Exploring the State of Veterinary Informatics

Kristine M. Alpi, William Rand Kenan, Jr. Library of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina, United States

Abstract:
Although there are few members in common between the Association for Veterinary Informatics and the American Medical Informatics Association, both are interested in promoting standards in terminology and technology. Many medical informatics areas are an integral part of veterinary practice—for example, digital radiology through Picture Archiving Communication Systems (PACS) and patient information portal software. While business information systems for practice management and herd health are common, these programs lack standards and functionality required for human electronic health records (EHRs) including drug alerts, application of encoded clinical practice guidelines, case identification through uniformly-accepted diagnostic codes, automatic laboratory reporting, and links to knowledge-based resources for just in time learning and evidence-based practice. The level of EHR functions at the veterinary teaching hospital, chains of integrated practices, and the individual practitioner are compared using examples in North Carolina. A survey of all veterinary teaching hospitals and their supporting libraries will explore the state of functional EHRs, the integration of knowledge-based information, and participation in the Veterinary Medical Database, a repository of case records. Known barriers include minimal use of standards for interoperability in practice systems. The primary knowledge based resources (KBI) in veterinary medicine (Veterinary Information Network, VetMed Resource, Clinics and other Elsevier and Wiley/Blackwell titles) are not connected to EHRs. A greater understanding of the informatics environment of veterinary practice is necessary to promote the integration of KBI in veterinary practice.

Introduction
Veterinary informatics is a discipline that brings together veterinary data and knowledge and technology. Its practitioners fall into two categories: veterinary personnel with an interest in using technology effectively to optimize veterinary practice and research, and technologists who have found themselves working in a veterinary context. The Association for Veterinary Informatics (AVI) is the organizational home for those driving the discipline. The AVI, formerly the American Veterinary Computer Society, was formed to expand the use of the computer as a tool in veterinary medicine and promote the use of standards-based information technology and electronic communications in veterinary information management.[1] AVI members share information through an email list and blog and meet at the Annual Talbot Informatics Symposium on Computers and Veterinary Informatics, generally held in conjunction with the American Veterinary Medical Association annual meeting. The Talbot Symposium invites submissions from both inside and outside the veterinary profession, wherever information technologies have been shown effective in solving real problems for veterinary practitioners, hopefully with information the practitioner can take back immediately to practice.

AVI membership is international, with over one third of the members working in the field of clinical veterinary medicine, one third in academia, and the remainder in industry, government, and other veterinary medicine areas. There are few veterinarians involved in the American Medical Informatics Association (AMIA), but AMIA member research and development efforts are relevant to veterinary informatics. Both associations are interested in
promoting standards in terminology and technology to ensure access to clinical information for practice and research. The National Library of Medicine (NLM) is a major player in informatics standards and the NLM provides support for Dr. Jeff Wilcke, Veterinary Medical Informatics Lab, Virginia-Maryland Regional College of Veterinary Medicine, to contribute to meetings of the Concept Committee of the International Health Terminology Standards Development Organization (IHTSDO). NLM also makes SNOMED-CT (Systematized Nomenclature of Medicine - Clinical Terms) available through the Unified Medical Language System. Another health information management group involved with veterinary informatics is the American Veterinary Health Information Management Association (AVHIMA-- http://avhima.org/), the veterinary medical records administration organization with 43 members from academic veterinary teaching hospitals and one industry member. The parallel medical informatics organization is the American Health Information Management Association (AHIMA), but neither AHIMA nor the Health Information Management Systems Society (HIMSS) address veterinary information management. Standards organizations active in health technology and devices such as Association for the Advancement of Medical Instrumentation and IEEE Engineering in Medicine and Biology Society have little info about veterinary applications beyond the connection to the Food & Drug Administration devices approvals involving animals.

