iGEM
IIT ROORKEE

Resource Booklet

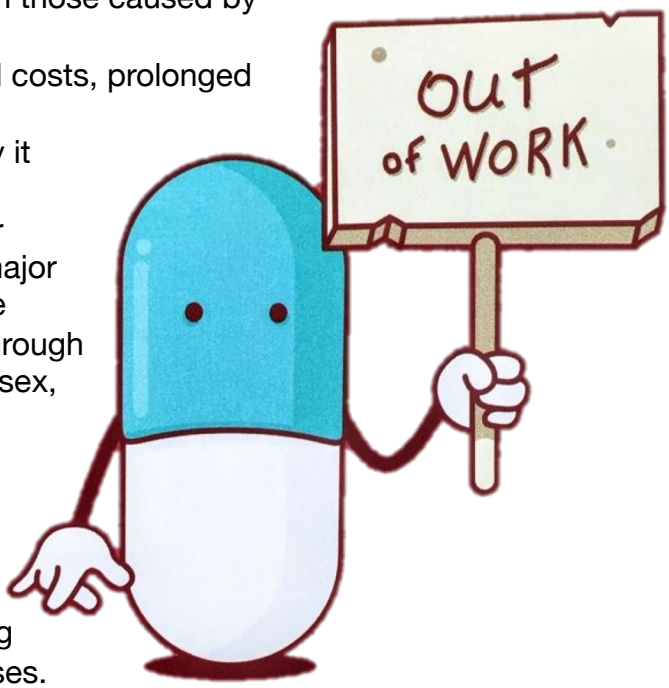
This Resource Booklet has been created by the iGEM IIT Roorkee Team for the students of Standard 11th and 12th

Contents

Getting to know AMR

Introduction

Antibiotics are medicines used to prevent and treat bacterial infections. Antibiotic resistance occurs when bacteria change in response to the use of these medicines.
Bacteria, not humans or animals, become antibiotic-resistant. These bacteria may infect humans and animals, and the infections they cause are harder to treat than those caused by non-resistant bacteria.
Antibiotic resistance leads to higher medical costs, prolonged hospital stays, and increased mortality.
The world urgently needs to change the way it prescribes and uses antibiotics. Even if new medicines are developed, without behaviour change, antibiotic resistance will remain a major threat. Behaviour changes must also include actions to reduce the spread of infections through vaccination, hand washing, practising safer sex, and good food hygiene.



Scope of the problem

Antibiotic resistance is rising to Dangerously high levels in all parts of the world. New resistance mechanisms are emerging and spreading globally, threatening our ability to treat common infectious diseases.
A growing list of infections – such as pneumonia, tuberculosis, blood poisoning, gonorrhoea, and foodborne diseases – are becoming harder, and sometimes impossible, to treat as antibiotics become less effective.
Where antibiotics can be bought for human or animal use without a prescription, the emergence and spread of resistance is made worse. Similarly, in countries without standard treatment guidelines, antibiotics are often over-prescribed by health workers and veterinarians and over-used by the public.
Without urgent action, we are heading for a post-antibiotic era, in which common infections and minor injuries can once again kill.

Prevention and control

Antibiotic resistance is accelerated by the misuse and overuse of antibiotics, as well as poor infection prevention and control. Steps can be taken at all levels of society to reduce the impact and limit the spread of resistance.

Individuals

To prevent and control the spread of antibiotic resistance, individuals can:

- Only use antibiotics when prescribed by a certified health professional.
- Never demand antibiotics if your health worker says you don't need them.
- Always follow your health worker's advice when using antibiotics.
- Never share or use leftover antibiotics.
- Prevent infections by regularly washing hands, preparing food hygienically, avoiding close contact with sick people, practising safer sex, and keeping vaccinations up to date.
- Prepare food hygienically, following the WHO Five Keys to Safer Food (keep clean, separate raw and cooked, cook thoroughly, keep food at safe temperatures, use safe water and raw materials) and choose foods that have been produced without the use of antibiotics for growth promotion or disease prevention in healthy animals.

Policy makers

To prevent and control the spread of antibiotic resistance, policy makers can:

- Ensure a robust national action plan to tackle antibiotic resistance is in place.
- Improve surveillance of antibiotic-resistant infections.
- Strengthen policies, programmes, and implementation of infection prevention and control measures.
- Regulate and promote the appropriate use and disposal of quality medicines.
- Make information available on the impact of antibiotic resistance.

