Lesson Plan 3: When antibiotics don't work

This session focuses on making children understand when antibiotics work and when they don't.

Time: 2 hours

Requirements:

Computer and internet connection (for YouTube videos) - not a must!
Screen and projector
Chickpeas, lentils and peas or various beads (described more fully in Activity 2)
cellotape and toothpicks
Activity sheets
Flipchart (if possible) or a blackboard

Prior knowledge of microbes is required for better understanding of this activity. For a primer, click here for activities to introduce various kinds of pathogenic microbes (bacteria, fungi, parasites and viruses) and their properties, if using this as a stand-alone activity.

Activity 1: Introduction to how antibiotics work

Start the session by playing this video , in which the antibiotics ask us to use them carefully and not to use them for everything. Let's try to understand why that is. To do that, we should first know how antibiotics work.

Play video till 1:20 secs

Discuss the video, so antibiotics act on bacteria by killing them or slowing down their growth, treating infections.

Image: Pixabay.com

But we also know that other microbes like viruses also cause infection. Do you think antibiotics are also effective against viruses and other microbes? They are called miracle drugs, does that mean they can treat all infections? There are times when antibiotics don't work as well. Let's now do a fun activity called 'dal mein kuch kaala hai' to understand when antibiotics don't work.

Activity 2: "Dal mein kuch kaala hai", when antibiotics don't work

Time: 1.5 hours

Overview: This interactive hands-on activity demonstrates the following:

1. The importance of finishing the full course of antibiotics

2. Antibiotics target features specific to bacteria and are therefore ineffective against viruses

3. How antibiotics affect the gut microbes causing some of the common side-effects

4. Antibiotic Resistance



Materials:

- About 50 Chickpeas (Chane) soaked and cooked representing bad (disease-causing) bacteria (bugs). Alternate material: White beads with holes (hole should be big enough for the toothpick to go in).

- Some uncooked split red lentils (Masoor dal) representing viruses. Alternate material: Half beads of a different colour

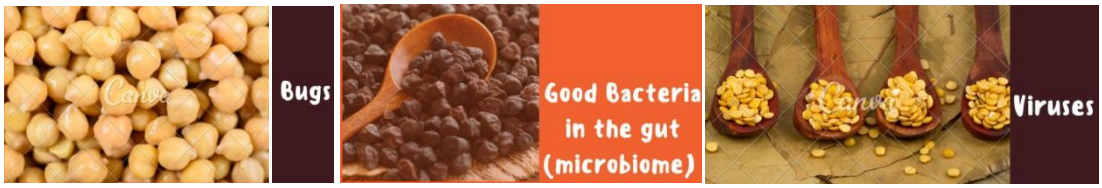
- Equal number of cooked and uncooked green peas (matar) or black chane representing good bacteria in the gut. Alternate material: Equal number of green beads with and without hole.

- About 50 cooked chickpeas wrapped in cellotape/uncooked chickpeas representing antibiotic resistant bacteria (superbugs). Alternate material: White beads with no hole (should be the same size and appearance as white beads with hole)

- Tooth picks representing antibiotics

- Glass bowls, to hold the different pulses

- A Chart with what each represents: bad bacteria (bugs), good bacteria, viruses, and antibiotic resistant bacteria (superbugs)



Activity:

1) Before beginning the activity, the students will form different groups of 5-6 students each.

2) Inform the students that the glass bowl in the center of each of their tables represents a patient that they will treat as a group of doctors. Ask the children to pick a name for their patient.

The below activity demonstrates the importance of finishing the full course of the prescribed antibiotic

3) Tell the children that their patient has a bacterial infection (choose a common infection like Typhoid*)*

a. Have a volunteer dump the cooked chickpeas into the patient. Tell students that these bad bacteria have now given your patient an infection. Ask, “What do we do when we have an infection (go to a doctor). What would you prescribe to the patient as doctors?” (medicine) “What specific medicine? (doctors will give antibiotics, after tests.)

Optional: Do you know how these tests are performed? Cultures of blood, urine or stool are used to detect the presence of bacteria or fungi depending on the site of infection, to identify the type present, and to guide treatment. Also, elevated levels of certain immune cells like white blood cells in blood or pus cells in urine may also indicate infection. Scientists are working hard to make these tests more reliable and faster for swifter and more accurate treatments.

b. Choose a volunteer to simulate the antibiotic. Ask, “So, what will happen when you put the antibiotic in the patient?” (The antibiotic will poke the bacteria). “We saw in the morning exercise that different antibiotics have different modes of action. All antibiotics have specific targets on the bacteria that enables them to act on the bacteria. Similar to how the toothpick is able to penetrate the cooked chickpeas due to the soft cover, what we are simulating in this example is the antibiotic penetrating through the cell wall of the bacteria, killing them and treating the infection.”

c. Have the volunteer put the antibiotic into the patient and take out as many bugs as possible in 10 seconds. Count the remaining bugs and make an entry in the activity sheet.

d. Ask children to take turns and repeat the above step, each turn representing one dose of antibiotic.