The American Animal Hospital Association (AAHA) is active in veterinary informatics since information management is a major piece of hospital activity. The electronic health record (EHR) is a focus area and they have worked with the Certification Commission for Healthcare Information Technology (CCHIT) on a veterinary example. They are also working to get practitioners’ attention focused on EHRs. For example, the American Board of Veterinary Practice /AAHA Kick-off Seminar: Electronic Health Records and AAHA Standard Diagnostic Terms at the ABVP meeting in 2009 featured presentations by Heidi Burnett, Noell Moseley, and Kimberly Smith. Dr. Heidi Burnett is the chair of the AAHA Electronic Health Records Task Force (EHRTF) and Dr. Moseley is a member of the EHRTF, Diagnostic Codes Review Committee, and Leadership Identification Committee for AAHA. Kimberly Smith is at the School of Health Information Sciences at the University of Texas Health Science Center at Houston and currently researches the use of computerized medical records in U.S. private veterinary practices and the factors that influence their use.

Veterinary informatics is not considered a discipline in veterinary medicine by the American Veterinary Medical Association (AVMA) or the American Association of Veterinary Medical Colleges (AAVMC). Craig Carter chaired a committee in 1990 that developed a petition for the AVMA Board on Veterinary Specialties to create a recognized specialty in Veterinary Informatics that was presented and turned down twice. [2] Other organizations with a natural interest in information systems are veterinary business management organizations like Veterinary Hospital Managers Association (VHMA-- http://www.vhma.org/) and VetPartners™ (formerly the Association of Veterinary Practice Management Consultants and Advisors-- http://www.avpmca.org/). The Evidence Based Veterinary Medicine Association (EBVMA-- http://www.ebvma.org/) may be another partner; the EBVMA also has a group of veterinary librarian members. Two ways that informatics could increase evidence-based veterinary practice are 1) connecting veterinarians to patient-specific knowledge based information (KBI) at the point of care, and 2) improving the outcome data and ability to do outcome and epidemiological studies across multiple institutions’ cases through improved data mining and transmission.

The State of Veterinary Informatics
Many informatics areas are already an integral part of veterinary practice—for example, digital radiology through Picture Archiving Communication Systems (PACS). While patient websites and business information systems for practice management and herd health are common, these programs lack standards and functionality required for human electronic health records (EHRs). Some of these areas include automatic laboratory test reporting, medication alerts, application of encoded clinical practice guidelines, case identification through uniformly-accepted diagnostic codes, and links to knowledge-based resources for just in time learning and evidence-based practice. The level of EHR functions at the veterinary teaching hospital, chains of integrated practices, and the individual practitioners are very different today.

The original charge of the AAHA Electronic Health Records Task Force was to encourage and enhance EMR use in small animal practices, define what companion animal practitioners need from paperless record systems, help software vendors address needs with system features, promote adoption of AAHA’s Standard Terms, and assess desirability, feasibility of true “Electronic Health Records.” Efforts in the first several areas included adapting CCHIT standards for veterinary use case, hosting webinars and a vendor summit with the veterinary software vendors, and publishing updates in the AVPMCA e-bulletin. The AAHA Standard Diagnostic Terms are really three inter-related lists of medical concepts: Diagnoses and Clinical Problems, Anatomic Locations, and Descriptors and Modifiers. The software vendors are welcoming these standardization efforts with virtually all planning to use the standard list. Other activities include arranging reference laboratory and other diagnostic Equipment Vendors Summits to discuss communication standards and interoperability; establishing relations with laboratory animal, zoo, equine, bovine, and other standards groups, especially along standards on breed lists, procedures/interventions, encounter types, and dealing with pharmacy, dispensary, and inventory items.[3]