Health professionals

To prevent and control the spread of antibiotic resistance, health professionals can:

- Prevent infections by ensuring your hands, instruments, and environment are clean.
- Only prescribe and dispense antibiotics when they are needed, according to current guidelines.
- Report antibiotic-resistant infections to surveillance teams.
- Talk to your patients about how to take antibiotics correctly, antibiotic resistance and the dangers of misuse.
- Talk to your patients about preventing infections (for example, vaccination, hand washing, safer sex, and covering nose and mouth when sneezing).

Healthcare industry

To prevent and control the spread of antibiotic resistance, the health industry can:

- Invest in research and development of new antibiotics, vaccines, diagnostics and other tools.

Agriculture sector

To prevent and control the spread of antibiotic resistance, the agriculture sector can:

- Only give antibiotics to animals under veterinary supervision.
- Not use antibiotics for growth promotion or to prevent diseases in healthy animals.
- Vaccinate animals to reduce the need for antibiotics and use alternatives to antibiotics when available.
- Promote and apply good practices at all steps of production and processing of foods from animal and plant sources.
- Improve biosecurity on farms and prevent infections through improved hygiene and animal welfare.

Recent developments

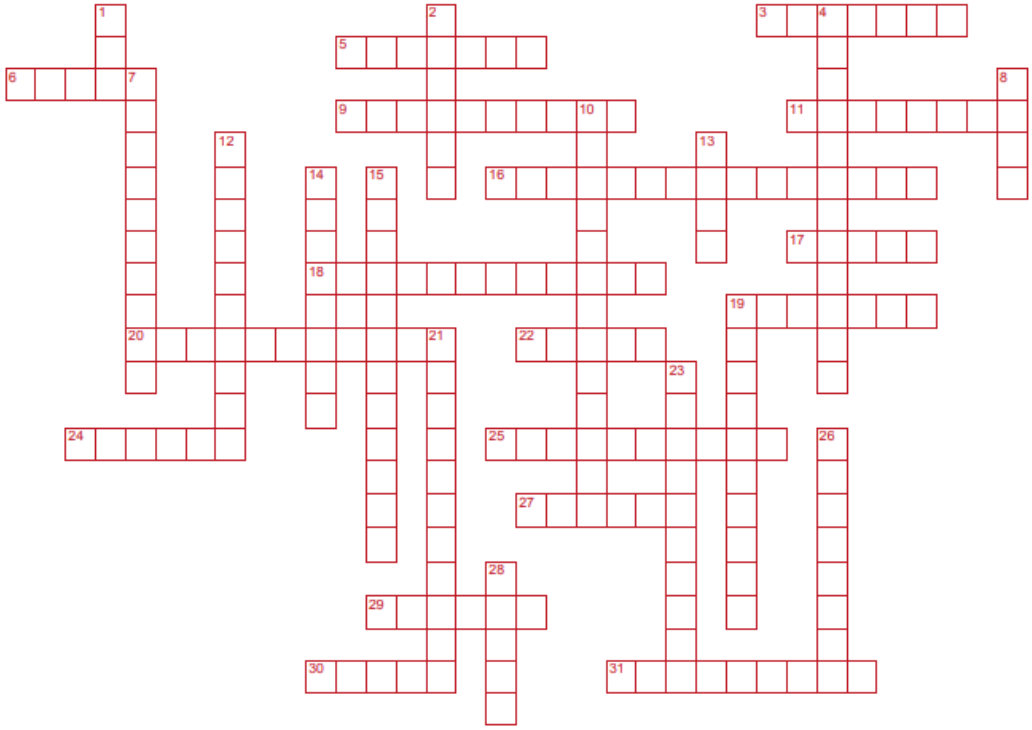
While there are some new antibiotics in development, none of them are expected to be effective against the most dangerous forms of antibiotic-resistant bacteria.
Given the ease and frequency with which people now travel, antibiotic resistance is a global problem, requiring efforts from all nations and many sectors.

