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EPIDEMIOLOGY FOR HIGH SCHOOL STUDENTS: IMPROVING THE PUBLIC HEALTH PIPELINE

Kristi J. McClamroch, MPH, PhD
JoLynn P. Montgomery, MPH, PhD

Epidemiology is often regarded as the science of public health. Epidemiologists are essential for detecting and tracking health problems associated with both infectious and noninfectious diseases, and developing ways to prevent, contain, and control these health problems. Unfortunately, recruiting and retaining highly skilled public health professionals, particularly in the field of epidemiology, is problematic.[1] Both the existing number of epidemiologists and the number of new graduates entering the workforce in state and local health departments are insufficient.[2] The number of public health workers in the United States declined from 220 workers per 100,000 in 1980 to 158 workers per 100,000 in 2000.[1] To compound the problem, the public health workforce is aging,[3] and up to 50% of the current workforce will be eligible to retire in the next few years.[4,5]

In addition to having too few epidemiologists working in public health today, there is a lack of diversity within the existing public health workforce.[2] While underrepresented groups represent 25% of the U.S. population, they represent only 10% of health professionals.[6] Better representation by minorities is important to improve the health disparities in the United States, as health professionals are often viewed as leaders in their community.[7]

To alleviate this problem, national associations have recommended expanding public health training opportunities. In 2006, the American Public Health Association published a list of evidence-based solutions to the problem of the declining public health workforce, which included expanding opportunities for students.[1] The Council of State and Territorial Epidemiologists (CSTE) recommends public health training in undergraduate programs and encourages targeting epidemiology training materials to all age groups. CSTE also suggests partnering with the Epidemiology Education Movement, a project funded by the National Institutes of Health to promote teaching epidemiology to middle and high school students.[2] The Institute of Medicine recommends that public health education be available to undergraduates.[8]

The emphasis of expanding the reach of epidemiology training to younger students may raise awareness of the field and address the problem that high school students in the U.S. perform below the international average when tested on general knowledge of mathematics and science.[10] Teaching epidemiology to these students gives them both a practical application for mathematics and science and a forum for multidisciplinary learning.[11] Summer enrichment programs that recruit minority high school and undergraduate students are a logical venue for teaching epidemiology; most high school teachers do not have the expertise to teach epidemiology to their students, but many epidemiologists are likely to be available in the summer to teach short courses to motivated students. While many such summer programs are well established[9,10,12–15] and resources are available to encourage epidemiology training,[16,17] few programs teach epidemiology as the core of the program.

One example of a highly successful summer enrichment program is the Telluride Association Sophomore Seminar (TASS). This program, which is conducted annually by the Telluride Association for high school sophomores, offers sessions at the University of Michigan and Indiana University. African American high school sophomores and high school sophomores from other minority groups are particularly encouraged to apply. The goal of the program is to strengthen the skills needed to compete in a college-level environment. Participants in TASS focus on improving reading, writing, analytic skills, public speaking, and computer

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skills through study of a subject area of interest. The program is highly competitive and free to students (http://www.tellurideassociation.org).

From 1993, when TASS began, to 2007, all but one of the TASS sessions were based in the social sciences. To broaden the focus of TASS, we developed a curriculum for high school students to increase interest and awareness in epidemiology. This was one of three different curricula offered as part of the TASS program during the summer of 2007. The goal of the curriculum was to promote public health and to make epidemiology interesting and accessible to highly motivated youth, many of whom were minorities. This article presents the successes and challenges involved in teaching epidemiology to high school students, as well as the results of a survey that queried the students about the topics and teaching materials used.

METHODS

We co-taught a six-week seminar on infectious disease epidemiology to 16 students in the summer after their sophomore year in high school. This seminar, one of three TASSs that are delivered each summer, was held at the University of Michigan during the summer of 2007. Students met five days a week for three hours per session. We introduced students to a number of topics relevant to epidemiology, including epidemiologic methods, disease transmission and control, and public health ethics. We organized the seminar in a way that would expose students to a variety of learning experiences using individual and group activities.

