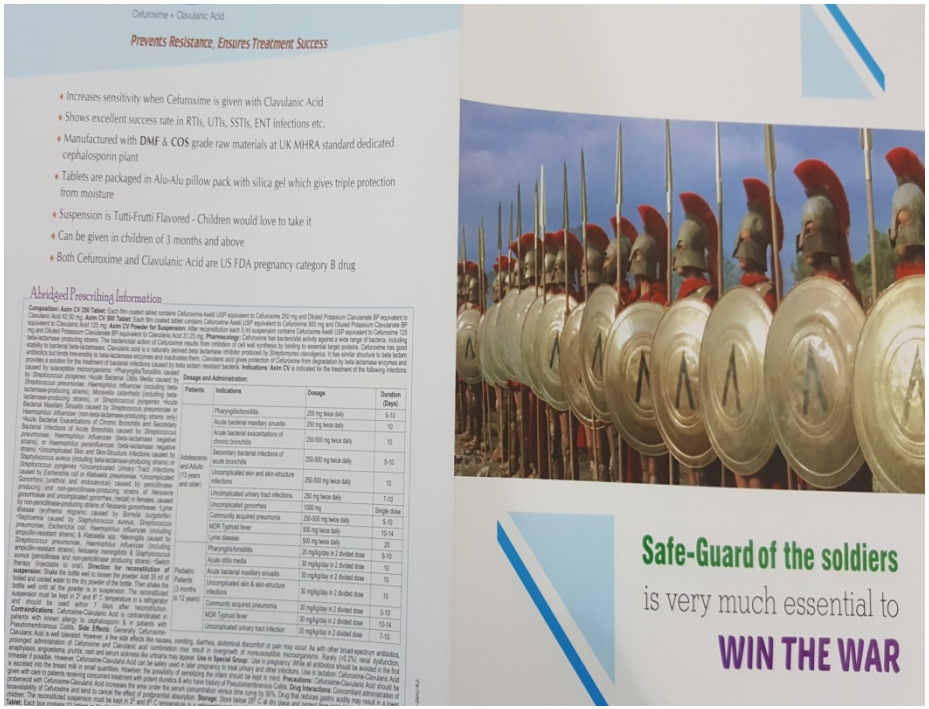
Bangladesh Scenario

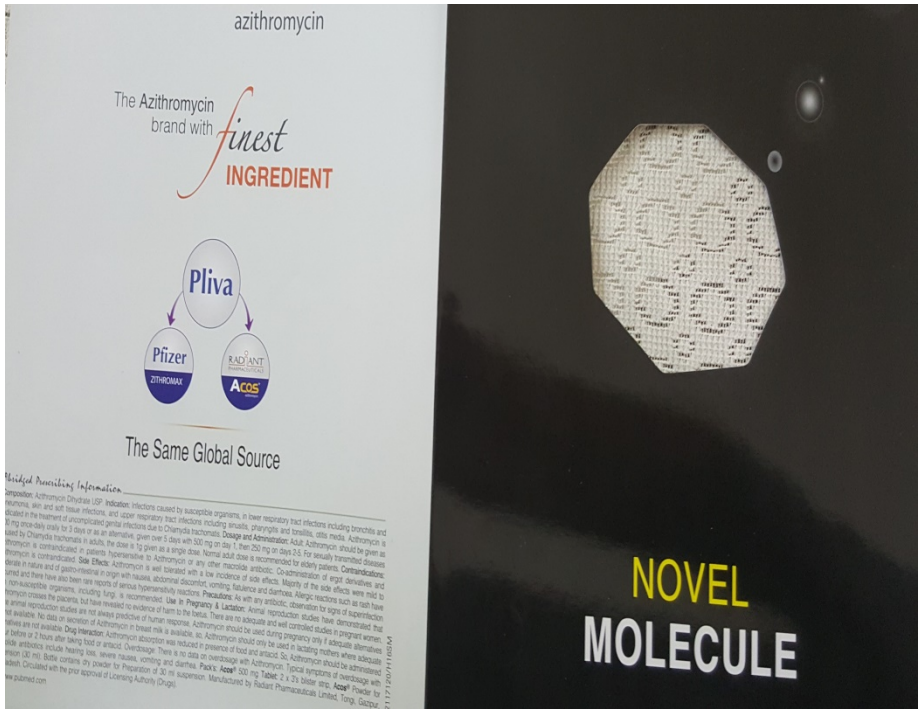
- OTC*:
- Past experience with the drugs
- Company and brand image
- Safe to use
- Level of education
- Preference of brand name over the generic name