Know the Drug

Which of these drugs are penicillin(s) or penicillin related? (tick)

Drug	Yes	No
Penicillin VK		
Gentamicin		
Phenoxymethylpenicillin		
Co-amoxiclav		
Augmentin		
Erythromycin		
Ceftriaxone		
Meropenem		
Cefotaxime		
Amoxicillin		
Flucloxacillin		
Clarithromycin		
Benzylpenicillin		
Cephalexin		
Vancomycin		
Cefuroxime		
Piperacillin/Tazobactam		
Tazocin		
Ciprofloxacin		
Doxycycline		

Crossword



Across

3 Veterinarians may prescribe antibiotics to these (7)
5 Antibiotics will most commonly be given to adults in these forms (7)
6 This type infectious agent will cause the common cold, coughs and the flu (5)
9 Medicine used to help treat fungal infections (10)
11 As an Antibiotic _11_, my actions help _19_ antibiotics for the children of tomorrow (8,7)
16 The main immune system cells for defending against bacterial infections (3 words: 5,5,5)
17 Antibiotics will most commonly be given to children in this form (5)
18 You require one of these for antibiotics (12)
20 These medicines should be used as prescribed and only when needed for bacterial infections (11)
22 Main professional group that administer and may prescribe antibiotics (5)
24 This infectious agent includes yeasts and moulds (6)
25 When the antimicrobials are no longer effective the microbes have developed this (10)
27 You often generate more of this when you have a cough, cold or flu and ranges in colour from yellow to green (6)
29 Professional who may prescribe antibiotics for humans (6)
30 Clean your hands to prevent the spread of these (5)
31 Medicine used to treat viral infections (9)

Down

1 You can get a vaccination jab against this viral seasonal illness (3)
2 When you have a viral illness you should consume lots of this (6)
4 Your body's natural defence system against infections (2 words: 6,6)
7 A common symptom of coughs, colds and flus (2 words: 4,5)
8 Runs from your nose, especially when sick with a viral infection (4)
10 This term covers antibiotics, antivirals and antifungals (13)
12 When you are ill and can make others ill with the same bug you are _____ (10)
13 A viral infection that causes sore throat and runny nose (4)
14 When you have a cough, cold or flu you should ask your pharmacist how to treat your _____(8)
15 Professional who may prescribe antibiotics for animals (12)
19 The first antibiotic discovered (10)
21 Taking antibiotics unnecessarily can lead to _____ such as diarrhoea (2 words: 4,7)
23 Ask this healthcare professional which over-the-counter medicines are best to treat your symptoms (10)
26 Misuse of antibiotics allows _____ to develop resistance (8)
28 Often a symptom of a respiratory tract infections caused by viruses (5)

DIY Experiments

How To Extract Your Own DNA?

Every one of your cells contains DNA, the molecular blueprint that makes you - You. Accessing that blueprint may seem like a job for scientists. But extracting DNA from your cells is actually surprisingly simple.

Mac Cowell, an advocate for open-source biotechnology, created a set of simple instructions that lets anyone isolate her own DNA in mere minutes. The rough-and-ready procedure uses basic kitchen supplies, including the best possible container: a shot glass. This DIY process won't create the cleanest sample, but avid biohackers can purify the DNA after it's extracted. Once you have a pure sample, you can try sorting the DNA fragments by size or building a DIY DNA-copying machine.

Instructions:

- Spit into the shot glass until it's a quarter full of your saliva. (If you're having trouble salivating, imagine you're sucking a lemon-flavored candy.) The saliva is laden with cells, shed from your cheeks and mouth lining, which are full of DNA
- Add a few drops of dish soap. This will break open the cells, a process called "lysing"
- Add a tiny splash of pineapple juice. This will clean up some of the proteins that have spilled out of your cells alongside your DNA
- Add a pinch of salt. This causes the DNA to start clumping together.
- Swirl the shot glass to mix the ingredients
- Gently fill the rest of the shot glass with the high-proof alcohol, which should sit in a layer on top of the mixture

(**Note** - To prevent it from mixing too much, you can add the alcohol gradually with a drinking straw: Put the straw into the alcohol, cap it with your finger, hold the straw right over the liquid in the shot glass, and release)

- Use a toothpick to spool up the cloudy, snot-like material that has formed in the glass. This is your DNA—a gross result of some cool science

Agar Plates

Make your own agar Petri dishes and grow bacterial colonies. You will be amazed at the diversity of bacteria around us all the time.

CAUTION - This science activity involves the use of boiling water. Hot water must only be handled by an adult.