During the seminar, students learned about a number of methodological concepts, including measures of disease frequency and association, random error and statistics, causality, epidemiologic study designs (e.g., experimental, cohort, case-control, cross-sectional, and ecological studies), confounding/effect modification, and screening. In quantitative workshops, the students calculated prevalence and incidence measures, risk ratios and odds ratios, sensitivity and specificity, and positive and negative predictive value. In addition, they assessed data for confounding/effect modification. They had hands-on experience to learn how to analyze simple epidemiologic data using Epi Info™ version 3.4.1.[18] Students learned to use PubMed to identify studies with various designs. The students watched the movie "Groundhog Day"[19] to learn about the concept of the counterfactual.

To teach about disease transmission, we first introduced anatomy and physiology. The students summarized the important parts and functions of the body's main systems in groups. The instructors and students went to the Detroit Science Center to see the IMAX movie "The Human Body,"[20] as well as the exhibit "Our Body: The Universe Within."[21] Discussions about disease transmission centered around the books *An American Plague: The True and Terrifying Story of the Yellow Fever Epidemic of 1793*,[22] *The Strange Case of the Broad Street Pump: John Snow and the Mystery of Cholera*,[23] and *The Hot Zone: A Terrifying True Story*;[24] as well as the movies "The Great Plague,"[25] "Influenza 1918,"[26] and "Outbreak."[27] The students also played the interactive computer game "Outbreak at Watersedge: A Public Health Discovery Game."[28] They learned about bioterrorism and the criteria for a disease to be an effective weapon, and they discussed in groups whether a specific disease could be used for bioterrorism. In addition, they watched the documentary "The Living Weapon."[29]

Discussions about public health ethics and priorities centered around the books *Bad Blood: The Tuskegee Syphilis Experiment*[30] and *Mountains Beyond Mountains: The Quest of Dr. Paul Farmer, a Man Who Would Cure the World*,[31] and the films "Ms. Evers' Boys,"[32] "And the Band Played On,"[33] and "Sicko."[34] The students watched the episode "Delivering the Goods"[35] from the Public Broadcasting Service (PBS) program "Rx for Survival: A Global Health Challenge," and played the games "Growing Up Healthy," "Investing Your Money Wisely," "Is the Water Clean Yet?", "How Hard Can It Be to Carry Water?", and "Unfair Race" from PBS's "Rx for Child Survival."[36]

Throughout the course, students applied the aforementioned concepts to identify populations at risk for negative health effects. The students attended three talks as part of the 42nd Graduate Summer Session in Epidemiology at the University of Michigan School of Public Health: "Emerging Infections: How Can They Continue to Occur?" by Dr. Philip Brackman, "When Germs Travel: Epidemics and Anxiety in American Society" by Dr. Howard Markel, and "Do We Know Enough to Improve Population Health?" by Dr. George Kaplan. They were asked to identify topics mentioned in the lectures that had been discussed during the seminar. To integrate the information from the seminar, the students read the *Morbidity and Mortality Weekly Report (MMWR)* each week, identified examples, and applied the concepts presented in the course.

At the beginning of the seminar, each student chose an infectious disease on which to focus. During the semester, each student wrote a two-part paper about his or her chosen disease. Part one covered basic facts about the disease, including mode of transmission, symptoms, and incubation period. For part two, students developed an interesting question about their chosen disease and provided a scientific response.

Based on comments from the instructors and peers, students wrote three drafts of the paper before the final version was due so they would learn to revise their own work. During the last week of the seminar, each student gave a 30-minute presentation that included facilitating a discussion about their selected disease. Students gave anonymous evaluations of each others' presentations.