Review of Veterinary Informatics Efforts

Talbot reviewed the veterinary informatics literature back in 1991 [4] and then Smith and Williams analyzed the field in a 2000 publication.[5] Kimberly Smith’s work in veterinary informatics includes an analysis of the PubMed-indexed literature from 1995-2004 [6]. She and her co-authors found that veterinary informatics has received little attention from the general biomedical informatics community. The categories of veterinary informatics with the most literature growth were information/bibliographical retrieval, hardware/programming, and radiology/imaging, with fewer than two articles per year in the areas of computerized veterinary medical records, clinical decision support, standards, and controlled vocabularies. Veterinary informatics articles primarily addressed production and companion animals. Six journals, The Journal of the American Veterinary Medical Association, The Veterinary Record, Preventive Veterinary Medicine, Veterinary Radiology and Ultrasound, Revue Scientifique et Technique (Scientific & Technical Review), and The American Journal of Veterinary Research, accounted for 31% of the veterinary informatics citations. Since practitioners interested in veterinary informatics are usually not in academia, it is relevant to see how they would have access to these journals. Of the six main sources, four are membership publications (JAVMA and AJVR for AVMA members; Vet Record for British Veterinary Association members; Vet Radiol Ultrasound for several veterinary radiology associations) and one (Rev Sci Tech) is available free online. The digital radiology supplement issue of Veterinary Radiology and Ultrasound is free online. The Journal of the American Medical Informatics Association provides open access
to its content after a 6-month embargo. A thorough review of the veterinary informatics literature was beyond the scope of this paper and would require searching across multiple databases such as PubMed for the informatics literature and CAB Abstracts for papers from conferences and veterinary journals not indexed by PubMed. Content from key conferences such as the annual Talbot Symposium is available online from the AVI website, but these papers are not indexed by the databases.

One area of informatics that is progressing faster in veterinary medicine than in human medicine for social, legal and ethical reasons is patient identification. Veterinarians work with millions of companion animals already microchipped and assist producers involved in uniform animal identifier programs such as the U.S. Department of Agriculture’s National Animal Identification System (http://animalid.aphis.usda.gov/nais/). In many cases these identifiers are tied to geographic information systems and remote sensing. In Italy, the National Reference Centre for Veterinary Epidemiology--Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale'--developed a Web-based National Information System (NIS) and a Geographical Information System (GIS) to track bluetongue.[7] Other areas where veterinary informatics are on the cutting edge are biomedical engineering and simulation modeling, computer assisted surgery and prosthetic design, and teleradiology.

Data repositories in veterinary medicine include OMIA – Online Mendelian Inheritance in Animals (http://www.ncbi.nlm.nih.gov/sites/entrez?db=omia) and LIDA-- Listing of Inherited Disorders in Animals, an online relational database, using non-technical descriptions written by veterinary students. LIDA (http://www.vetsci.usyd.edu.au/lida/) allows users to select from the 180 recognized dog breeds in Australia and find out which ones are prone to the more than 500 inherited disorders on record. It was developed in consultation with a number of supporting organizations, including the local breeders' governing body and animal-welfare groups, as well as owners. Many breed and condition specific registries also exist to store information about unaffected and affected animals. Toxicology and drug residue databases are also available.

Expert systems and decision analysis have waxed and waned in popularity. CONSULTANT [8] is perhaps the best known of these for a variety of symptoms, but more exist for specific diseases such as rabies, and in production animal medicine where costs and uncertainty come into play. Stevenson et al. reviewed the [9] needs and systems available for monitoring food animal health. Gibbens et al. report on the use of comparisons of laboratory data in Farm File to reduce the time to detect new diseases in livestock. [10]

Other areas where developments in human medicine should be appropriated for the use of veterinary informatics include automatically capturing external laboratory results and internal monitoring data from devices and linking those results to the patient record. Adverse event registries and clinical trial registries have all received federal funding, but have not been made to accommodate multiple species. For example, the Food and Drug Administration does not have a vaccine or drug reporting system for veterinary medications and vaccines that they have approved. There is no technical reason that the Vaccine Adverse Event Reporting System (VAERS - http://vaers.hhs.gov/) system used for human medicine could not be expanded to add a species indicator to allow veterinary vaccine experience and adverse reaction reporting and searching. ClinicalTrials.gov could also be expanded to allow searching by species for clinical trials.

