Virtual International Experiences in Veterinary Medicine: An Evaluation of Students' Attitudes toward Computer-Based Learning

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ABSTRACT

While many studies have evaluated whether or not factual information can be effectively communicated using computer-aided tools, none has focused on establishing and changing students' attitudes toward international animal-health issues. The study reported here was designed to assess whether educational modules on an interactive computer CD elicited a change in veterinary students' interest in and attitudes toward international animal-health issues. Volunteer veterinary students at seven universities (first-year students at three universities, second-year at one, third-year at one, and fourth-year at two) were given by random assignment either an International Animal Health (IAH) CD or a control CD, ParasitoLog (PL). Participants completed a pre-CD survey to establish baseline information on interest and attitudes toward both computers and international animal-health issues. Four weeks later, a post-CD questionnaire was distributed. On the initial survey, most students expressed an interest in working in the field of veterinary medicine in another country. Responses to the three pre-CD questions relating to attitudes toward the globalization of veterinary medicine, interest in foreign animal disease, and inclusion of a core course on international health issues in the veterinary curriculum were all positive, with average values above 3 (on a five-point scale where 5 represented strong agreement or interest). Almost all students considered it beneficial to learn about animal-health issues in other countries.

After students reviewed the IAH CD, we found a decrease at four universities, an increase at one university, and no change at the remaining two universities in students' interest in working in some area of international veterinary medicine. However, none of the differences was statistically significant.

Key words: international; computer-based; education; veterinary medicine

INTRODUCTION

There are many reasons that all scientists, veterinarians included, need to understand the global situation in their professions. For one thing, unprecedented changes in human and animal demographics, diseases, and biotechnology are occurring.[1] There is also a growing interdependence among nations and economies, and, therefore, many universities are placing a high priority on the internationalization (or globalization) of curricula and programs,[2] defined as "the process of incorporating international content, materials, activities and understandings into university teaching, research and service programs."[2] Much of the current focus in international veterinary medicine is on livestock production and food safety, and little attention is given to the fact that the global companion animal population is rapidly increasing, while zoonotic infectious diseases are one of the world's leading causes of death.[3] Veterinarians are needed in all areas of international health. The convergence of global issues in animal, human, and environmental health has created the need for veterinarians with a level of knowledge and skills that is not currently being achieved by either new graduates or the current pool of veterinarians.[1] Unfortunately, while there is a recognized need to internationalize core and elective course standards further for professional and graduate students,[4] integrating adequately trained instructors and international programs into current veterinary curricula is not considered a high priority at many veterinary schools. In a survey of 30 veterinary schools and colleges in the United States and Canada,[2] nearly all respondents (deans of the schools or colleges) reported appreciating the importance of globalizing the curricula and programs; but, for various reasons, ranging from lack of initiative to lack of financial support, internationalization of the curriculum generally receives less emphasis than other types of international-related activities. Including in the curriculum technologies and procedures developed in other countries was viewed by approximately half the respondents as a low to zero priority,[2] and 20 of the 30 respondents (67%) indicated that adding courses in international veterinary medicine was a low or zero priority. Similarly, including international materials in the curriculum was viewed as a low or zero priority by more than half (57%) of the respondents.[2] How veterinary students feel about the importance of globalizing veterinary medicine, learning more about foreign animal diseases, and making international health a core course in the veterinary curriculum has not been reported.

The rapid development of new computer technologies to deliver information is already having a major impact on

veterinary education, and it is likely that this influence will continue to grow in the future.[5] Since most veterinary students today have at least basic computer skills, using tools such as CD-ROMs to expose them to a variety of international animal issues seems a promising avenue. The CD-ROM medium is widely used to distribute multimedia programs, especially those requiring large digital video files,[5] which makes it a very beneficial tool for presenting animal-health issues in other countries to veterinary students at home or in a classroom. Computer-based instruction may be an excellent, cost-effective way of exposing students to veterinary issues in an international context without requiring them to travel great distances or spend large amounts of money. The published proceedings from the first US symposium on the internationalization of veterinary education recommend the use of information technology and the development of modules or auto-tutorials addressing global dimensions of veterinary medicine to counter the lack of international content in veterinary curricula.[4] As there is a significant need to expose veterinarians to animal-health scenarios outside their native countries,[1] the potential for computer-based instruction to stimulate and nurture student interest in international animal-health issues warranted investigation.