On the last day of class, the students completed an anonymous course evaluation. The students used five-point Likert scales to rate topics for importance (1 = very important, 2 = important, 3 = neutral, 4 = unimportant, and 5 = very unimportant) and interest (1 = very interested, 2 = interested, 3 = neutral, 4 = not really interested, and 5 = not at all interested). They also ranked their enjoyment of the various books, films, workshops/group activities, games, and assignments using the five-point Likert scale (1 = loved, 2 = liked, 3 = neutral, 4 = disliked, 5 = hated). Students rated perceived importance of public health before and after the seminar, their willingness to take a university class in public health, and their willingness to consider either having a career in public health or incorporating public health into their career. They rated each instructor, teaching assistant, and the degree to which their expectations of the class were met. Finally, they had the opportunity to write open-ended comments.

We analyzed these data using Epi Info. We collapsed categorical variables on topic importance into important, neutral, and not important. We collapsed categorical variables on topic interest into interested, neutral, and uninterested. We combined categorical variables about enjoyment of books, films, workshops/group activities, and assignments into enjoyed, neutral, and did not enjoy. We defined a new variable to represent change in perception of the importance of public health before and after the class. We assessed differences by gender using Fisher's exact Chi-square tests. *P*-values less than 0.10 suggested an association.

RESULTS

The class comprised seven males and nine females. Fourteen of the 16 students were African American; the other two students—one male and one female—were also from racial minority groups. The students came from across the United States, including Michigan, Illinois, Indiana, New York, Maine, Maryland, Kentucky, Missouri, Florida, Georgia, and Kansas. All of the students were either 15 or 16 years old. Ten of the students came from public schools and six were from private schools. The size of their schools' sophomore class ranged from 50 to more than 600 students. One-third of the students in the seminar qualified for free or reduced-price lunch programs at their school.

Of the three TASSs offered in the summer of 2007, this seminar was the first choice for all 16 students. On their TASS applications, all but two of the students indicated that they wanted to go into the medical profession, most to become physicians.

More than half of the students expressed interest in the majority of the topics covered in the seminar (Table 1). The most popular topics were infectious disease transmission and outbreaks (93% were interested). These were followed by bioterrorism (87%), anatomy and physiology (80%), and public health ethics (73%). None of the students reported being uninterested in any of these topics. The least popular topics were study designs (40%) and confounding/effect modification (13%). The only gender difference was for screening:

Table 1. Students' level of interest in infectious disease epidemiology topics for the 2007 Telluride Association Sophomore Seminar (*n*=16)[a]

Topic	*Interested* N *(percent)*	*Neutral* N *(percent)*	*Not interested* N *(percent)*
Measures of disease frequency and association	8 (53)	7 (47)	0 (0)
Anatomy and physiology	12 (80)	3 (20)	0 (0)
Infectious disease transmission	14 (93)	1 (7)	0 (0)
Surveillance	8 (53)	7 (47)	0 (0)
Outbreaks	14 (93)	1 (7)	0 (0)
Study designs	6 (40)	3 (20)	6 (40)
Confounding/effect modification	3 (20)	10 (67)	2 (13)
Public health ethics	11 (73)	4 (27)	0 (0)
Health inequalities	9 (60)	4 (27)	1 (7)
Screening[b]	8 (53)	7 (47)	0 (0)
Bioterrorism	13 (87)	2 (13)	0 (0)

[a]Percentages may not add to 100% due to rounding.

[b]There was a significant difference between males and females (p=0.04).

males found the topic more interesting than females (p=0.04).

More than three-quarters of the activities were enjoyed by at least half of the students (Table 2). The most enjoyed activity was the movie "Sicko" (100%). The most enjoyed workshop/group activity was the discussion of whether specific diseases could be used for bioterrorism (94%). The most enjoyed book was *The Hot Zone* (81%). The most enjoyed movies after "Sicko" were "And the Band Played On" (94%) and "Outbreak" (93%) (n=15). The least enjoyed activities were reading *The Strange Case of the Broad Street Pump* (88%) and *MMWR* (38%). The only gender difference for enjoyment of activities was for the body exhibit; females enjoyed the exhibit more than males (p=0.09).