The State of Academic Veterinary Medical Records
Academic veterinary teaching hospitals participate in the Veterinary Medical Database (VMDB), a repository of case records (http://www.vmdb.org/). The VMDB started in 1964 as an initiative of the National Cancer Institute for the purpose of studying cancer in animals with the NCI collecting a standardized abstract of every case that passed through the Veterinary Teaching Hospitals at the Schools of Veterinary Sciences in North America. Since then, 26 universities have submitted more than 7 million records to this database, making VMDB a valuable resource for researching animal diseases and effectiveness of treatments. VMDB routinely provides more than thirty summary breakdowns for retrieved data. Typical summaries include breed, age, sex, geographical region and date of disease onset. [11]

These hospitals submit case data at various levels of automation: paper, free text digital and SNOMED coded digital. There are 12 academic veterinary teaching hospitals using UVIS (Universal Veterinary Information System) but every school has a set of customizations. The schools do meet to discuss improvements to this client-server software which is being implemented as a web-based version at many schools. In the North Carolina State University implementation of UVIS, the pharmacy function is internal, while looking into other systems such as RIS (radiological information system), THIS (the old system for historical data) or across systems to search keywords across discharge summaries are external functions tied in by query screens. UVIS is primarily a billing system built around a product table of drug formulary, central supply, laboratory testing, examinations, and treatment charges that are updated monthly. The diagnosis table is an area that needs enrichment. The alphabetic list of laboratory tests includes instructions for gathering the sample that are read from a location within UVIS that can be customized by the laboratory manager.

Dr. Allan Hahn of the Information Technology Group, College of Veterinary Medicine, University of Missouri, has worked extensively on automated ways to prepare data stored in UVIS for transmission to the VMDB and distribute the system to all UVIS users for inclusion in their local implementations of the system. [12,13] Guptill,Glickman and Glickman used the VMDB data for a time trends and risk factor study on diabetes in dogs. [14] VMDB has recently started a program to collect clinical case data from veterinary practitioners using SNOMED as a standard vocabulary language and Health Level 7 as a standard transmission protocol. This should allow a greater investigation of primary care problems that do not make it into veterinary referral hospitals.

The organizations with the most integrated veterinary information systems are commercial enterprises, such as VCA Animal Hospitals/ANTECH (founded as Veterinary Centers of America) with over 435 hospitals in 38 states and provide diagnostic services to over 14,000 independent hospitals nationwide and the Banfield hospitals with more than 730 full-service hospitals across the country, two in the U.K. and one in Mexico. Banfield electronic medical records have been mined for both small geographic area case finding in chemical poisoning [15], to incredibly large reviews of basic problems such as parasites. [16] The role of the informatician in these health care systems is to leverage the information gathered as means to improve care or generate revenue or make the organization more efficient through informatics. These large organizations may choose to make proprietary advances in informatics integration for business reasons. VCA Antech, for example, provides for the integration of laboratory results ordering and reporting through Zoasis in an XML format rather than HL7 due to the challenges in getting all veterinary software companies to use HL7 messaging. AAHA has coordinated vendor summits to bring together system developers to work on interoperability and standards. The School of Veterinary Medicine, University of Milan (Italy) developed a
veterinary electronic patient record using open-source software compliant with the IT standards (HL7, DICOM and IHE) in order to improve the veterinary hospital workflows, making the stored clinical data more homogenous and sharable, thereby increasing the integration with current and future software applications.[17]

Surveys of Informatics Activities

Initial plans for a formal survey of all veterinary teaching hospitals and their supporting libraries to explore the state of functional EHRs and the integration of knowledge-based information were exchanged for a brief survey to which informatics efforts are getting traction in AVI member institutions and a separate survey about librarian involvement with veterinary informatics efforts. A 25-question online survey was developed and distributed to the AVI email list on March 31, 2009. The survey and its results appear as Appendix 1. To see what involvement librarians had with veterinary informatics, a 10-question survey was pilot tested and then distributed to the Veterinary Medicine Libraries (VETLIB-L) email list on March 31, 2009. The survey and its responses appear as Appendix 2.

