

Use of an “Attenuated” Computer Virus as a Mechanism for Teaching Epidemiology

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Students often perceive epidemiology as a dry subject and not relevant. These same students, also often, do not perceive themselves to be personally at risk of infection. To make the teaching of epidemiology more interactive and to graphically demonstrate the concept of risk, an experiential learning exercise was developed. The experience was designed so students would access a weekly computer quiz in the computer laboratory. One of the computers was “infected” with a silent computer virus (tagged file). Therefore, while answering questions, the students exposed their disks to an infection, which was transmitted to other computers and disks. At the end of the term, the spread of infection throughout the class was monitored by identification of infected disks and computers. Explaining the infection which had been passed throughout the class facilitated a discussion of epidemiology and risk assessment. Students were surveyed to assess their response to this exercise which was found to be extremely favorable.

INTRODUCTION

Teaching Microbiology and Immunology to Pharmacy students has led to the observation that while students are concerned about infection and disease, they have little interest in developing an understanding of epidemiology. We believe that this lack of interest stems from their perception that epidemiology is memorization of terms and dry statistics relating to the spread of disease through a population. In

short, students do not connect the principles of epidemiology to either their personal lives or their careers in health sciences. One outcome of this lack of connectivity between classroom learning and personal life, is that our second and third year students have a reasonable knowledge of sexually transmitted

¹Internal surveys, 1993, communicated by I. Kaplan, Albany College of Pharmacy, 106 New Scotland Avenue, Albany NY 12208 (July 1993).

diseases, yet report behaviors considered to be high risk for contracting such diseases (internal surveys 1993¹). Possible explanations for this discrepancy between knowledge of disease and failure to modify behavior include lack of appropriate risk assessment and a sense that "it can't happen to me". Therefore, a stimulus existed to make epidemiology and risk evaluation more "real" for the students.

The concept for this exercise was born from difficulties one of us (D.G.M.) was experiencing with a microcomputer in the laboratory. This microcomputer was repeatedly infected with a computer virus, which was traced to a floppy disk used by a single student both in the laboratory and in the student computer center. The student denied responsibility stating "I don't use infected computers!" However, when questioned, she responded that she did not scan for viruses, or use virus protective software. Again, student beliefs and behavior were at odds with the facts. Thereafter, a student initiated discussion ensued which focused on safe practices and how to maintain a virus-free disk. In short, the chance of computer virus infection had become a personal reality for this student.

During collegial discussions, we realized that the experience of the one student with a laboratory computer could be expanded to create an "experiential" epidemiology learning exercise. The exercise we developed consisted of infecting members of the class with a mock computer virus and charting its spread through the class and other microcomputers. The class was not informed of the "infection" until the end of the semester when all the parameters were revealed and discussed.

Since its inception, this program has been used with three classes of Microbiology students and three classes of Immunology students. The goals of this experiential learning program were to: (i) give the students a realistic demonstration of the spread of infections in a safe manner; (ii) make the possibility of infection more personal and realistic for the students, in as safe a manner as possible; and (iii) make epidemiology more interesting to the students while they were becoming more familiar with the concepts and terms used by epidemiologists.

METHODOLOGY

In each of the Microbiology and Immunology classes, each student was issued a floppy disk and informed that a test bank of self-study questions would be available on a weekly basis in the computer laboratory. Each student was assigned to take a self-study quiz (five questions randomly selected from the bank by the computer) each week. To enhance participation, each student was awarded five points for taking each weekly quiz. The students were informed that to verify participation, the computer would transfer their results into an encrypted file once each week when they logged on. Students were allowed to log on more than once per week to view additional questions.