Cont…

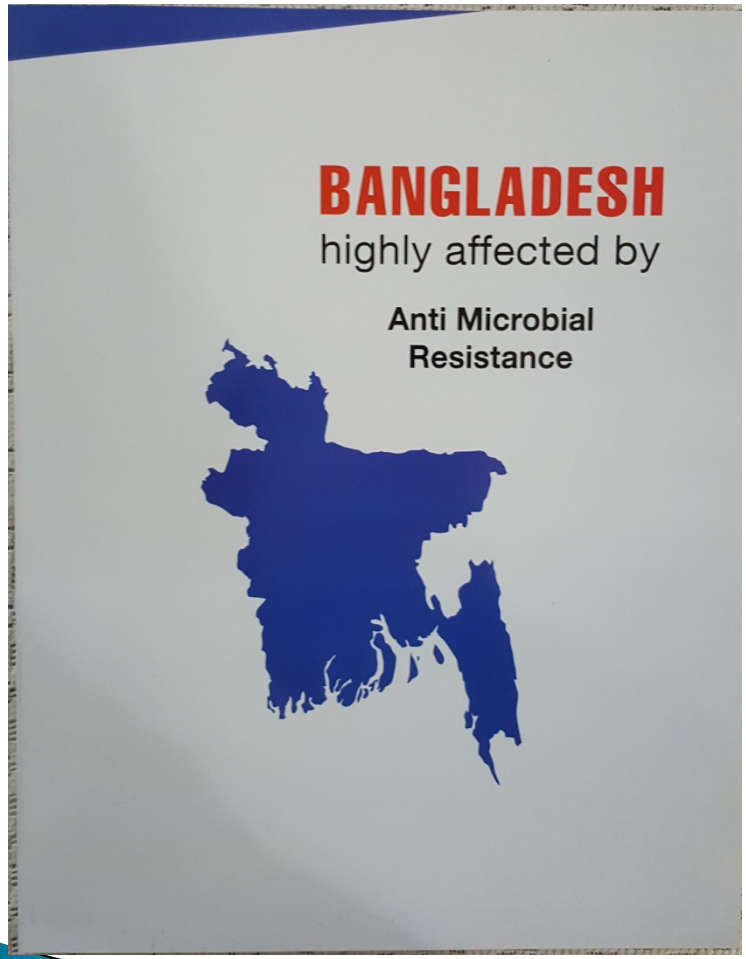
- Distrust over the physician
- Prior assumption of physician prescription
- Information on the label and package
- Side effect of the selected drug
- Awareness about the medicines
- Companies promotional activities