There were only 5 respondents to the survey distributed to AVI, so the data are only presented here as a pilot to give a sense of what respondents understood from the questions and which areas might be further investigated. The librarian survey [Appendix 2] had 14 respondents from the 212 VETLIB-L list members (6.6% response rate). In several cases, librarians shared that they had to start a dialogue with personnel outside the veterinary library to respond to one or more of the questions. Both the informatics and library surveys asked about what exposure to veterinary informatics is provided to veterinary students at their institutions. The difference between informatics and information technology proficiency is not easily understood. The papers in a special section of the Journal of Veterinary Medical Education (Winter 2003, Volume 30, Issue 4) entitled “Informatic and Technology Approaches to Veterinary Education” gives some examples of veterinary school efforts. Neither of the groups reported having licensed veterinary content tied to their electronic medical records. Since this is a prime area of librarian-informatician-clinician engagement in human medicine, this became a focus area for the rest of the investigation.

Knowledge-Based Resources in Veterinary Medicine

In human clinical medicine, large publishers sell knowledge-based information (KBI) resources specifically for integration with the EHR. The primary KBI resources in veterinary medicine are not connected to EHRs. This includes content from the Veterinary Information Network, the International Veterinary Information System, CABI’s VetMed Resource and the Animal Health & Production Compendium, Elsevier’s Kirk's Current Veterinary Therapy and the Veterinary Clinics series, and Wiley/Blackwell’s 5-Minute Consults series and Plumb’s Veterinary Drug Handbook. A greater understanding of the informatics environment of veterinary practice is necessary to promote the integration of KBI in veterinary practice. To this end, in April 2009, the Veterinary Medical Libraries Section (VMLS) of the Medical Library Association has appointed a task force on Connecting the Veterinary Health Record to Information Resources. The group’s charge is as follows:
This task force will explore how to encourage connections between publishers of veterinary resources and veterinary health record/practice management systems developers and vendors. Specifically, the task force will serve as point of contact and compiler of a list of information providers who have content that could be beneficial at point of care in veterinary systems, and then coordinate with the American Animal Hospital Association's Electronic Health Records Task Force (EHRTF) which is working closely with the systems vendor community.

The major veterinary publishers are not advertising point of care integration with EHRs for individual users or for library-licensed content. The Health Level Seven (HL7) Infobuttons standard is one proposed standard for using patient-specific information in the EHR to inform the retrieval of KBI.[18] The following publishers were contacted to inquire about the state of their electronic resources and the possibilities of connecting to systems using the HL7 Infobuttons proposed standard. Personal communications with these publishers indicated various levels of interest and technological readiness; here is one response: “Wiley-Blackwell has identified that there is a significant opportunity to integrate select veterinary content into electronic patient records and has initiated discussions with the commercial veterinary practice management software providers to gauge their respective interest in working together on this.” (Antonia Seymour, April 3, 2009) Smaller veterinary publishers such as AAHA Press and Sudz Publishing have very good content, but many need to explore partnerships to make their content available using current standards. Many electronic resources are packaged for the individual veterinarian to use on a username-password basis as a separate tool. The Veterinary Consult package (http://www.us.elsevierhealth.com/article.jsp?pageid=6752) from Elsevier is an example of content that veterinarians may already own, but not have integrated.

Kirk's Current Veterinary Therapy XIV, 14th Edition
http://www.us.elsevierhealth.com/product.jsp?lid=5&iid=0&sid=407&isbn=9780721694979

A fully searchable companion Evolve website adds chapters from Kirk’s Current Veterinary Therapy XIII, with information that has not changed significantly since its publication. It also includes an image collection with over 300 images, and references linked to PubMed. Useful appendices on the website provide a virtual library of valuable clinical references on laboratory test procedures and interpretation, normal reference ranges, body fluid analyses, conversion tables, nutritional profiles, a drug formulary, and more.