In addition to reading *MMWR* and *The Strange Case of the Broad Street Pump*, the other activities that were enjoyed by fewer than half of the students included the workshops on confounding/effect modification and screening, and the movies "The Great Plague," "Influenza 1918," and "Delivering the Goods."

The majority of students enjoyed the assignments. The students developed interesting theses for their papers: for example, the impact of malaria on Zambia's economy and culture; prevention efforts of African

Table 2. Students' level of enjoyment of infectious disease epidemiology activities for the 2007 Telluride Association Sophomore Seminar (n=16)[a]

Activity	*Loved or liked* N *(percent)*	*Neutral* N *(percent)*	*Disliked or hated* N *(percent)*
Workshops/group activities			
Disease frequency and association	7 (50)	7 (50)	0 (0)
Presentation of body systems	12 (75)	4 (25)	0 (0)
Epi Info™[b]	9 (56)	6 (40)	1 (7)
Identifying study designs	10 (63)	5 (31)	1 (7)
Confounding/effect modification calculations	7 (44)	4 (25)	5 (31)
"Our Body: The Universe Within"[c,d]	12 (75)	2 (13)	2 (13)
Screening calculations	7 (47)	4 (27)	4 (27)
Bioterrorism criteria	15 (94)	1 (6)	0 (0)
Morbidity and Mortality Weekly Report	5 (31)	5 (31)	6 (38)
Books			
An American Plague: The True and Terrifying Story of the Yellow Fever Epidemic of 1793[e]	11 (69)	3 (19)	2 (13)
The Strange Case of the Broad Street Pump: John Snow and the Mystery of Cholera[f]	1 (6)	1 (6)	14 (88)
Bad Blood: The Tuskegee Syphilis Experiment[g]	13 (87)	0 (0)	2 (13)
Mountains Beyond Mountains: The Quest of Dr. Paul Farmer, a Man Who Would Cure the World[h]	8 (50)	7 (44)	1 (7)
The Hot Zone: A Terrifying True Story[i]	13 (81)	3 (19)	0 (0)
Films			
"The Great Plague"[j]	5 (31)	9 (56)	2 (13)
"Influenza 1918"[k]	5 (31)	5 (31)	6 (38)
"Groundhog Day"[l]	12 (86)	2 (14)	0 (0)
"Ms. Evers' Boys"[m]	15 (94)	0 (0)	1 (6)
"And the Band Played On"[n]	15 (94)	1 (6)	0 (0)
"Delivering the Goods: Rx for Survival"[o]	5 (33)	8 (53)	2 (13)
"The Human Body"[p]	13 (81)	3 (19)	0 (0)
"Sicko"[q]	16 (100)	0 (0)	0 (0)
"The Living Weapon"[r]	8 (53)	6 (40)	1 (7)
"Outbreak"[s]	14 (93)	1 (7)	0 (0)
Games[t]			
Investing your money wisely			
Growing up healthy	9 (56)	4 (25)	3 (19)
Unfair race	9 (56)	4 (25)	3 (19)
Is the water clean yet?	14 (88)	1 (6)	1 (6)
How hard can it be to carry water?	13 (81)	3 (19)	0 (0)

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Table 2 (continued). Students' level of enjoyment of infectious disease epidemiology activities for the 2007 Telluride Association Sophomore Seminar (*n*=16)[a]

Activity	*Loved or liked* N *(percent)*	*Neutral* N *(percent)*	*Disliked or hated* N *(percent)*
Assignments			
Disease papers[c]	11 (69)	5 (31)	0 (0)
Revisions of disease papers[c]	8 (50)	7 (44)	1 (6)
Disease presentations	12 (75)	2 (13)	2 (13)
Evaluations of disease presentations	13 (87)	1 (7)	1 (7)

[a]Percentages may not add to 100% due to rounding.