While many studies have evaluated whether or not factual information can be effectively communicated using computer-aided tools,[6] thus far none has focused on establishing and changing students' attitudes toward international animal-health issues. This study used a pre-CD questionnaire to describe veterinary students' attitudes toward and interest in international veterinary medicine and subsequently evaluated whether or not viewing an international animal-health CD affected these attitudes or interests by comparing baseline information recorded in the first questionnaire with responses to a similar post-CD questionnaire, completed four weeks after the CDs were distributed.

MATERIALS AND METHODS

Computer CDs

Two different interactive CDs were used in this project: a case-based International Animal Health (IAH) CD and a parasite database/encyclopedia, the ParasitoLog (PL) CD. The IAH CD presents different international animal-health scenarios from three different countries: Chile, South Africa, and Mexico.[7] Each case offers the unique experience of ''exploring'' an actual local animal-health problem, evaluating the situation epidemiologically, developing differential diagnoses, performing laboratory tests, and suggesting solutions. Video segments and interactive questions are used to enhance each scenario. In contrast, the PL CD is fact-based (as opposed to case-based) and encyclopedic, allowing users to choose from a list of parasites and then view specific information on a particular organism, such as its biology, clinical appearance, epidemiology, and potential associated zoonoses. Both CDs are available through the computer-assisted learning facility (CALF) at the School of Veterinary Medicine, University of California, Davis.[a]

Study Design and Data Collection

The University of California, Davis (UC Davis), and six other veterinary schools/colleges participated in the study. In the other six schools, faculty members who were known to the primary investigators and had access to a course that veterinary students would be taking for at least four weeks between January and June 2004 were asked to collaborate in the study. Faculty members met with their groups of students, introduced the study, and asked for volunteers for ''a study involving computerized educational modules and international veterinary medicine.'' Faculty collaborators were provided with a standardized script to be read when distributing surveys; two different questionnaires; and an appropriate number of each of the two CDs.

Two questionnaires were used in the study. The purpose of the first (pre-CD) questionnaire was to gather initial data on students' attitudes and interests regarding international animal-health issues before they examined the CD. The pre-CD survey was also used to establish background information on students' international experiences and previous computer instruction. Changes from baseline information obtained in the pre-CD questionnaire were detected using the second (post-CD) survey, administered four weeks after students received their study CD. The pre-CD and post-CD questionnaires had the same ''interest'' and ''attitude'' questions, in order to allow comparisons for individual students. ''Control'' questions were asked on the pre-CD and post-CD questionnaires to ascertain students' knowledge of specific international veterinary issues and parasites of veterinary significance. Both questionnaires were approved by the University of California, Davis, Human Subjects Review Board. Informed consent was obtained from students: all were notified that participation was anonymous and voluntary and would not influence their course grade.

The study population consisted of students enrolled in veterinary schools or colleges in the United States, the Netherlands, and the United Kingdom between January and June 2004 who volunteered for the study. Five US veterinary schools were included: UC Davis, the University of Minnesota, Iowa State University, Washington State University, and Michigan State University. Two European veterinary universities were also surveyed: Utrecht University in the Netherlands and the University of Glasgow in Scotland. Throughout this article, results will be presented in this order, which is the chronological order in which each university entered the study from January and June 2004. Participating students were in their first, second, third, or fourth year of the veterinary program.

CDs were arranged in random order, and sets were mailed to participating schools; within each set, each CD had a unique identification number. As students received their pre-CD questionnaires, they were given a CD from the randomly arranged group and asked to record the CD number, so that, at the end of the study, they could put that number on the post-CD survey and receive the alternative CD. The primary incentive for students to participate in the study was to receive two free educational CDs. At the time the pre-CD survey was distributed, the faculty member read from a standardized script, reminding the students that their participation was voluntary, that they had four weeks to review the CDs, and that they were not to share or discuss their CD with classmates. Students were instructed to review their CD at some point in the four-week period;

1. The veterinary medical profession is moving towards becoming an inter-connected global community. Use an 'X' to mark your level of agreement on the scale below.

]_____[

strongly disagree no opinion strongly agree

2. Do animal health problems in other countries interest you? Mark your response as an 'X' on the scale below.

]_____[

no interest some interest extremely interested

3. International animal health should be a core class, required of all veterinary students. Use an 'X' to mark your level of agreement on the scale below.