According to the Elsevier Veterinary Medicine and Technology Publisher, almost all of the veterinary products are available on Veterinary Consult now or probably will be in the future. As of 5/8/089, the package price for a book plus electronic access is 20% above the price of the textbook alone or an individual can purchase electronic access only to that title for the same cost of that book. Vet Consult allows downloading the book to two computers for searching the entire book; one can make notes, add highlights, and study more efficiently. In reality, you aren't actually downloading the book itself to your computer as the content still resides on a server. All of the Veterinary Consult books will work together on your electronic "bookshelf", so that one can search across one’s entire library of Elsevier veterinary books. (Penny Rudolph, May 8, 2009)
Online pharmacology resources are perhaps the most ready for integration due to their standard formats. The Veterinary Information Network (VIN)’s pharmacology resources provide generic & commercial names, dosage, side effects and possible interactions—Veterinary Clinical Pharmacology (Virginia-Maryland Regional College of Veterinary Medicine), Veterinary Drug Summaries (Veterinary Anesthesia & Analgesia Support Group) and Dr. Wade's Pharmacology Tables (Bryan J. Wade, DVM) and others which may have been licensed including Plumb's Veterinary Drug Handbook and Pet Pharmacy client handouts.

Veterinary publishers are pushing their digital content out in other ways. Veterinary Research Digest (http://www.veterinaryresearchdigest.com/) is a free service from Wiley-Blackwell that alerts veterinarians to selected new research across all of their veterinary journals. Compiled by practicing veterinarian, Alex Gough, the first issue of Veterinary Research Digest contains seven papers with a take home summary for practice and links to the full-text articles online which has been made free to access.

The publishers need to partner with the software developers. Vendors need to be aware that veterinarians and hospital staff need to access sources of information related to the patient information in their software. Publishers need to know what it will take to make their existing digital content amenable to integration with veterinary medical record systems. Only some have the content in XML that could be parsed to allow focused queries of the content. The AAHA software forums could provide a venue for these discussions similar to the IHE (Integrating the Healthcare Enterprise) Connectathons (http://www.ihe.net/connectathon/index.cfm) which bring together EHR developers, device vendors, academics, and consultants to test software and hardware interoperability. The AAHA EHRTF and the VMLS share the goal of getting good quality data and KBI into the hands of clinicians who can truly use it, when and wherever needed.

Upcoming events in veterinary informatics include the 15th Annual Talbot Informatics Symposium on Computers and Veterinary Informatics - August 2010 entitled "Informatics ¬ the Foundation and Future of Veterinary Medicine" to take place at the AVMA Annual Convention in Atlanta, Georgia.

One of the most important tools for a veterinary practice of any size is an efficient workflow. Technologies to facilitate and enable efficient workflow allow veterinarians to spend more time on patient care, which in turn is maximized through use of an effective electronic medical record. An EMR provides data which can be analyzed for epidemiology within an institution, and across institutions. This data facilitates the analyses and publications that become the core of evidence-based medicine. Underlying all of this is the S-word, standards. The focus this year will be on characterizing and exploring these strata of information management, demonstrating that, in fact, informatics is a foundational part of veterinary medicine now and into the future.

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References
2. Carter C. AVMA support for informatics. Post to AVI Discussion List. March 26, 2009

Appendix 1: Pulse of Veterinary Informatics Survey
Owner: Kristine Alpi, North Carolina State University
Respondents = 5/132 (3.8%)

Please respond to these 25 questions about electronic veterinary medical records and other areas of veterinary informatics. You are asked to identify your institution at the end of the survey only to avoid duplicate responses. Thank you. If you have any questions, or wish to submit the survey via email, please contact Kristine Alpi at Kristine_alpi@ncsu.edu.