[b]Centers for Disease Control and Prevention (US). Epi Info™: Version 3.4.1. Atlanta: CDC; 2007.

[c]There was a significant difference between males and females (p=0.04).

[d]Our body: the universe within. Baltimore: The Universe Within Touring Company, LLC; 2007.

[e]Murphy J. An American plague: the true and terrifying story of the yellow fever epidemic of 1793. New York: Clarion Books; 2003.

[f]Hempel S. The strange case of the Broad Street pump: John Snow and the mystery of cholera. Berkeley (CA): University of California Press; 2007.

[g]Jones JH. Bad blood: the Tuskegee syphilis experiment. New York: Free Press; 1993.

[h]Kidder T. Mountains beyond mountains: the quest of Dr. Paul Farmer, a man who would cure the world. New York: Random House; 2003.

[i]Preston R. The hot zone: a terrifying true story. New York: Random House; 1994.

[j]The Great Plague [video recording]. Princeton (NJ): Films for the Humanities & Sciences; 2003, 2001.

[k]Influenza 1918 [video recording (DVD)]. Alexandria (VA): PBS Home Video; 2005.

[l]Groundhog day [video recording]. Culver City (CA): Columbia TriStar Home Video; 2002.

[m]Ms. Evers' boys. New York: HBO Home Video; 1997.

[n]And the band played on. New York: HBO Home Video; 1993.

[o]Public Broadcasting Service. Rx for child survival [cited 2007 Dec 4]. Available from: URL: http://www.pbs.org/wgbh/rxforsurvival/campaign/givetime/index.html

[p]The human body [IMAX film]. The Learning Channel and BBC Worldwide of a Discovery Pictures/BBC coproduction; October 2001.

[q]Sicko. New York: Weinstein Company; 2007.

[r]The living weapon [video recording (DVD)]. Alexandria (VA): PBS Home Video; 2007.

[s]Outbreak [video recording]. Burbank (CA): Warner Home Video; 1997.

[t]Delivering the goods: Rx for survival [video recording (DVD)]. Boston: WGBH Boston Video; 2005.

trypanosomiasis (*Trypanosoma brucei gambiense*); a comparison of the media response to Typhoid Mary and Andrew Speaker; and the pros and cons of the chickenpox vaccine. Males enjoyed writing and revising the papers more than females (p=0.03). None of the students said they did not enjoy writing the papers. The paper revisions were more varied: 50% enjoyed the revisions, and 44% were neutral about them.

One-half of the students had heard of epidemiology before the seminar. Of the 16 students, 11 thought that public health was at least somewhat important before the class, one thought it was somewhat unimportant, and four had no opinion. In contrast, all of the students thought that public health was at least somewhat important after the seminar. Four of the students did not change their opinion of public health. Seven of the students thought public health was more important after the class compared with before the class. All of the four students with no opinion before the class said after the class that public health was important. Only one student thought public health was less important after the class than before the class, but at both times, the student reported that public health was important.

Six of the students reported that their expectations of the seminar were completely met, six said they were mostly met, and three said they were somewhat met. Only one of the students said that their expectations were not at least somewhat met. As compared with females, males more often reported that their expectations were met (p=0.02).

All but one of the students reported being willing to take a college course in public health; that student was neutral. Of the 16 students, 10 reported a willingness to include public health in their career plans, six had no opinion, and two were somewhat unwilling.

DISCUSSION

Overall, we felt that the seminar was a success. We were impressed with the students' ability to process and apply some of the concepts of epidemiology that are often difficult for graduate students. While some of these concepts took a little longer to teach to high school students, and required innovative modes of teaching, the end result was quite positive.