]_____[

not important no opinion extremely important

Figure 1: Format of three questions to assess students' attitudes toward international issues in veterinary medicine. These questions were included in both pre- and post-CD questionnaires, in order to assess changes in attitude after viewing the CD.

CD evaluation was performed on the students' own time, unconnected to the class involved in the distribution of the CDs and surveys. At the end of the designated period, the post-CD questionnaire was distributed; students were required to record their CD number on this survey, so that it could be matched and compared with pre-CD survey data. Upon collection of the post-CD questionnaire, each student was given a copy of the other CD.

Data Presentation and Statistical Analysis

Background information on prior international exposure and previous experience with computer-based teaching methods was obtained in the pre-CD questionnaire, which also gathered baseline information on participants' age and gender.

Primary outcomes included one specific question regarding interest and three ''attitude'' questions dealing with international veterinary medical issues. To facilitate the analysis, these questions were exactly the same on both pre-CD and post-CD surveys. Students were included in the final data analysis only if they returned a post-CD questionnaire with a CD number exactly matching a pre-CD questionnaire. Surveys that did not have a matching counterpart or that were missing data on a specific question of interest were not included in the analysis.

The ''interest'' question was, ''Are you interested in practicing veterinary medicine or participating in animal health research in a country other than the one where you are currently receiving veterinary education/training?'' A chi-square test[8] was used to evaluate the statistical significance of any observed change in proportions between pre- and post-CD data.

The three ''attitude'' questions are shown in Figure 1. A scale line of approximately 14 cm (5.5") in length was used to assess the three ''attitude'' questions on both surveys (see Figure 1 for design of the scale lines). For statistical analysis, the distance from the left of the scale to the place where the student placed an *X* on the line was measured in centimeters with a standard ruler. The post-CD response was subtracted from the pre-CD response to give a value for each of the three questions. A two-way ANOVA[9] was performed on each of the three ''attitude'' questions. Statistical analysis was performed using SAS Proprietary Software Release 8.2 for Windows.[b] The null hypothesis for this test was that the median difference between post and pre-CD questionnaires was zero, indicating that the CD viewed, the school attended, or an interaction between the CD viewed and school attended had no effect in changing student's attitudes. The two-sided alternative hypothesis was that the median difference in attitude scores was not zero, indicating that the CD, the school, or an interaction between the two did have an influence on the students, either positive or negative. Therefore, the covariates entered into the model were CD received (IAH or PL), school attended, and the CD/school interaction. A rank transformation was performed on two of the three questions to satisfy the model assumptions; *p*-values less than 0.05 were considered significant.

RESULTS

Pre-CD Survey

The pre-CD questionnaires collected demographic information from each student, while also establishing a record of students' previous international experiences (both veterinary and non-veterinary) and gathering baseline data on attitudes toward computers. Table 1 shows characteristics of the veterinary programs at each participating university, the students surveyed, and those completing both questionnaires.

Students were asked about previous international experiences in the pre-CD questionnaire to establish the degree of their foreign activities and veterinary work opportunities, as these experiences may have played a role in the CD's effectiveness at changing their interest and attitudes. Nearly all students had visited another country (range: 72–93%), but only 5–38% had either worked or lived in another country, with higher percentages reported by students at the European universities. When given a selection of ranges for the total amount of time spent in foreign countries, 31–49% of students reported spending between one and 12 months abroad. A range of 0% (Utrecht and Glasgow) to 22% (Iowa State) had not spent any time in another country, and from 5% (Michigan State)

Table 1: Demographic information for the students and institutions participating in the study and responses indicating veterinary students' interest in and attitudes toward international animal health and related computer-based teaching CDs

Veterinary School or College	UC Davis	Minnesota	Iowa State	Washington State	Michigan State	Utrecht	Glasgow
Undergraduate pre-veterinary education required	Yes	Yes	Yes	Yes	Yes	No	No
Length of vet program (years)	4	4	4	4	4	6	5
Class of students surveyed	First year	First year	Second year	Third year	First year	Fourth year	Fourth year
(estimated) # of students in class surveyed	125	100	102	60	114	100	106
# of students completing pre-CD survey	85	75	79	47	82	40	43
% female in pre-CD population	75	86	78	69	90	72	81
% 18–25 years of age in pre-CD population	52	60	70	38	80	90	86
# students completing both pre- and post-CD surveys	41	39	53	36	53	39	31
# (%) of students with IAH CD who completed post-CD survey	22 (54)	22 (56)	28 (53)	15 (42)	25 (47)	27 (69)	17 (55)
Average time spent with IAH CD (minutes)	64	65	71	117	88	107	109

to 55% (Utrecht) had spent more than one year in another country. The majority of students (range: 63–88%) had no previous international experience specifically associated with veterinary medicine.