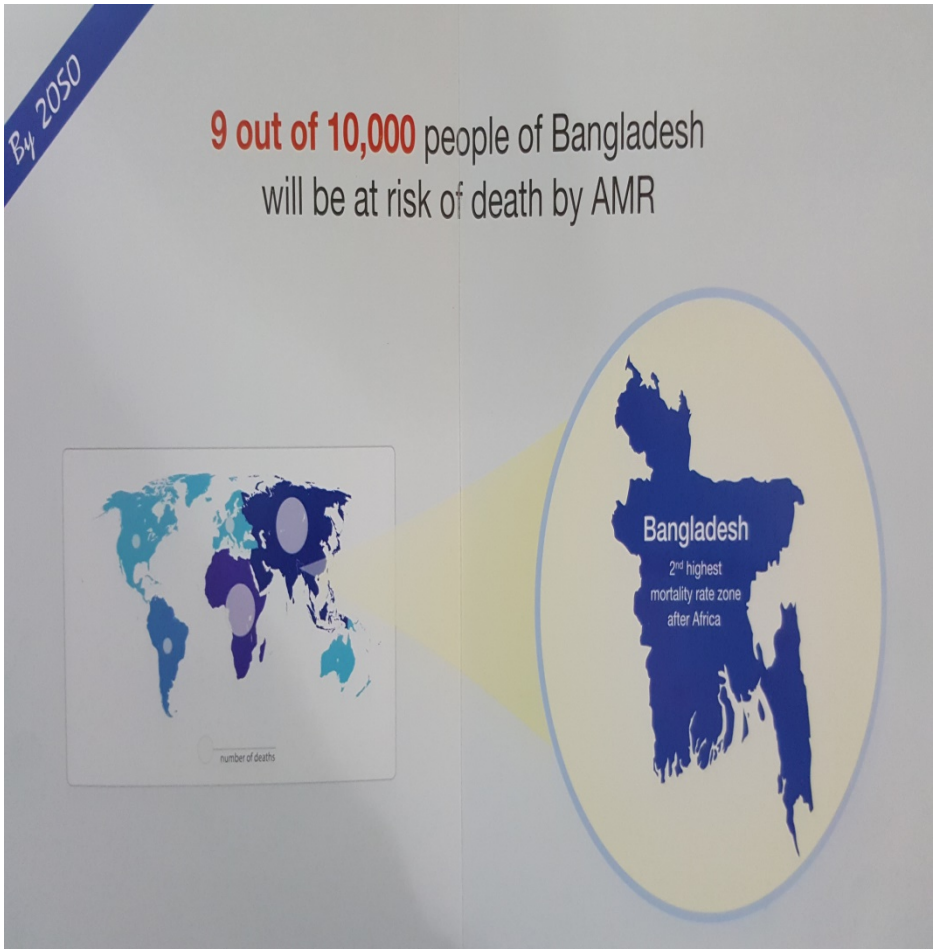
* M Babu,2007.Factors contributing to the purchase of Over The Counter(OTC) drugs in Bangladesh:An Empirical study.The Internet Journal of Third World Medicine.Vol 6,Number 2





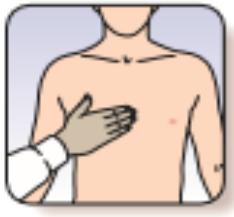
Companies promotional activities.


BANGLADESH
highly affected by
Anti Microbial
Resistance


By 2050
9 out of 10,000 people of Bangladesh
will be at risk of death by AMR
number of deaths
Bangladesh
2nd highest
mortality rate zone
after Africa

Stages in the selection and refinement of antimicrobial therapy: 'Start Smart – Then Focus'

Clinical diagnosis



Laboratory investigations: microbiological diagnosis

Antimicrobial susceptibility results

Information available:

- Organ system involved
- Endogenous or exogenous infection
- Likely pathogens

- Infecting organism(s)
- Likely antimicrobial susceptibility

- Antimicrobial susceptibility of infecting organism(s)

Level of knowledge of infecting organism(s)

Antimicrobial spectrum of agent(s) used

1 Empiric therapy
Based on:
- Predicted susceptibility of likely pathogens
- Local antimicrobial policies

2 Targeted therapy
Based on:
- Predicted susceptibility of infecting organism(s)
- Local antimicrobial policies

3 Susceptibility-guided therapy
Based on:
- Susceptibility testing results

Conclusion

- The issue of antibiotic misuse is of global concern because of the spreading and developing resistance of most common bacteria to most inexpensive generic antibiotics

- Antibiotic resistance now has been universally identified as public health priority and necessary plan of action to combat resistance should be developed

- Improving the quality, not just the quantity of medication will require public and professional education towards rational use of antibiotics

- Better diagnostic tests, promotion and evaluation of medical and veterinary practice guidelines, restriction of antibiotic use as growth promoters in food and animals, development of novel antibiotics are some of steps required

- Above all, patients, providers and health care leaders must make a serious commitment to change the dynamics of outpatient prescribing

- If we want to prove the prediction of an impending post-antibiotic era wrong, the time has come to drastically improve our antibiotic prescribing practices and to strengthen research to identify cost-effective strategies for controlling resistance

- If this could be achieved, the care of an individual patient at large can be substantially improved

HANDLE
ANTIBIOTICS
WITH CARE

Choose the Appropriate Antibiotic

Think before prescribing Are we using Right drug for the Right bug ?

Thank you