The students disliked few topics. The students were least interested in study design and confounding/effect modification, which are conceptually difficult topics. They were most interested in more "flashy" topics including infectious disease transmission, outbreaks, and bioterrorism. The students' least enjoyed workshop/group activity was reading *MMWR*, which also challenged them to synthesize what they had learned. They were more divided on the application of confounding/effect modification and screening activities, which were the most quantitative. They tended to enjoy the Hollywood movies more than the documentaries. We addressed the limitations and misperceptions in the Hollywood movies, but they provided a good teaching opportunity. None of the students disliked writing the disease papers, perhaps because they were able to choose their own topics. In addition, they entered the TASS program with the expectation of writing and presenting. Perhaps they were more divided on the quantitative activities because they did not know ahead of time that they would be expected to use a calculator.

Through the process of teaching this seminar, we identified both challenges and rewards of teaching epidemiology to high school students. We feel that it was a worthwhile exercise to introduce students to public health and epidemiology and to give them challenging material. With thorough explanations and some handholding, the students were able to master the material. They were able to handle difficult quantitative and conceptual topics. We feel that the following are useful suggestions to other public health professionals who are considering teaching a public health seminar to high school students: (*1*) combine challenging and "flashy" topics as a way to engage the students; (*2*) balance Hollywood movies and documentaries; (*3*) use a variety of teaching techniques and modes of learning; (*4*) use a variety of media (e.g., journals, computer presentations, group discussions, films, nonfictional and fictional books, and the Internet); (*5*) give students the chance to interact with each other; (*6*) give the students a lot of attention and positive feedback; (*7*) provide students with the opportunity to select their own paper topics; and (*8*) encourage students to give feedback on the seminar.

Although the format of many graduate-level classes focuses on lectures alone, we feel that the seminar would not have been successful had we lectured for six weeks. In addition, the six-week time frame was appropriate to cover a substantial amount of material without overwhelming the students. One of the advantages of the TASS format was that the seminar was held on the University of Michigan campus during the School of Public Health summer session, so we were able to take advantage of evening public health lectures. Although our experience was based on a fairly small sample size, the students in the seminar did represent a fairly wide range of backgrounds.

A number of students in the seminar showed interest in applying for the Telluride Association Summer Program (TASP), which is the equivalent of TASS but for students in their junior year of high school. As more programs like TASS and TASP are offered, we urge public health professionals and academics to become involved. These types of experiences benefit both the high school students and the faculty.

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Kristi McClamroch is an Assistant Professor in the Department of Epidemiology and Biostatistics at the University at Albany School of Public Health, Albany, New York. JoLynn Montgomery is a Research Investigator in the Department of Epidemiology at the University of Michigan School of Public Health, Ann Arbor, Michigan.

Address correspondence to: JoLynn P. Montgomery, MPH, PhD, 109 S. Observatory St., Ann Arbor, MI 48109; tel. 734-763-2330; fax 734-764-9293; e-mail <jpmont@umich.edu>.

REFERENCES

1. Perlino CM. Issue brief: the public health workforce shortage: left unchecked, will we be protected? Washington: American Public Health Association; September 2006.
2. Council of State and Territorial Epidemiologists. Special report: workforce development initiative. June 2007.
3. Mahan CS, Malecki JM. Confronting the impending public health workforce crisis in America: perspectives from academia and public health practice. Florida Public Health Rev 2004;1:4-7.
4. Council of State Governments, Association of State and Territorial Health Officials, National Association of State Personnel Executives. State public health employee shortage report: a civil service recruitment and retention crisis. Washington: ASTHO; 2004.
5. Partnership for Public Service. Homeland insecurity: building the expertise to defend America from bioterrorism. Washington: Partnership for Public Service; 2003.
6. Institute of Medicine. In the nation's compelling interest: ensuring diversity in the health care workforce. Washington: National Academies Press; 2004. Also available from: URL: http://www.nap.edu/openbook/030909125X/html/23.html [cited 2007 Dec 4].
7. The Sullivan Commission. Missing persons: minorities in the health professions. A report of the Sullivan Commission on Diversity in the Healthcare Workforce. September 2004.
8. Gebbie KM, Rosenstock L, Hernandez LM, editors. Who will keep the public healthy? Educating public health professionals for the 21st century. Washington: National Academies Press; 2003.
9. Bediako MR, McDermott BA, Bleich ME, Colliver JA. Ventures