Depending on the term, six to seven computers were used and each was loaded with a bank of test questions and appropriate teaching software. One of the computers was then purposely "infected" with an attenuated or mock computer virus (a tagged information file which could not enter any other programs). The virus would spread only within the quiz bank software via transmission on floppy disks. When a floppy disk infected an uninfected computer, the newly infected computer was also able to transmit an infection. The infectivity rate was fixed at 33 percent and the experiment allowed to continue for 10 weeks. During this time, the students did not know that a "virus" was present. Therefore, their behavior provided an

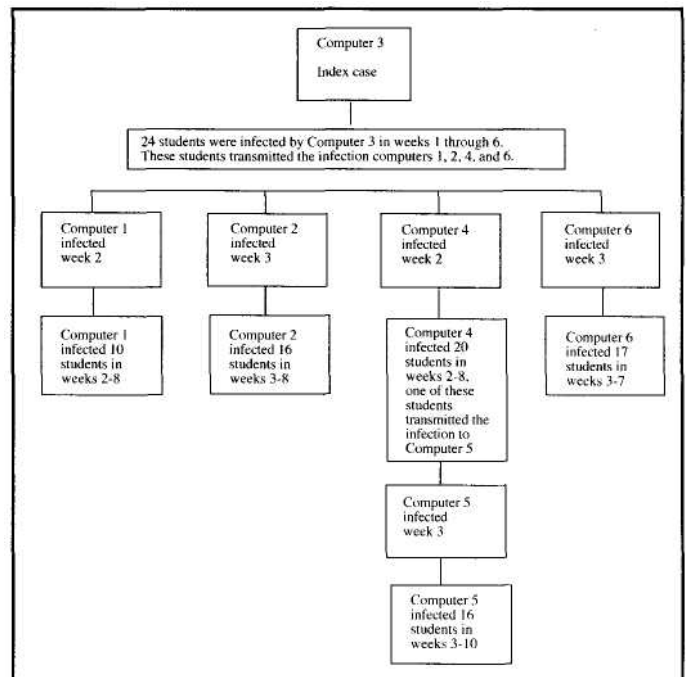


Fig. 1. The spread of a computer "virus" through a class of approximately 120 students and six microcomputers over ten weeks.

independent risk assessment. Seven computers were used, when convenient, by 118 students. Most students used whichever computer was available. At the end of the semester, all the disks were collected and a time line of the "virus" transmission was determined and charted, in conjunction with a summary lecture on epidemiology. The results were presented to the class with a description of the experiment.

Students' attitudes toward the experience were analyzed anonymously using a survey at the end of the semester. The survey would assess the students' attitudes toward understanding the spread of disease through a population, understanding epidemiological terms, possibility of infection and personal behavior, and usefulness of the experience. The survey questions were presented as statements to which the students could Agree Strongly, Agree Generally, Agree Sometimes/Disagree Sometimes, Disagree Generally and Disagree Strongly. The statements are contained in the figures with the student responses.

RESULTS AND DISCUSSION

The experience of self-assessment via computer quizzes with an "attenuated" or mock virus embedded in the quiz program was designed to make the possibility of infection more real to the students and to make learning epidemiology more stimulating with a greater understanding of the material. After the collection of the disks, the students were informed of the "virus" embedded in the program. The results of the "virus" infection, its spread from the "index case" or "primary vector" were presented in figure form and an example of a typical class is seen in Figure 1. The spread of the infection in the class using six computers was charted from the index case (computer three) through infection of virtually the entire class by Week 10. This figure also illustrated to the students the spread of an infection from one individual (computer) to another and then to additional students (disks). When possible, an example is made of a computer (three) infecting a student disk in Week One. The infected disk then infected a different computer (four) in Week Two. This computer (four) was able to infect six additional

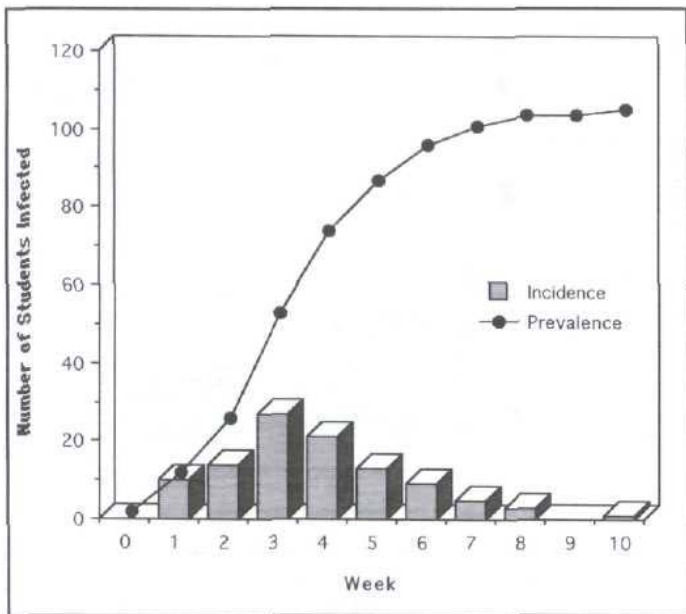


Fig. 2. The incidence and prevalence of a computer "virus" in a class of approximately 120 students over the ten week exercise.