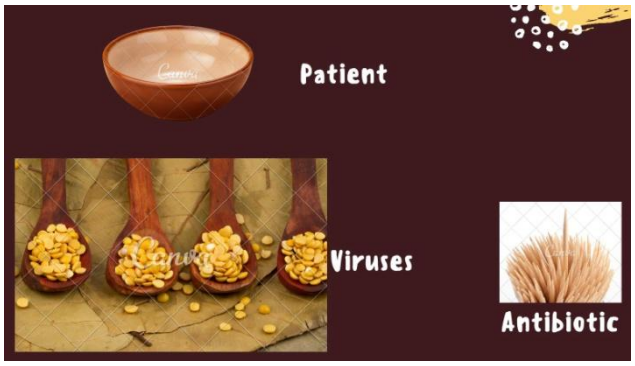
e. After the third dose ask, “Is your patient cured yet? Should he stop taking the antibiotic? He is starting to feel better.” (No, because there are still bugs in him.)

f. The children should continue to take turns to simulate the antibiotic to clear the infection four more times, representing a total of 7 doses. At the end of 7 doses, there will be no bugs remaining. This demonstrates why it is important to take all of the antibiotics prescribed.

Note: Ensure that bugs remain till the 7th dose by adjusting the number of starting chickpeas, in our experience this is usually 45 chickpeas. If a few remain after the 7th dose, it can be explained that the patient’s own immune system should be able to tackle such small numbers of bacteria. This can also be used as an opportunity to explain that most times, the immune system takes care of the bacteria without an antibiotic, it is only when the bacteria divide faster than the body is able to defend through its immune system that we start to feel sick and need external help.

The below activity demonstrates that antibiotics do not work on viral infections:

4) Remove the chickpeas and add the uncooked red lentils into the bowl. Explain to the children that your patient now has common cold due to the viruses.



a. Ask one of the children to put the antibiotic in and try and remove the virus. Ask “What did they remove?” (Nothing) Ask why. (Because the antibiotic is not able to target the viruses as they are hard). Ask the children to recollect from the previous session (see Activity 2 of Lessonplan-2) “what are viruses covered with, do they have a cell wall?” (virus has a thick protein coat (capsid) and no cell wall). “What else is different between bacteria and virus?” (let the children list out all the differences including the point that viruses do not have their own biochemical

processes and use their hosts machinery to reproduce). Explain that antibiotics usually target the cell wall or biochemical machinery inside the bacteria, which are absent in viruses. Antibiotics cannot target viruses for this reason and are thus useless against viral infections.

b. Ask students “How do we then get rid of a cold caused by a viral infection?” (Rest, fluids and healthy food). Get the children to remove the lentils by hand while explaining that those actions, along with our immune system, clear the cold.

The below activity demonstrates the effect of antibiotics on the good bacteria in the gut

5) Put both the cooked and uncooked green peas/black chane into the glass bowl representing the patient’s microbiome.

a. Ask the students to recollect from the previous session (See Activity 4 of Lessonplan 2)what the role of good bacteria in our guts is (they help in digestion of the food and provide us with essential nutrients)

b. Add the cooked chickpeas again and inform the children that the patient is back with the bacterial infection and ask them what they suggest for the patient as doctors. (Antibiotic)

c. Have a volunteer put in the antibiotic and remove what they can from the patient in 10 secs. Ask “What comes out?” (both bad and good bacteria). Ask what they notice about the peas keeping in mind what they just learned about bacteria and viruses. (Some of the green peas are soft and some hard). Ask students “What does that mean?” (The antibiotics can target some of the good bacteria too and remove them.)

d. Get one more child to repeat this step.

e. Tell students that this is why some patients feel nauseous and some have vomiting or diarrhea when they are on antibiotics. It is therefore a good idea to eat yogurt (as it is made by the good bacteria Lactobacillus) and take probiotics (which are nothing but foods or supplements containing live bacteria and yeasts that are good for our digestive system) when you are taking antibiotics. It replenishes the good bacteria that the antibiotics kill in the process of killing bad bacteria.

f. Leave the microbiome green peas in the bowl and add the viruses (split red lentils). Tell students that the patient now has a viral cold. Ask them, “Should he take an antibiotic?” (No) “Why?” (It will remove his good bacteria) “Will it help get rid of his cold viruses?” (No, it will only do damage to his good microbiome.)