1. Do you currently use an electronic health record (EHR) system at your teaching hospital? If so, which one? If not, what computer applications are used for your medical records? (n=5)
   No 1
   Other responses 4
   Names of Systems: UVIS, home-grown HIS, EHR embedded in LIMS (USA – LIMS)
   NB: LIMS is laboratory management system

2. Is your EHR or medical records system web-based? (n=5)
   No 3
   In Development 1
   Yes 1

3. Is remote access to medical records available to clinicians? (n=5)
   No 2
   Yes 3
   Unsure 0

4. Is remote access to medical records available to veterinary students on clinical rotations? (n=5)
   No 3
   Yes 2
   Unsure 0

5. Does the system connect to a formulary or other drug information database in real time? (n=5)
   No 3
   In Development 1
   Yes 0
   Unsure 1

6. If yes or in development, please name the drug resource. If no, please comment on whether the pharmacy has an online formulary. (n=1)
   Example: Home-grown onsite and web access for Rx submissions.

7. Does the system have built-in linkages to connect to knowledge-based information such as electronic textbooks or clinical practice guidelines? (n=5)
   No 4
   In Development 0
   Yes 1
   Unsure 0

8. If yes or in development, please give examples: (n=1)
   Example: Our laboratory SOPs (Standard Operating Procedures) are linked to test definitions.

9. Describe the data mining capacity available through searches and reporting of your system. Is it used to identify candidates for clinical research studies? (n=3)
   Examples:
   Very poor.
   SQL selects and standardized SQL reporting tools mostly. Epidemiological and trend studies done routinely.
Text based search on all cases through structure [sic] data elements that include: Presenting Complaint, History, Physical Findings, Diagnostic Tests, Diagnostic Case Assessment, Treatment Recommendations, Follow Up, and Clinician Comments.

10. Do records from the system get submitted to the Veterinary Medical Database? (n=5)
   No  2   Yes  1   Unsure  2

11. How do you transmit reports to referring veterinarians? Do they have access to the medical record system? (n=3)

   Examples:
   Fax, email and website that they can access.
   Fax, email or mail, web access can be granted to rDVMs (referring veterinarians) assigned.
   By mail with no direct access to the medical record system.

12. Do you provide a patient portal with information for owners from their animals' medical records? (n=5)
    No  5   Yes, but not part of medical record system  0   Yes  0

13. Are any training videos or other educational materials connected to the medical record system for just-in-time learning? (n=5)
    No  4   In Development  0   Yes  1   Unsure  0

14. Give examples of any learning materials connected to your medical record systems. (n=1)

    Example: On-line help is available for all LIMS functions as a training aid.

15. Do you store digital genetic data or sequence-based testing results in the medical record system? (n=5)
    No  3   Yes  1   Unsure  1

16. What other types of files are incorporated into the medical records system? (n=3)
    3  Still photos
    1  Videos
    2  Diagnostic test results directly from devices such as EKG, EEG, etc.
    1  Others, please list  (none listed)

17. Are the laboratory information systems interfacing with the medical record systems using LOINC, HL7, or other electronic data interchange standards? (n=5)
    No  2   In Development  2   Yes  1   Unsure  0

18. Describe the veterinary informatics taught (may not be called VI--IT or computer systems in veterinary medicine) in your institution. Where is it taught? In curriculum, selectives, library workshops, etc...? (n=5)

    Examples: N/A. None to my knowledge.
Workshops and training to outside groups/clients
I teach a required veterinary informatics course to the 2nd year students. It’s a 1 hour course. First year lecture called “IT in veterinary medicine.” Topics presented in this series of lectures are university network, library, veterinary resources on the web, different tools (powerpoint, word, endnote, photoshop), web searching and presentation of the medical record systems.

19. Do you offer any bioinformatics training focused on animal genetics or animal health issues? (n=5)
No 3  Yes 0  Unsure 2

20. Have you or others at your institution been involved with veterinary vocabulary development (SNOVET, SNOMED, CAB Thesaurus, MeSH, UMLS, etc.)? (n=5)
No 1  Yes 4  Unsure 0

21. Do you use a PACS (digital radiography) system? (n=5)
No 1  Yes 3  Unsure 1

22. Does your institution provide teleradiology services (remotely interpreting submitted radiology images)? (n=5)
No 2  Yes 2  Unsure 1

23. Do all clinicians and students using the system have to read or sign a confidentiality of medical records statement? (n=5)
No 0  Yes 3  Unsure 2

24. What, if any, aspects of veterinary informatics or electronic health records development are in the works at your institution and/or teaching hospital? (n=5)
Examples:
Clinical decision support tools; Animal disease cluster-detection systems; Animal health forecasting systems.
Direct test results from Lab Information System. PACS/RIS interfacing to Hospital Information System; Automated Faxing/Emailing of MR/letters from HIS. Interfacing locally developed RIS and commercial PACS with UVIS.