You Need:

- 1 teaspoon of beef stock powder
- A cup of water
- 1 teaspoon of sugar
- 1 teaspoon of gelatin
- Saucepan for boiling mixture
- 2 Petri dishes
- Spoon
- Sticky tape
- Felt-tip pen to label petri dishes
- Cotton swab (optional)
- 35 to 37 °C incubator oven (optional), warm spot behind fridge, near a heater, box with a desk lamp inside or on top

What to do:

- Pour the water into the saucepan and bring to the boil
- Add beef stock powder, sugar and gelatin to the boiling water and stir for a minute until all the ingredients have dissolved
- Cool your new agar mixture slightly for 10 minutes. The mixture needs to be still hot to avoid the gelatin setting in the saucepan and to prevent contamination from bacteria in the air

(**Note** - The conditions are far from sterile, but you want to avoid as much contamination as possible)

- Take the lid off the Petri dishes and have an adult half-fill the petri dish with the hot mixture. Only take the lid off the petri dish when you are ready to pour your agar, or they will become contaminated with the bacteria in the air
- Immediately put the lid back on the Petri dish and put it in the fridge for about 4 hours until the agar has set. Do not touch the agar or you will contaminate it with bacteria on your fingers
- Now it's time to collect and grow your bacteria (or fungi) on the agar Petri dishes. Note: the Petri dishes can be stored in the fridge for 1-2 days before use
- Bacteria is not hard to collect because it is everywhere. Try exposing one plate to the air in your house or classroom, and the other to the air in your backyard or playground. Touch one with your thumb and the other with a piece of hair. Add the scrapings from your finger nail, or touch with a piece of grass or dirty tissue. If you have some cotton swabs - using a clean one each time - run it along things like the inside of your mouth, your hands, the door handle, mobile phone, computer keyboard, and then rub it lightly across the agar in a zig-zag pattern
- Put the lids back on the Petri dishes, label them, tape them closed and place them upside down in your make-do incubator (if you have one) for 1 to 2 days. If you don't have an incubator, leave the plates at room temperature for 3-5 days
- Although your grown bacteria colonies and fungi is likely to be harmless, just as a precaution, do not open your sealed Petri dishes. Dispose of the entire sealed plate in the bin

Why is it so?

Bacteria are so tiny they can't be seen with the naked eye, and often millions of bacteria are condensed in a small spot. Growing bacteria in a nutrient agar plate is a great way to see bacteria because each one becomes a colony of thousands of bacteria. The agar serves as food for the bacteria. Growing bacteria can be tricky so don't give up if your first couple of attempts fail. Once you have them growing, count the number of colonies and note the differences in colour, shape and other properties. Did you find more bacteria on the bathroom sink or on the computer keyboard? Try adding a drop of hand sanitizer or the like to the middle of your growing plate. Does this make a difference to the number of colonies and type of growth in this area of the plate? Do washed hands have less bacteria than unwashed hands?

Quiz

1. Antibiotic empirical (best guess) guidelines recommend the same antibiotic for the same condition in every Trust in UK
True/False

2. Antibiotic resistance is due to the human body, not the bacterial cell
True/False

3. IV vancomycin can be used to treat Clostridium difficile infection
True/False

4. If a patient is colonised with MRSA in their groin, they just need Octenisan as a body wash and not mupirocin nasal ointment for their nose
True/False

5. Tazocin is a penicillin and must not be given to patients who have had anaphylaxis when given flucloxacillin
True/False

6. Patients who have a history of infection with an extended spectrum beta-lactamase producing organism (ESBL) should be isolated to protect other patients
True/False

7. If Pseudomonas and anaerobes are isolated in a venous leg ulcer, the patient should always be treated with antibiotics
True/False

8. Vancomycin levels should be taken 6-14 hours after the dose has been given
True/False

9. If a patient's urine smells 'strong', they must have an infection and need antibiotics
True/False

10. It is important to document the indication for any antibiotic prescriptions on the drug chart so that the antibiotic can be stopped or changed if an alternative diagnosis is made.
True/False

1.False – the resistance patterns are different in every trust and guidelines must reflect the expected organisms for each organisation.

2.False – resistance is a mechanism developed by the bacterial cell

3.False – IV vancomycin does not produce high enough levels in the GI tract so oral or rectal must be used

4.False – decolonisation must take place for the body and nose if any part of the body is colonised.