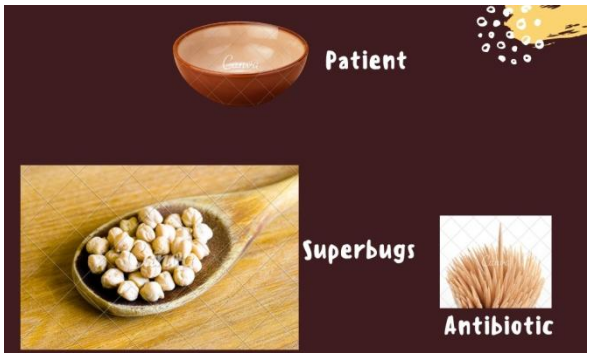
g. Have a volunteer put the antibiotic in the patient and see what comes out (good bacteria)

h. Drive home the point that antibiotics do harm to our good microbiome causing some of the side-effects. So, it is OK to take them for a bacterial infection because you have to get rid of it, but not for a viral infection, because they do no good, only harm.

The below activity demonstrates antibiotic resistance

6) Put a mixture of 25 cooked chickpeas and 25 cooked chickpeas wrapped in cellotape/uncooked chickpeas into the glass bowl.

a. Tell students that these bugs have once again given the patient the bacterial infection. "What would you prescribe as doctors?" (Antibiotic)



b. Choose a volunteer to simulate the antibiotic. Ask, "So, what will happen when you put the antibiotic in to the patient?" (The antibiotic will poke through the bacteria because they have the specific target.)

c. Have the volunteer put the antibiotic into the patient and pull out as many bacteria as possible in 10 secs (representing a dose of antibiotic).

d. Let the students take turns and repeat the above step 7 times (representing full course of antibiotic). However, the antibiotic will be successful in removing only some bacteria, as the chickpeas with cellotape/uncooked chickpeas remain in the bowl.

e. Ask, "Is the patient cured yet? (No, because there are still bacteria in him.)

f. The antibiotic will not be able to remove these chickpeas in spite of any number of attempts. Ask the students, "why is the antibiotic unable to target these bacteria?" Let the students examine these peas with their hands and identify the cellotape.

g. Explain to the students that a change in the target (cell wall) made the antibiotic ineffective. This change can be a change in the cell wall or pump that takes the antibiotic inside the bacterial cell, for example.

Ask the students if they know how this change happens? This happens because of change in the bacterial genes. Ask them to recollect what they have learned about genes in the previous session (See Lessonplan-1). These changes happen all the time and are called mutations. Most of the times, these mutations are useless. But sometimes some mutations give a survival advantage to the bacteria.

h. Ask "Is the patient able to get rid of the infection with this antibiotic?" (No)

Introduce the concept of antibiotic resistance.

Antibiotic resistance occurs when bacteria or other disease causing microbes change in a way that causes antibiotics to become less effective or to not work at all. Bacteria become stronger when they change, which reduces the effectiveness of antibiotics. For example, some bacteria can break down antibiotics or

prevent the antibiotic from attaching to the site it needs to work. When bacteria come in contact with an antibiotic, the weaker bacteria (normal cooked chickpeas here, bugs) die, but stronger ones (due to the mutation, with the cellotape/uncooked in this example) survive. When the strong bacteria multiply, more and more strong bacteria are produced that are resistant to the antibiotic. Bacteria can change more than once so that they are resistant to several antibiotics. This makes some bacteria very hard to kill. These bacteria are called superbugs.

"Can you think of reasons why antibiotic resistance is a problem?"

Antibiotic resistance is a problem because we need antibiotics to treat bacterial infections that our bodies need help to get rid of. When bacteria are resistant to antibiotics, doctors have a hard time finding other antibiotics that will work to kill the bacteria.

Homework suggestion 1: to initiate a discussion with parents on antibiotics.

Interview your parents, and ask them if they have used antibiotics. If they have, for what diseases have they used it for? What were their symptoms? Did they confirm if they had a bacterial infection? Did they finish the course or did they stop as soon as they began to feel better?

Homework suggestion 2: to check if students remember what antibiotics work on, and what are the different ways to deal with infections.

Give pamphlets to each individual or group, each describing a diseased condition, like diarrhoea, viral fever, cold and cough. In the sheet mention what is the causative organism of the condition (bacteria/virus). Ask the students to think of themselves as doctors and suggest steps to be taken as prescriptions.

End of the activity reflection:

Form a line of all students and ask them to come a step forward if they think the sentence is true, and one step backwards if the sentence is false. Call out the following sentences, discuss each sentence after the children's action:

- Antibiotics are made by fungi as well as bacteria (True)

- Antibiotics can kill all kinds of microbes (False)

- When you eat antibiotics, your gut bacteria are also killed causing indigestion (True)

- When you feel sick you can decide yourself if you can take an antibiotic (False)

- When we have cold, many a times we have to just rest, eat healthy food and wait for our bodies to fight the microbes (True)

- Antibiotics kill good and bad bacteria (True. Discuss with students how killing good bacteria affects the microbiome).

- If you are sick with a cold, you should get rest, drink plenty of fluids, eat healthy and take antibiotics. (False. All are good actions except taking an antibiotic. A cold is caused by a virus, and antibiotics do not kill viruses).

- You should eat yogurt and other probiotics when taking antibiotics. (True. It replenishes the good bacteria. Make sure students know what probiotics are – good bacteria).

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