When asked about previous computer experiences, 91% of the students completing the pre-CD survey (411/451) reported having used computer-aided teaching programs in their university education. Nearly all students reported that the computer-based programs they had formerly used in their studies were informative. Few students (range: 0–13%) at any university reported previously using a computer-based program that was focused on epidemiology and approaches to disease investigation; 19–68% of students responding reported using programs focused on animal health and problem solving (see Figure 2).

On both pre-CD and post-CD surveys, students were asked the same ''interest'' question (relating to their interest in working abroad). Results for the pre-CD survey showed that in all schools except Iowa State, the majority of students were interested in working in veterinary medicine in another country. For the three different ''attitude'' questions asked on the pre-CD survey, almost all responses were above the midpoint on the 14-cm scale, suggesting that students generally had positive attitudes toward the selected international veterinary topics.

The final question on the pre-CD survey asked students, ''What are some of the advantages of teaching veterinary students about animal disease problems and approaches to animal health investigations in other countries?'' Of all 447 students who replied, only four (<1%) believed that there would be little or no benefit to veterinarians or veterinary

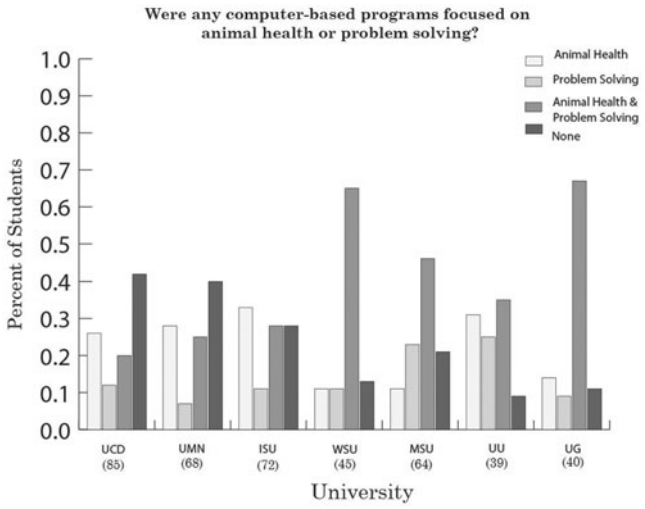

Figure 2: Students' responses to the question regarding the nature of the computer-based programs they have used in their university education. Numbers below the schools indicate the number of students responding to this question.

students from teaching this topic. In all schools, students saw several potential benefits to teaching various aspects of international veterinary medicine. The advantage mentioned by the highest percentage of students was that teaching veterinary students about animal-health issues in other countries would be helpful in providing information on foreign animal diseases.

Table 2: ''Indicate how you felt about the veterinary CDs that you were given *in this study*.'' Values shown below represent the percentage of students who responded to the question and completed the post-CD questionnaire.

	US Veterinary Students		Non-US Veterinary Students	
	IAH ($N=107$)	PL ($N=106$)	IAH ($N=43$)	PL ($N=25$)
Informative	95	98	91	100
Fun	50	53	56	12
Useful in developing problem-solving skills	42	15	60	4
Helpful in focusing on epidemiology	55	24	47	24
Useful for providing self-assessment of knowledge	42	39	37	24
Motivating	20	28	26	4
Helpful for long-term knowledge retention	17	31	28	24

Table 3: Percentages of students responding affirmatively to the question, ''Are you interested in practicing veterinary medicine or participating in animal health research in a country other than the one where you are currently receiving veterinary education/training?'' on *both* questionnaires

	UC Davis	Minnesota	Iowa State	Washington State	Michigan State	Utrecht	Glasgow
Interest before IAH CD	27	38	19	19	21	63	35
Interest after IAH CD	20	26	19	22	19	63	29
Interest before PL CD	27	36	15	36	33	29	29
Interest after PL CD	24	28	19	22	29	29	35

Post-CD Survey

About two-thirds of students who completed the pre-CD survey also completed a post-CD survey. It is important to determine how similar the two populations were (i.e., the population of students completing only the pre-CD questionnaire versus the population completing both questionnaires), because only data from the latter group were used to evaluate possible changes in attitudes after viewing the CDs. Demographic information for the population of students completing both pre-CD and post-CD questionnaires was nearly identical to that for the population completing only the first survey, as shown in Table 1. Therefore, we do not believe it likely that the one-third of students who ''dropped out'' of the study created bias in the results.