25. Your institution: [Redacted for privacy purposes].
Appendix 2: Library Involvement in Veterinary Informatics  
Respondents: 14/212 (6.6%)

1. Does your institution's veterinary hospital use an electronic health record or other computer application for medical records? (n=14)  
   If yes, what system is it? (n=8)
   
   No 0  
   Yes 10 (71.4%)  
   Unsure 4 (28.6%)

   Names of Systems: UVIS (2), VADDS/Vetstar, Doki for Vets, self-developed/home-grown (2), converted VA hospital software, PACS

2. Is the medical record system accessible from computers in the library? (n=14)
   
   No 9 (64.3%)  
   Yes 5 (35.7%)

3. Are any of the library's electronic resources (licensed or free) connected to the medical records system? (n=14)
   
   No 10 (71.4%)  
   Yes 0  
   Unsure 4 (28.6%)

4. Describe the veterinary informatics taught (may not be called VI--IT or computer systems in veterinary medicine) in your institution. Where is it taught? In curriculum, selectives, library workshops, etc...? (n=12)

   Examples:
   
   Designated trainers for UVIS for new users. Selective on practice management covers practice management information systems. Selective on bioinformatics. Library workshop on bioinformatics. Library workshops on other veterinary resources and on using the course management system.
   
   Curriculum responses and timing very diverse ranging from none, to small amounts in the first 2-3 weeks for first year students to an entire one credit course at the start of the 2nd year. Specific courses: Introduction to Production Animal Informatics, Advanced Dairy Production Informatics, and Advanced Swine Production Informatics.

5. What involvement do you or your library have with veterinary informatics? Include past activities if relevant. (n=12)

   Examples: Varied involvement with database or system development. Teaching about finding literature and using EndNote. Lectures on EBVM and finding resources for patient management. Include expert systems like Caddis and CONSULTANT in our “library informatics” curriculum. Current awareness services on SNOMED/SNOVET. Researching citation patterns.

6. Have you or others in your library ever been involved with veterinary vocabulary development (SNOVET, SNOMED, CAB Thesaurus, MeSH, UMLS, etc.)? (n=13)

   No 10 (76.9%)  
   Yes 3 (23.1%)

   Vocabularies listed include: CAB Thesaurus, MeSH, SNOMED, Snopad (Hungarian Veterinary Thesaurus) and wildlife vocabulary to be determined.
7. Do you advise students about use of clinical case information, medical record images, or other confidential information in presentations or any other context? (n=14)
   No  10 (71.4%)  Yes  2 (14.3%)  Have not, but would be willing.  2 (14.3%)

8. Do you offer any bioinformatics training focused on animal genetics or animal health issues? (n=14)
   No  13 (92.9%)  Yes  1 (7.1%)

9. What, if any, aspects of veterinary informatics or electronic health records development are in the works at your institution and/or teaching hospital? (n=10)

Examples: Working to connect Diagnostic Pathfinder, a computer-based tool developed by Dr. Holly Bender (http://vetmed.iastate.edu/pathfinder/birg/BIRG.html) to the book “Fundamentals of Veterinary Clinical Pathology” in collaboration with Wiley Publishing. Upgrades to new information systems or considering replacements or enhancements to existing systems. Possible grant-funded wildlife pathology database. Faculty research information database.

10. Who is the primary informatics person at your institution? Please provide name, title or area, and name of institution if the person could be contacted. Otherwise just provide title or area and institution and say do not contact. [Redacted for privacy purposes]