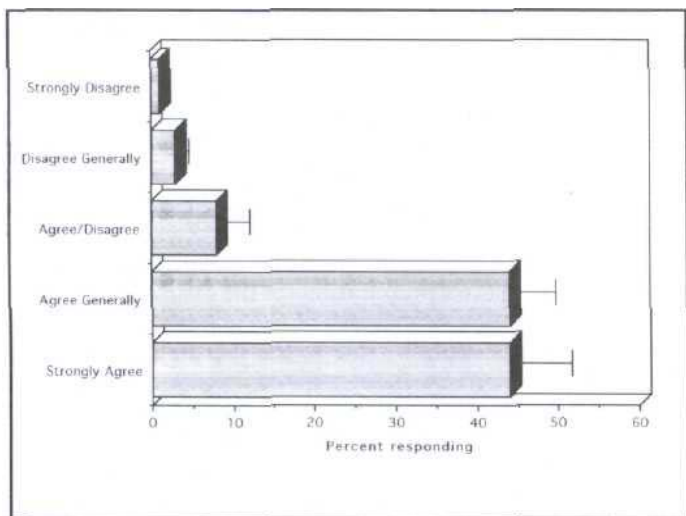


Fig. 3. The response of students to the statement: After the computer virus experiment, the spread of disease through a population is more understandable to me.

disks during week two and one of these disks infected a third computer (five) in Week Three. All the computers continued to infect individuals through at least Week Eight.

As the pattern of the spread of disease was revealed, the students had additional questions. They wanted to know exactly who was initially infected and who was subsequently infected. Since our students will become health care professionals, they learned directly the impact of "naming names" on patient confidentiality. This led to a discussion of ethical issues surrounding patient confidentiality. The idea of patient confidentiality has increased in importance as patient data become both computerized and centralized. Health care professionals will be increasingly responsible for maintaining a patient's privacy.

In class, students were encouraged to use the data to plot incidence and prevalence of the disease. In this part of the exercise, the computers were designated as vectors, rather than infected individuals, and allowed discussion of the role of vectors in transmission of disease. In addition, the following

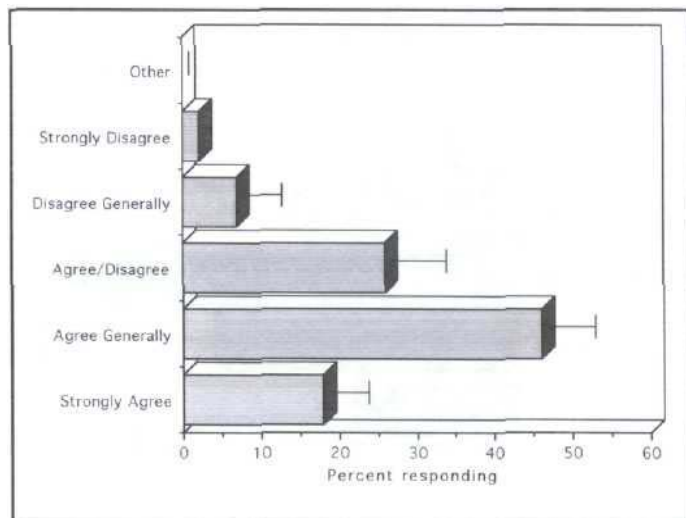


Fig. 4. The response of students to the statement: After the computer virus experiment, the terms used by epidemiologists are more understandable to me.