Most students found both CDs relatively uncomplicated to use. CD usability was recorded by means of an X on a scale from 1 to 5 (5 = ''extremely easy to use''); most (78%) of the 281 students reported a usability score of 3 or more; 17% recorded a usability score equal to 3; and only 5% (14/281) gave a usability score of less than 3. For US veterinary students, the PL CD had a slightly higher mean usability score than the IAH CD (4.36 versus 4.16); the opposite was true for non-US students, who gave the IAH CD a mean usability score of 4.06, versus 3.63 for the PL CD. University origin did not significantly affect students' usability ratings for the CDs.

Additional questions about time spent reviewing the CDs and video accessibility were asked only of those students who received the IAH CD. The last row of Table 1 shows the average amount of time students spent reviewing the entire IAH CD, ranging from 64 minutes (UC Davis) to 117 minutes (Washington State). Since the videos on the IAH CD were intended to enhance the learning experience, students were asked whether or not they were able to view *all* the videos. Of the students who initially received the IAH CD, between 45% (UC Davis) and 82% (Glasgow) were able to view all videos; these figures indicate that many students (18–55%) were unable to view all videos from cases documented on the IAH CD.

Students' general feelings about computerized teaching programs they had previously used were assessed in the pre-CD survey. Therefore, questions on the post-CD survey were geared to assess students' feelings about the particular CD they were given in the study. Students were given the same set of choices as on the pre-CD survey; their responses are recorded in Table 2. Almost all students (96%) reported that the study CDs, like computer-based learning tools they had previously used, were informative. The most notable difference between other programs and the CDs provided by this study was that the study CDs were considered more helpful in focusing on epidemiology and approaches to disease investigation.

Table 3 shows the results from the question addressing students' interest in participating in some aspect of the veterinary medical field in another country, both before and after viewing either the IAH CD or the PL CD. Overall, after students reviewed the IAH CD, there was a decrease (four universities), an increase (one university), or no change (two universities) in interest in working in some area of international veterinary medicine. However, none of these differences was statistically significant, as determined by a chi-square test. Results for the PL CD groups were similar.

For the three ''attitude'' questions (see Figure 1), results of the two-way ANOVA yielded no significant results. For the question regarding globalization of the veterinary community, the *p*-value for the covariate of school attended was 0.08; all other *p*-values for the three covariates (CD, school attended, and CD/school interaction) were greater than 0.35.

DISCUSSION

Baseline information obtained from the pre-CD questionnaire showed that a high percentage of veterinary students, especially European students, had visited other countries. Of course, it is expected that veterinary students within the European Community will have had more international contact, since Europeans are, in general, more likely than residents of the United States to visit other countries. A relatively low percentage of respondents reported doing veterinary-related work internationally, which is understandable, since most participants in the study were 18–25 years old and all were veterinary *students*. The wide range of student cohorts in the study (ranging from first- to fourth-year students) introduced another factor that made interpretation of results difficult. Most students from six of the seven universities initially reported being interested in performing some aspect of veterinary work in a different country; at only one university did less than half of students initially report being interested in international veterinary medicine. Almost all students saw some benefit in teaching veterinary students about international animal-health topics; providing information on foreign animal diseases was the highest-ranked perceived advantage.

Evaluation of changes in veterinary students' interests and attitudes focused on the IAH CD. However, a second CD was incorporated in the study as a control, in order to minimize potential error due to the Hawthorne Effect. This effect, which is usually positive or beneficial, may occur when people know they are being measured or studied and tend to modify their behavior as a result.[10] The name derives from observational studies of workers at an electric plant in Hawthorne, IL.[10] The PL CD was selected as the control because it was a newly developed interactive CD that covers different content in an encyclopedic fact-based approach, rather than the case-based format of the IAH CD.