5.True – Tazocin is a penicillin, as is flucloxacillin, and anaphylaxis is likely with both drugs if there is a history with either

6.True – this is especially important if patients are incontinent

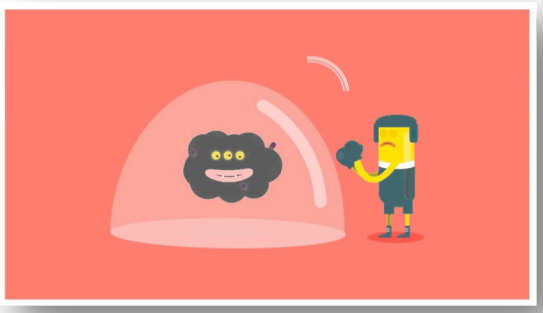
7.False – Pseudomonas may be a coloniser in a venous leg ulcer and stringent wound toilet should reduce the bacterial load. Using antibiotics can lead to resistance

8.False – Vancomycin levels should be taken immediately before the dose (a trough level)

9.False – smell is not an indicator of infection

True – not knowing the indication for an antibiotic makes it difficult for staff new to the patient to monitor or adjust the prescription

Watch it on YouTube



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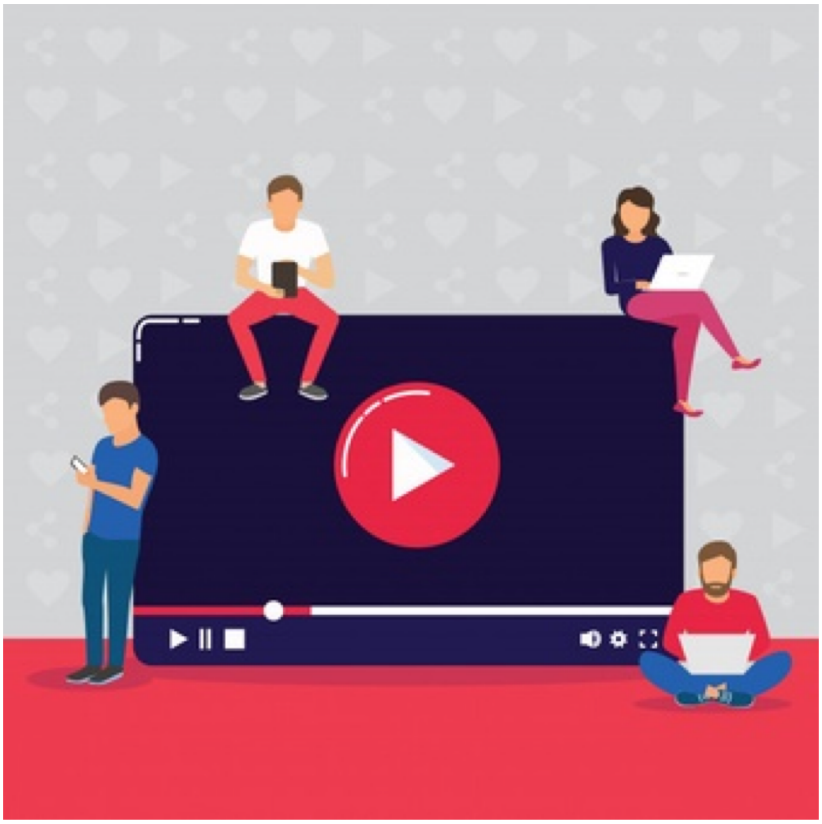

About iGEM

- **World's Largest Synthetic Biology Competition**
- Started in **Massachusetts Institute of Technology in 2003**
- Engineering + Biology →Solve local and global problems

47+
Countries

350+
Teams

4000+
Participants

Meet the Team

We, the young leaders of the Global Biotechnology Revolution, are glad to interact with stakeholders of the society and share some exciting insights on where science continues to lead and how future technologies look. The session intended to highlight the importance of bioengineering with increasing advancement. Also, we encourage you to have more open discussions with your teachers and invest in problem-solving. We urge that each and everyone shall take the responsibility of being an Antibiotic Guardian, and educate your friends and family in the same regard. Stay healthy and love science.

Sanjeevani Marcha
Team Leader

Harkirat Singh Arora | **Pradum Kumar** | **Tishee Natani** | **Yash Aggarwal** | **Kanishka Sugotra** | **Siddharth Fitwe**

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