in education: a pipeline to medical education for minority and economically disadvantaged students. Acad Med 1996;71:190-2.
10. Rosenbaum JT, Martin TM, Farris KH, Rosenbaum RB, Neuwelt EA. Can medical schools teach high school students to be scientists? FASEB J 2007;21:1954-7.
11. Stroup DF, Thacker SB. Epidemiology and education: using public health for teaching mathematics and science. Public Health Rep 2007;122:283-91.
12. Thurmond VB, Cregler LL. Why students drop out of the pipeline to health professions careers: a follow-up of gifted minority high school students. Acad Med 1999;74:448-51.
13. Winkleby MA. The Stanford Medical Youth Science Program: 18 years of a biomedical program for low-income high school students. Acad Med 2007;82:139-45.
14. University of Michigan School of Public Health. Health management and policy summer enrichment program for undergraduate students [cited 2007 Dec 4]. Available from: URL: http://www.sph.umich.edu/hmp/sep_hmp.html
15. Fincher RM, Sykes-Brown W, Allen-Noble R. Health science learning academy: a successful "pipeline" education program for high school students. Acad Med 2002;77:737-8.
16. Centers for Disease Control and Prevention (US). EXCITE!—Excellence in Curriculum Innovation through Teaching Epidemiology and the Science of Public Health [cited 2007 Dec 4]. Available from: URL: http://www.cdc.gov/excite
17. Young Epidemiology Scholars. YES student competition [cited 2007 Dec 4]. Available from: URL: http://www.collegeboard.com/yes/fs/atc.html
18. Centers for Disease Control and Prevention (US). Epi Info™: Version 3.4.1. Atlanta: CDC; 2007.
19. Groundhog day [video recording]. Culver City (CA): Columbia TriStar Home Video; 2002.
20. The human body [IMAX film]. The Learning Channel and BBC Worldwide of a Discovery Pictures/BBC coproduction; October 2001.
21. Our body: the universe within. Baltimore: The Universe Within Touring Company, LLC; 2007.
22. Murphy J. An American plague: the true and terrifying story of the yellow fever epidemic of 1793. New York: Clarion Books; 2003.
23. Hempel S. The strange case of the Broad Street pump: John Snow and the mystery of cholera. Berkeley (CA): University of California Press; 2007.
24. Preston R. The hot zone: a terrifying true story. New York: Random House; 1994.
25. The Great Plague [video recording]. Princeton (NJ): Films for the Humanities & Sciences; 2003, 2001.
26. Influenza 1918 [video recording (DVD)]. Alexandria (VA): PBS Home Video; 2005.
27. Outbreak [video recording]. Burbank (CA): Warner Home Video; 1997.
28. University of Minnesota, Centers for Public Health Education and Outreach. Outbreak at Watersedge: a public health discovery game. 2004 [cited 2007 Dec 4]. Available from: URL: http://www.mclph.umn.edu/watersedge
29. The living weapon [video recording (DVD)]. Alexandria (VA): PBS Home Video; 2007.
30. Jones JH. Bad blood: the Tuskegee syphilis experiment. New York: Free Press; 1993.
31. Kidder T. Mountains beyond mountains: the quest of Dr. Paul Farmer, a man who would cure the world. New York: Random House; 2003.
32. Ms. Evers' boys. New York: HBO Home Video; 1997.
33. And the band played on. New York: HBO Home Video; 1993.
34. Sicko. New York: Weinstein Company; 2007.
35. Delivering the goods: Rx for survival [video recording (DVD)]. Boston: WGBH Boston Video; 2005.
36. Public Broadcasting Service. Rx for child survival [cited 2007 Dec 4]. Available from: URL: http://www.pbs.org/wgbh/rxforsurvival/campaign/givetime/index.html