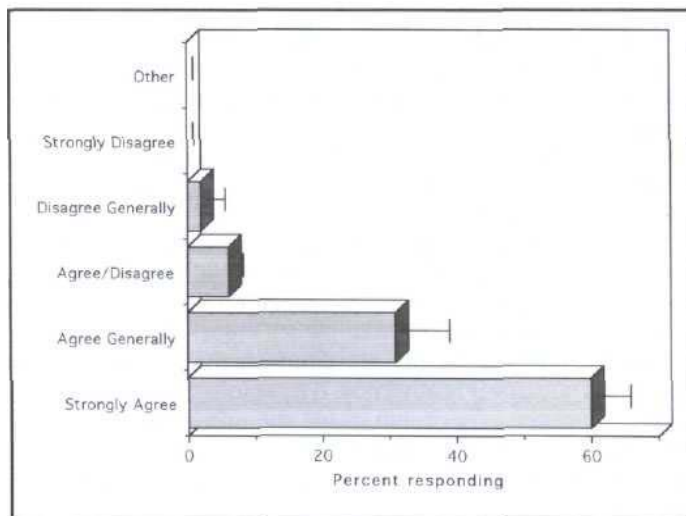


Fig. 5. The response of students to the statement: After the computer virus experiment, I am more aware of the possibility of my being infected with an infectious agent.

points were demonstrated: as the number of vectors increased (infected computers) the number of new infections per week also increased. However, when there were fewer uninfected individuals the incidence of disease decreased, even as the prevalence in the community approached (but did not reach) 100 percent (103 infected/109 student disks, nine students did not hand in their disk). In Immunology classes, this data has led to a discussion of the effects of vaccination and herd immunity.

When the students were surveyed about whether their understanding of the spread of disease increased, 88 percent strongly or generally agreed with the statement (Figure 3). Less than 10 percent agreed sometimes/disagreed sometimes and less than five percent disagreed generally or disagreed strongly. The comments associated with this overwhelming positive response include: "... very creative way to teach an idea..." "It was a great way to make an analogy that was easy to understand and will be hard to forget." "... The computer virus experiment made it easy to understand how easily and rapidly viruses can be spread throughout a population." "Definitely, I felt the computer experiment gave me a physical example of the spread of a disease"

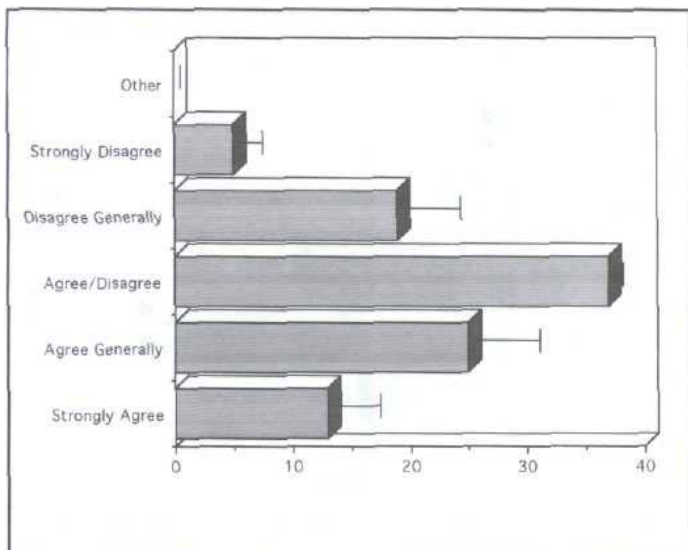


Fig. 6. The response of students to the statement: After the computer virus experiment, I am likely to change my personal behavior.

When the students were asked about their understanding of the terminology used (Figure 4). The results here show that: 62 percent strongly or generally agreed with the statement, 30 percent agreed sometimes/disagreed sometimes and less than eight percent disagreed generally or disagreed strongly. Their comments ranged from "Absolutely" to "I understood them already" to "Not really."

Ninety-one percent of those surveyed indicated that they were more aware of their risk of infection, only six percent were neutral and two percent disagreed generally, no one disagreed strongly to the statement (Figure 5). In addition, student comments on this statement included: "It helps to show that you never really know if a person is infected or not". "The computer experiment made me much more aware of how susceptible each of us is." "Shows how quickly a disease can spread without anyone knowing." "It was scary how easily the virus spread."

