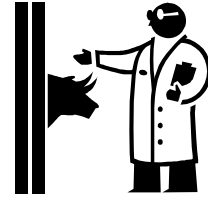


Political Advocates Against Pathogenic Microbes: a role-playing exercise

A curriculum activity to complement the December 1999 HHMI Holiday Lecture "2000 and Beyond: Confronting the Microbe Menace".



By Bob Noiva, University of South Dakota School of Medicine, Vermillion, SD

This activity has students investigate how the agricultural use of antibiotics can pose serious public health concerns. The activity requires students to first research the agricultural use of antibiotics and then prepare themselves to adequately argue against their use in livestock feed. Alternatively, students can research the use of vaccines to eradicate pathogenic bacteria from livestock. Students will produce abbreviated reports that briefly outline major talking points supporting their positions.

Learning Objectives

- To understand the dangers presented by pathogenic bacteria in our environment.
- To understand the dangers of antibiotic misuse.
- To learn more about efforts to use vaccines to combat future outbreaks of deadly pathogens.
- To gain practice using the scientific literature.

Activity

1. Watch the lecture "The Microbes Strike Back" by B. Brett Finlay on the HHMI Holiday Lecture DVD "2000 and Beyond: Confronting the Microbe Menace"
2. Read the following clipping from the Associated Press:

E. Coli in Cattle

October 21, 1999 - The Associated Press
MARY ESCH, Associated Press Writer

ALBANY, N.Y. (AP) -- According to this story, a hundred cows awaited judging in a fairground barn. Groomed and pampered, they were the pride of their farms.

One harbored a deadly germ. But nobody knew that. Not until later, when medical sleuths figured out what killed a 3-year-old girl and a 79-year-old man, and made more than 1,000 other fair-goers terribly sick.

The malignant microbe at the Washington County Fair was *Escherichia coli* O157:H7. Within less than a decade, the bacterium has gone from relative obscurity to major health threat, causing outbreaks of disease linked first to fast-food hamburgers, then lettuce.

apple cider, alfalfa sprouts, and other foods. At the fair, it infected drinking water.

A war has been waged on many fronts against the toxic bacteria since 1993, when an outbreak at Jack-in-the-Box restaurants in the Pacific Northwest infected more than 700 people and killed four.

Regulators have tightened meat inspection requirements. Health officials have issued cooking and sanitation guidelines. Medical researchers have developed better diagnostic tests. Legislators have proposed the creation of a new federal food safety agency.

But some scientists and consumer advocates say the ultimate solution may be to rout the enemy from its headquarters: the gut of the cow.

Dr. Robert Elder, a U.S. Department of Agriculture microbiologist in Clay Center, Neb., was quoted as saying, "We're trying to completely eliminate it from cattle at some point."

Normally, E. coli bacteria are beneficial inhabitants of the intestines of humans and other creatures. But O157:H7 is a mutant strain. In humans, it destroys the intestinal wall and can cause hemolytic uremic syndrome, or HUS, which attacks the kidneys -- sometimes fatally.

Scientists believe the mutant strain was created when a virus infected benign E. coli and gave it a string of DNA from Shigella -- a bacterium that causes severe, bloody diarrhea. In both Shigella and E. coli O157:H7, as few as 10 germs can cause illness; by comparison, it takes about a billion salmonella bacteria to make you sick.

An estimated 73,480 people a year are infected with E. coli O157:H7, and about 600 of those cases are fatal, according to the federal Centers for Disease Control and Prevention.

The outbreak at the end of August at the Washington County Fair, 33 miles north of Albany, resulted when a fairground well was contaminated by manure from a nearby cattle barn, according to investigators from the state Health Department and the CDC. Kristine Smith, a Health Department spokeswoman, was cited as saying that genetic testing indicated that the E. coli came from the digestive tract of a single cow.

The U. S. Department of Agriculture is sponsoring several research efforts aimed at ridding cattle and manure of toxic forms of E. coli. Complicating the effort is the fact that the bacteria don't make cows sick. Until recently, it wasn't even clear how widespread the organism was.

Last year, scientists estimated that about 1 percent to 3 percent of cattle were infected with E. coli O157:H7. Now, USDA researchers say it appears the number is much higher.

Elder was quoted as saying, "In every herd we've tested, there have been at least some animals positive for O157. The old methods used for testing cattle were not as sensitive as the tests we have developed here."

Elder was further cited as saying that with the growing number of media reports of outbreaks, it may seem like E. coli is becoming more widespread, but that's probably a misperception, adding, "I think five or 10 years ago the incidence (in cattle) was just as high, but now we're able to detect it better. The same is true in the human field. We have better diagnostics to identify E. coli. Outbreaks in the past may have gone unreported because we didn't know what to look for."

The story adds that several researchers are trying to develop an effective vaccine, including Elder and colleague James Keen.

"The thing we're looking at is a vaccine not only against O157, but also the O111 and O26 E. colis," Elder said. All three are mutant entero-hemorrhagic strains, meaning they produce the Shigella toxin that causes bloody diarrhea and HUS.

Michael Doyle, director of the Center for Food Safety and Quality Enhancement at the University of Georgia was cited as saying that developing a vaccine against O157:H7 in cattle is difficult, because the organism doesn't make cattle sick, it doesn't stimulate their immune system to make blood antibodies, adding, "Traditional vaccines aren't likely to be effective for that reason."

Doyle is more optimistic than Elder is about competitive exclusion treatments in cattle. "We have selected three strains of good bacteria which produce anti-microbials that kill O157," said Doyle.

In a recent study, the Georgia researchers exposed 20 adult cattle to O157:H7, and then gave 10 of them feed inoculated with the probiotic bacteria. After 33 days, the 10 animals that were not given probiotics were still positive for O157:H7. Of the 10 that got the treatment, only one was still positive. An earlier study with calves had similar results.

Additional studies are needed, not only to verify the results, but also to see how long the effect would last and determine whether the animals would have to be continually fed probiotics to prevent O157:H7 infection, Doyle said. He hopes to get FDA approval for a commercial probiotic that can be added to cattle feed. However, such a product is several years away, he said.

Activity (cont.)

3. Ask your class what possible additional dangers using antibiotics in livestock feed could create. (They should understand that use of antibiotics might lead to the generation of drug-resistant bacteria, which would increase the health risk to the general public.)
4. Tell the students that your state legislature is considering new legislation banning the agricultural use of antibiotics in livestock feed. Tell the students that paid lobbyists from the livestock feed companies, the beef and pork industry, and several pharmaceutical firms have spent considerable time and money informing the state legislature of the benefits of antibiotics in livestock feed.
5. Suggest that the students in your class testify in front of the legislative committee studying the use of antibiotics in livestock in order to present opposing opinions.
6. Divide the class into groups to work on developing presentations for the legislative committee. Have the students select a topic to present to the legislative committee. The topic would be either:
 - the importance of banning the use of antibiotics in livestock feed
 - requests for funding to develop a livestock vaccine against E. coli strain O157:H7.
7. Remind the students that quoting authoritative references will greatly enhance their position and the credibility of their report to the committee. Give the students access to the library and/or computer lab to research their topic.
8. Have the students create “talking points” explaining their position to the study committee of the state legislature.
9. Have each group submit a paper listing their five main talking points. Remind the students that the knowledge of the state legislators may be limited so they should provide some background material. The final report must have references.