One explanation for the lack of change in students' interest levels and attitudes toward international veterinary medicine after viewing the IAH CD is that students did not consider the material compelling or well presented. This does not seem to have been true, judging by the favorable comments from students. Another possible explanation is that 18–55% of students reported not being able to view all the videos on the IAH CD. All the software required to view the videos is on the CD, with instructions for its installation on computers that do not already have QuickTime[c] installed. However, some students may not have read the technical instructions section of the CD, instead deciding to forgo viewing the videos. Furthermore, students at Utrecht University are not allowed to add or remove programs from faculty computers, which may have created another constraint. The videos were specifically designed to make each case more realistic and to allow the student viewer to feel ''on location,'' talking with veterinarians and animal owners involved in the case. Students who were not able to view the videos, which are one of the highlights of the IAH modules, may have become frustrated and given up on trying to navigate the rest of the case or subsequent cases, and this may have left them with a negative attitude for the entire study. Computer-aided instruction programs are slightly less effective for students with more negative attitudes about using computers.[6]

Another possible reason that no positive effect was measured in students' attitudes toward international veterinary medicine after viewing the CD was that participating students were a self-selected volunteer group, probably already interested in international animal health, and this further exposure to the subject did not affect their attitudes. Of the estimated 707 students initially approached to volunteer for the study at the seven participating universities, only 451 completed the pre-CD questionnaire, and just under two-thirds of those 451students completed the post-CD survey as well. Also, not every student answered every question on both surveys, and those questionnaires without matching responses were excluded from the analysis for that question. However, as explained earlier, the sub-population of students who completed both pre- and post-CD questionnaires was similar to the group that entered the study (i.e., completed the first questionnaire), and therefore we do not believe that or data were biased in this way.

The IAH CD was originally designed to be used in a class, but in this trial students were given no instructions or guidance for optimizing the features provided by the CDs, and there was no organized discussion with faculty afterwards. While the IAH CD may be useful in introducing international animal health scenarios, it is likely that, as has been found in other studies,[11] direct instructor contact is necessary for integration and retention of the subjects and skills presented.

Computer CDs are already being used as teaching supplements in many veterinary courses.[11–14] Computer-based programs allow educators to reach more people, encourage peer-to-peer learning, and accommodate different learning styles while also offering an element of fun.[15] Veterinary students' abilities and attitudes towards computers and associated software products, such as CD-ROMs, influence the degree to which computer-aided instruction can be used effectively.[6] Although the IAH CD apparently did not change students' interest levels or attitudes, many students did find it easy to use and reported that it was informative. These results are consistent with those of another study, which showed that although students exposed to traditional methods of teaching veterinary surgery performed better

than those exposed to a computer-aided software program, the computer-aided instruction program was well received by the students and was found to be an effective training tool.[11]

Currently, some veterinary schools and colleges are exploring the option of expanding interactive case-based computer CDs to interactive Web sites for the purpose of supplying and enhancing distance learning.[5] One of the suggestions made at a US symposium on the internationalization of veterinary education was to increase international content and awareness in the veterinary curriculum by using information technology to access international content, materials, expertise, and opportunities.[4] The IAH CD makes it possible to bring veterinary experiences from countries across the globe to students sitting at computers in their homes or in a classroom at their home institution. Therefore, the IAH CD and the principal concepts that it addresses could realistically and quite feasibly be a useful component for integrating international animal-health issues into veterinary education.

CONCLUSIONS

We did not demonstrate that the IAH CD had any effect in changing students' attitudes toward international veterinary medicine. However, it was not possible to eliminate or control for other factors, such as previous international experience and year of study in veterinary school. Students did find the program informative.

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The program is accessible on the Web at <http://www.calf.vetmed.ucdavis.edu/html/International_web/international_menu.html>. Dial-up modem users and those with no Internet connection can request a CD from the Office of the Dean, School of Veterinary Medicine, University of California, Davis, CA 95616-8734 USA. E-mail: svmacadprog@ucdavis.edu. Phone: (530) 752-1234. Fax: (530) 752-2801.

NOTES

a See <http://www.calf.vetmed.ucdavis.edu/>; click "products" for the PL CD and "current projects" for the IAH CD.

b © 1999–2001, SAS Institute Inc., Cary, NC 27513-2414 USA <http://www.sas.com>

c Apple Inc., Cupertino, CA 95014 USA <http://www.apple.com/quicktime/download/win.html>.

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