Even armed with a demonstration of how disease can spread, only 38 percent of the students strongly or generally agreed with the statement "I am likely to change my behavior" (Figure 6). Thirty-seven percent agreed or disagreed sometimes and 24 percent disagreed generally/disagreed strongly to the statement. One explanation for these results is that approximately 27 percent of college age students are abstinent or consistently use condoms(1). Their reasons for disagreeing included "I don't have any risky personal behaviors", "old habits are hard to change," "my habits have already changed a great deal after microbiology" and "my behavior will be what it always has been, whatever strikes me at the moment."

With regard as to whether this was a useful experience, there was overwhelming support: 91 percent of the students strongly or generally agreed, less than 10 percent were neutral or disagreeing, and no one disagreed strongly (Figure 7). Student comments reflected their ratings. "I think it was a great way to illustrate the spread of disease," "I think it was a very different way of getting across to the students how important the spread of disease was. Things like this keep the class interested and the class itself enjoyable." "The idea is good and makes you (the students) laugh, but if you pay attention you'll realize it means something." "Definitely a good way to show things in real life, not just under a microscope," and "...You can draw a lot of parallels between this

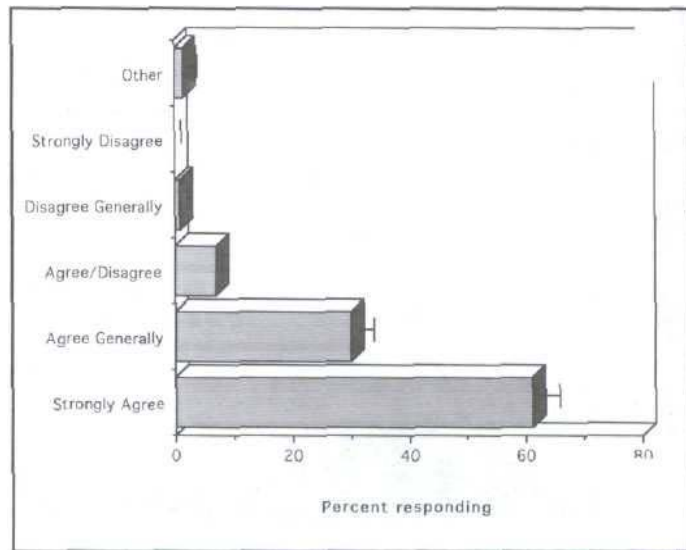


Fig. 7. The response of students to the statement: I believe that this experience was useful and should be continued with other classes.

and the AIDS epidemic." This last comment reflects on the initially silent and apparently harmless nature of the virus. This silent period without overt symptoms or difficulties caused the students to think directly about HIV and AIDS.

An unexpected benefit to this experiential learning situation was that students studied more and expressed a great deal of satisfaction with the quizzes. In addition, they often worked in small groups to study the material on the quizzes, argued the correct response and came to their own conclusions. While the average grades in the classes did not vary significantly with the introduction of this experience, student satisfaction with their preparation for the exams increased as did their perception of mastery of the material. The lack of change in grades could be due to the fact that grades were recorded after a curve was determined. In general, the grades have been curved less frequently since the institution of these quizzes. Certainly, student satisfaction is higher. One observation that has surprised the researchers and faculty is that the student "rumor mill" has not extended to this experience. We have no explanation for this surprising development in the student information network. In the future, we hope to publicize the possibility of infection and look for modifications in student behavior (monogamous use of computers, use of viral detection software, etc.), by providing a reward, in the form of bonus points, for not becoming infected. In addition, this program can be used to demonstrate the differential between male and females (by changing the parameters for infection within the program) with regard to ease of infection with sexually transmitted diseases.

In general, this learning exercise was well accepted by the students. Their attitudes and perceptions of the experience were surveyed at the end of the experience and it was determined that greater than 90 percent of the students were more aware of the risks of infection and considered it a useful exercise which should be continued. In addition, greater than 50 percent of the class felt more comfortable with the terms used by epidemiologists.

Am. J. Pharm. Educ., 62, 141-144(1998); received 11/4/97, accepted 3/10/98.

Reference

- (1) Centers for Disease Control and Prevention, CDC Surveillance Summaries, November 14,1997;46(No. SS-6)