

1

Introduction to the Study of Cell and Molecular Biology

CASE STUDY: Will antibiotics cure the common cold?

Picture the scene: it's winter, your head aches, your sinuses are clogged, the coughing and sneezing won't stop. You've got a cold (or maybe even the flu). Do you wait it out at home? Or go to your doctor or the medical clinic on campus? Maybe they can give you some antibiotics to clear it up...

Colds, the most frequently transmitted infectious diseases in humans, are primarily caused by a group of viruses known as rhinoviruses (from Greek and Latin words for "nose poisons"). Viruses are non-cellular infectious agents that co-opt our cellular machinery to reproduce. The physiological response to a rhinovirus infection involves activation of the immune system, which leads to many symptoms we associate with the "common cold." But since these reactions may not be specific to the pathogen, it can be hard to know whether rhinovirus or other viruses such as adenovirus or influenza are the culprit. Bacteria, while not the direct cause of cold symptoms, can cause secondary infections that occur during or after the onset of a cold.

Questions:

1. Penicillin is an antibiotic that acts by inhibiting the formation of peptidoglycan cross-links in a cell wall. Based on what you know about the nature of viruses and bacteria, will penicillin effectively kill the rhinovirus?

Answer: Bacteria have cell walls, but neither the rhinoviruses that enter our cells nor the cells that they enter have a cell wall. This means that the penicillin will not kill the virus and will be ineffective in dealing with the primary infection. Antibiotics are prescribed to combat secondary bacterial infections, but will not shorten the duration of the cold.

2. People talk about catching a cold by touching surfaces that have been touched by someone else with a cold, such as a door handle or faucet knob. Is this because viruses can colonize and grow on these surfaces?

Answer: The cold virus cannot replicate or reproduce on surfaces outside the body. This is because the virus needs the machinery of our cells to reproduce itself. However, rhinoviruses can persist on these surfaces for several hours and can enter the body when you contact a contaminated surface and then touch your eyes, mouth, or nose.

3. After entering cells, viruses use the host cell machinery to transcribe their viral DNA into RNA or make new copies of their RNA, which will then be translated into proteins that are needed for virus function and replication. There has been a lot of interest and some

progress in the development of anti-viral drugs that act to halt the viral replication cycle. Do you think it would effective to target a drug to cellular RNA polymerase to halt viral replication? Why or Why not?

Answer: This would not work well. Viruses replicate by co-opting the host cell machinery to drive their reproduction. While targeting RNA polymerase would halt the production of viral RNA, it would also halt transcription in the host cell, thus killing the host! Scientists therefore focus their efforts on developing drugs against virus-specific targets. One problem has been the diversity of virus species and the high rate of mutation in viral genomes, which makes it hard to develop antiviral drugs that are specific and will remain effective.

Where can I learn more?

1. Palmenberg AC, Spiro D, Kuzmickas R, et al. Sequencing and analyses of all known human rhinovirus genomes reveal structure and evolution. Science. 2009;324(5923):55–59. doi:10.1126/science.1165557
2. Common Colds: Protect Yourself and Others [Internet]. Centers for Disease Control and Prevention; [updated 2019 Feb 11]. Available from: <https://www.cdc.gov/features/rhinoviruses/index.html>